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Weed Control Guide for Field Crops

Check out Table 2G for the Recommendations and Guidelines for Weed Control in Roundup Ready 2 Xtend (dicamba-resistant) Soybean (pages 99-101).

New!

Recommendations for glyphosate and multiple-resistant Palmer amaranth, waterhemp, and horseweed (marestail) management on pages 209 and 213, respectively.

Visit the MSU Weed Control Web site at **www.msuweeds.com**.

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2018

Weed Control Guide for Field Crops

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Pesticides must be registered with the U.S. Environmental Protection Agency and the Michigan Department of Agriculture and Rural Development before they can be legally used in Michigan. This bulletin suggests using pesticides in the management of crop pests. Purchase only those pesticide products labeled for 1) the crop you wish to use it on and 2) the pest you wish to manage on that crop. Remember, the pesticide label is the legal document on pesticide use. The label must be read carefully and all instructions and limitations followed closely. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals and the environment, and also lead to civil fines and/or condemnation of the crop. Pesticides are management tools for the control of pests in crops but only when they are used in an effective, economical and environmentally sound manner.

See pesticide emergency information — page 223.

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Weeds reduce crop yields by competing for water, nutrients and light. Some weeds release toxins that inhibit crop growth, and others may harbor insects, diseases or nematodes that attack crops. Weeds often interfere with harvesting operations, and at times contamination with weed seeds or other plant parts may render a crop unfit for market. Profitable crop production depends on effective weed control.

Effective weed control in field crops requires the use of a combination of management techniques, including cultural methods and herbicides. Growing the same crop year after year and using the same weed control techniques encourage the development of problem weeds. Rotation of crops, herbicides and tillage methods help reduce this problem.

Cultural Control of Weeds

Crop competition is a very useful method of weed control. Maintaining production practices that optimize crop growth means the crop plants can compete more effectively with weeds. Several crop management practices can improve the competitive ability of the crop. These practices include crop and variety selection, planting date, population, soil fertility, drainage, etc. Recommended crop production practices are also beneficial weed control practices.

Crop and herbicide rotation may also be helpful in maintaining adequate weed control. Many weeds cannot tolerate crop rotation. Using the same herbicide program each year allows weeds tolerant of the herbicides to expand. Rotate herbicide programs to prevent this problem and to reduce the likelihood of herbicide-resistant weeds (e.g., triazine-resistant weeds) becoming a problem.

Cultivation

Timely, shallow cultivation may be necessary following herbicide application. Be sure to cultivate as shallowly as possible to prevent bringing new weed seeds from below the herbicide layer to the soil surface.

Do not cultivate most preemergence herbicides for at least 2 weeks after application unless weeds appear. If dry weather persists for 7-10 days after herbicide application, rotary hoe or cultivate shallowly. Delay cultivation after postemergence herbicide applications for at least 7-10 days to allow the chemical to move into weed stems and roots.

Chemical Control of Weeds

The first step for successful weed control with herbicides is to identify the weed species present. Note that some weed species are resistant to all of the present selective herbicides.

Annual weeds are easier to kill when they are small seedlings and when conditions favor rapid growth. However, crop plants are also easily injured under these conditions. Selective herbicides should control the weeds with little or no injury to the crop.

Timing and rate of application are very important with chemical weed control. Spraying at the wrong time often results in poor weed control and crop injury. No crop plant is completely resistant to injury from herbicides. Too much chemical can damage the crop.

Types of Herbicides

Chemical control of weeds can be obtained with either preplant incorporated, preemergence or postemergence herbicide applications. Many herbicides can be applied by more than one of these methods.

Preplant incorporated herbicides are compounds incorporated into the soil prior to planting. Incorporation of some of these herbicides is necessary to prevent losses of volatile active ingredients (e.g., EPTC) or to overcome photo-decomposition losses if the mater-ials (e.g., trifluralin) are left on the soil surface. Preplant incorporated herbicides have increased activity in the absence of rainfall that is required to move the herbicide into the weed-seed germination zone. This concept is often referred to as herbicide "activation."

Advantages of preplant incorporated herbicides:

(1) No weed competition to the crop with early control of weeds.

(2) Weeds are already controlled when wet weather causes delays in cultivation or spraying.

(3) Less reliance on rainfall to position the herbicides in the weed seed germination zone of the soil.

(4) Much more effective control of some perennial weeds (nutsedge) than with preemergence herbicide applications.

Disadvantages of preplant incorporated herbicides:

(1) Incorporation operation represents added cost and fuel usage in herbicide application.

(2) Soil compaction is increased by the incorporation operation.

(3) Herbicide may be diluted by improper incorporation (too deep), resulting in reduced weed control.

(4) "Streaking" pattern of good and poor weed control can result from incomplete incorporation. Two-pass incorporation helps prevent this problem.

(5) Planting operations may be slowed somewhat because of the added incorporation operation.

Preemergence herbicides are compounds applied to the soil surface after the crop has been planted but before the crop seedlings emerge through the soil.

Advantages of preemergence herbicides:

(1) No weed competition to the crop with early control of weeds.

(2) Weeds are already controlled when wet weather delays cultivation or spraying.

(3) Planting and herbicide application may be one operation.

(4) In the case of corn, herbicides can be used which may be a hazard to nearby 2,4-D- or dicamba-sensitive crops and plants if applied later in the season.

Disadvantages of preemergence herbicides:

(1) Preemergence applications are generally ineffective under dry soil conditions. Some preemergence herbicides are ineffective if dry conditions persist for only a few days; other herbicides may give weed control after as much as 10 days to 2 weeks of dry weather.

(2) On sandy soil, heavy rains may leach the herbicide down to the germinating crop seed and cause injury.

(3) Perennial weeds usually are not controlled by preemergence herbicide applications.

Postemergence herbicides are compounds applied to the foliage of weeds. They may burn off the aboveground parts of weeds (contact herbicides) or they may be translocated throughout the plants and kill the growing points (systemic herbicides).

Advantages of postemergence herbicides:

(1) They are not applied until the weeds are present in the field.

(2) Can be used on any soil type, and soil moisture conditions are usually not a problem.

(3) Are usually more effective (though more injurious to the crop) at high temperatures.

Disadvantages of postemergence herbicides:

(1) Should not be applied to weeds when the foliage is wet with dew or rain.

(2) There is a risk of crop injury for certain crops.

(3) With many postemergence herbicides, timing of application is critical for effective control.

(4) Rain may prevent application at the proper time.

Temperature greatly influences the effectiveness and volatility of many postemergence herbicides. Ideally, herbicides should be applied when temperatures range between 65° and 80°F. Low temperatures (below 60°F.) can result in reduced weed control; temperatures above 80°F. can result in crop injury. Late afternoon herbicide applications are less likely to result in injury than are early morning applications. Early morning application predisposes the crop plant to danger periods of high temperatures, which increase the potential for herbicide injury.

Volatile herbicides, such as dicamba (*Banvel/Clarity/DiFlexx/ DiFlexx DUO/Status*) or ester formulations of 2,4-D, may vaporize at temperatures as low as 70°F. Wind may then move sufficient vapors to areas with sensitive crops to cause crop injury. Amine formulations of 2,4-D may eliminate some of the danger of vapor drift; however, spray drift (droplets) may still occur. Extreme caution is required when applying herbicides near sensitive crops.

Herbicide Formulations and Additives

Herbicides are available in a variety of formulations; granular and those mixed in water are most common. Usually, equal weed control can be expected from granular and those mixed in water. In some cases, granules have given less control. Generally, this has been due to (1) use of equipment giving non-uniform distribution of the granules or (2) formulations with too high a concentration, resulting in inadequate volume for uniform distribution.

The use of granular formulations does not eliminate the need for calibration. Various materials will "feed" differently because of variations in carrier and particle size. Therefore, granular applicators, like sprayers, should be accurately calibrated.

Herbicide Formulations

- **AS** — *Aqueous capsule suspension*
- **CS** — *Capsule suspension*
- **DC** — *Dry concentrate*
- **DF** — *Dry flowable*
- **DG** — *Dispersible granule*
- **DS** — *Dry soluble granule*
- **EC** — *Emulsifiable concentrate*
- **EW** — *Emulsion*
- **F** — *Flowable*
- **G** — *Granule*
- **L** — *Liquid*
- **SC** — *Suspension concentrate*
- **SG** — *Soluble granule*
- **SL** — *Soluble concentrate*
- **SP** — *Soluble powder*
- **WG** — *Water dispersible granules*
- **WP** — *Wettable powder*
- **ZC** — *Zeon concentrate*

Combinations of Herbicides

Two or more herbicides are usually applied as a tank mix rather than separate applications. Combinations are used to give more consistent or broader spectrum weed control, to decrease herbicide residue (for example, atrazine carryover) or to obtain adequate season-long weed control. Growers and commercial applicators are responsible for poor weed control, crop injury and/ or unwanted herbicide residue from herbicides labeled for single application but misused in combinations.

Compatibility of Pesticide-Fertilizer Combinations

Combinations of herbicides, insecticides and/or fungicides applied in either water or liquid fertilizer carriers decrease trips over the field and application costs; however, compatibility is critical. Always test the compatibility of each mixture to be applied even though the product labels allow mixing. Follow the label instructions closely during any mixing operation after you have tested for compatibility.

A single compatibility test requires only a glass quart jar and the pesticides and liquid fertilizer to be mixed. Place 1 pint of liquid fertilizer in the quart jar and add 2 teaspoons of the liquid pesticide. If the pesticide is a wettable powder, add 2 teaspoons of powder in sufficient water to form a slurry and add the slurry to the fertilizer. Cover the jar, shake well, and observe the mixture for 30 seconds. Check the mixture again after 30 minutes. If the mixture does not separate, it is compatible; however, check each batch of liquid fertilizer — they may vary in mixing

properties. Also, check compatibility if the water source changes — water pH and mineral content influence compatibility.

If more than one pesticide is to be mixed with liquid fertilizer or water, the pesticides should be premixed in liquid fertilizer or water and tested for compatibility by mixing appropriate proportions of all components. The combination should be thoroughly agitated before each additional pesticide is added, and a specific mixing order should be followed.

Generally, unless label directions state otherwise, add the pesticides being tested in the following order:

1. Water conditioners (e.g., AMS) and drift reducing agents (DRAs)
2. Wettable powders or dispersible granules.
3. Flowables or aqueous liquids.
4. Emulsifiable concentrates.
5. Crop oil concentrates or surfactants.

Spray tanks should be at least half filled with the carrier before the pesticide premixes are added. If the mixture foams excessively, separates or becomes syrupy, do not apply the mixture. Compatibility agents are available that may be added to improve mixing ability.

Even if all components appear compatible, the field tank mixture will require constant, vigorous agitation to prevent separation or improper pesticide distribution in the tank. Be sure the entire tank is agitated and mixed before spraying. Do not store pesticide mixtures overnight unless they are constantly agitated. Best results are obtained by applying the entire mixture in one day.

Additives for Herbicides— Some Definitions

(1) Adjuvant — any substance that enhances the herbicide's effectiveness, an "added ingredient."

(2) Surfactant — a surface active material that can facilitate emulsifying, dispersing, spreading, wetting, sticking or other surface-modifying characteristics of herbicide solutions.

(3) Crop oil concentrates — contain a mixture of emulsifiers and surfactants. A common ratio is 80% oil and 20% surfactant.

(4) Emulsifier — an agent that promotes the dispersion of one liquid in another.

(5) Wetting agent (spreader) — reduces water surface tension, causing better contact between spray solution and treated surfaces.

(6) Soap — sodium or potassium salts of fatty acids. Can form insoluble materials in hard water. *Detergents* are synthetic materials used for cleaning.

(7) Sticker — Deposit builder. Increases herbicide adhesion to plant surfaces.

(8) Defoaming agent — self-explanatory.

(9) Compatibility agent or cosolvent — may aid in dispersion of otherwise incompatible mixtures.

During the development of a herbicide, the chemical company attempts to formulate the active ingredient to optimize performance, mixing and handling under diverse conditions. Every commercially available herbicide formulation contains its own particular set of additives to accomplish this. Sometimes additional additives are required for specific applications or when compatibility or mixing problems occur. The herbicide label will describe the need and use of these additives. The indiscriminate use of additives should be avoided because they may not improve herbicide performance and may actually reduce weed control or cause crop injury.

Additives can be referred to as "adjuvants." This term merely denotes an added ingredient. Surface active additives are called surfactants. Therefore, all surfactants are also additives or adjuvants.

Compatibility Problems

Compatibility problems in tank mixing herbicides usually occur when mixing directions are not followed. Some common causes of compatibility problems: mixing two herbicides in concentrated form, adding an EC to the spray tank before suspending the wettable powder, insufficient agitation, excessive agitation and air leaks. Problems are much more likely when mixing herbicides with liquid fertilizers. The fertilizer solution is already loaded to near capacity with nutrients. Adding a herbicide to the already loaded solution may cause problems. Also, the fertilizer may interfere with the herbicide formulation additives. Fertilizers may vary greatly from batch to batch, so the only safe procedure is to test for compatibility in a small container before mixing a large quantity. If compatibility problems are encountered, the addition of *compatibility agents* may help.

Foaming is usually due to excessive agitation or a bypass line that empties above the spray solution level in the spray tank. When foaming is a problem, addition of a *defoamer* can help.

Herbicide Application Equipment

Sprayer Implements — A good weed control sprayer should be made of non-corrosive materials, be easy to clean and have the following features:

(1) A *tank* with a volume of 100 to 300 gallons to reduce filling and mixing operations.

(2) A *pump* with a capacity of at least 4 gallons per minute and pressure up to 100 pounds per square inch (PSI).

(3) An *agitation system* — The bypass from the pressure control is a good source of agitation. Direct the bypass line into the bottom of the tank.

(4) *Screens* — There should be 50-mesh screens in the intake line and at each nozzle.

(5) *Pressure gauge* — The pressure gauge should accurately measure pressures up to 100 PSI.

(6) *Adjustable spray boom* — The boom should be adjustable from 16 to 36 inches above the ground.

(7) *Nozzles* — Drift reduction flat fan nozzles of 110° angle are best suited for most weed control applications. Commonly used nozzle volumes can vary from 0.1 to 0.8 gallons per minute, depending on the application. Good general-use nozzles are 11004 or 11006. These nozzles permit the boom to be carried closer to the ground and thus reduce spray drift.

Herbicide Incorporation

Disks, especially large tandem disks, are poor tools for incorporation. Depth and ridging are difficult to control and non-uniform distribution of the herbicide in the soil is likely.

If a disk is used, it should be set at a depth of 4 to 5 inches and a speed of 4 to 6 mph. Incorporation must be done in two directions.

A field cultivator can give acceptable one-pass incorporation of herbicides if special care is taken in setup and operation. Wide sweeps give better incorporation than points. Shanks should be close enough to allow for this, and three sets of sweeps are also required. It is important to follow with a leveling tool, such as a flex-tine drag or spring-tooth harrow, to smooth out ridges behind the cultivator.

The speed of the cultivator should be at least 6 mph, at a depth of 3 to 4 inches. Actual incorporation will occur at one-half the tool depth. Caution must be taken not to run the back portion of the cultivator lower than the front. If the back of the tool is lower, untreated soil can be brought to the surface, burying the herbicide.

Danish-type harrows equipped with "S" tines and rolling baskets can do a good job of one-pass incorporation. Rolling baskets outperform other trailing operations.

Operation considerations are similar to those with the field cultivator. Good soil tilth is a prerequisite for one-pass incorporation.

PTO-driven tools do a good job of one-pass incorporation. However, their application in Michigan may be limited. These tools are operated at lower speeds and are not as wide as other implements.

The most consistent incorporation (no streaking), especially when using a disk or field cultivator alone, is achieved with two passes at an angle to each other. However, new tillage implements have made one-pass incorporation of herbicides a possibility. Although a majority of the questions concerning incorporation concern the best implement to use for one-way incorporation, soil condition influences the success of incorporation more than the tool used. The reliability of one-pass incorporation will also be influenced by the tillage system used.

In clean tillage (low crop residue) situations, preemergence applications made on wet soil will likely perform as well or better than two-pass incorporated treatments. One-pass incorporation is not a good approach with less than optimum soil tilth.

High crop residue levels (corn stalks disked or chisel plowed with one or two secondary tillage operations) make one-pass incorporation difficult. If the residue level is great enough to clog the incorporation tool, two-pass incorporation is advisable. The soil should also have good tilth, as outlined above.

Where ridges are left from fall plowing or use of a chisel plow in the spring, it is advisable to level the ground before herbicide application. Streaking is favored by application of the herbicide to rough or uneven ground.

Soil Types

Soil texture (sand, silt, clay) and organic matter influence the effectiveness of soil-applied herbicides. In general, lower rates of herbicides are used on sandy (coarse- textured) soils than on clays or soils high in organic matter (fine-textured) to obtain the same level of control. **Herbicide rate recommendations in this bulletin are given for medium-textured soils with greater than 3% organic matter.** Clay and organic matter adsorb herbicides, making them less available to kill weeds. Soils with high clay and organic matter content require higher herbicide rates for adequate weed control. Sandy soils with low organic matter content require careful herbicide rate selection to avoid crop injury.

Soil pH can influence the activity of soil-applied herbicides. Some herbicides are more persistent at higher soil pH, and crop rotation must be considered before applying a herbicide. Some herbicides are more available at higher soil pH. Rates must be reduced to avoid crop injury. Knowledge of the soil pH in a field is critical — soil pH may vary greatly within a field.

Organic matter analysis is available through MSU County Extension offices or directly through the MSU Soil and Plant Nutrient Lab (www.css.msu.edu/SPNL/). Organic matter analysis may be determined on soil samples submitted for N-P-K analysis for an additional charge. Organic matter levels change slowly and may need to be checked every four years.

Soil sample analyses are only as accurate or representative as the soil sample, so each field should be checked individually. See the Soil and Plant Nutrient Lab website: **www.spnl.msu.edu** or Extension bulletin E-498, "Sampling Soils," for proper soil sampling procedures.

Remember, follow herbicide label recommendations, always know the soil pH, and adjust herbicide rates for soil texture and organic matter as specified on the label.

Accurate Calibration

Accurate applicator calibration is essential for effective chemical weed control without crop injury. Calibrate a new sprayer before use and routinely recalibrate the sprayer during the growing season.

Use the following steps as a guide to calibrate a ground sprayer for broadcast application.

(1) Determine the desired application volume of carrier (usually water) in gallons per acre (GPA). For most weed control applications, 5-30 GPA at 30 to 40 PSI is sufficient.

(2) Adjust the boom height so that spray overlap is about 100% at the spray target. This would be a minimum of 18 inches on a 20-inch nozzle spacing and 24 inches on

a 30-inch nozzle spacing for 110° nozzles. Boom height is important in maintaining spray overlap for uniform distribution. Check each nozzle at the recommended pressure for output. Replace any defective nozzles and screens. All nozzles should deliver within 10% of one another.

(3) Fill the spray tank and system with water.

(4) Spray a measurable area in the field, at a fixed speed and at the desired pressure. Spray at least 20% of the total tank volume and at least 2 acres of area.

(5) Measure the volume of water (in gallons) needed to refill the tank.

(6) Determine the area (in acres) that was test sprayed, using the following formula: length of area sprayed (in feet) X boom width (in feet) ÷ 43,560 = acres sprayed.

(7) Divide the volume sprayed by the area sprayed to obtain the actual output of the sprayer in gallons per acre.

(8) Make adjustments to tractor speed, pressure or nozzle size and repeat steps 3–7 to change application rate to the recommended values.

(9) Calculate the amount of formulated pesticide needed to treat the desired area.

The following procedures can be used to calibrate a ground sprayer for either banded or broadcast applications.

(1) Determine the desired application volume in GPA.

(2) Check each nozzle at the recommended pressure for output. Replace any defective nozzles and screens. All nozzles should deliver within 10% of one another.

(3) For band application, accurately determine the width, in inches, of the band sprayed. For broadcast application, measure the distance, in inches, between adjacent nozzles.

(4) Locate this width in the table below and read off the corresponding course distance.

WIDTH (inches)	COURSE DISTANCE (feet)
10	408
15	272
20	204
30	136

(5) In the field to be sprayed, mark off the course of the proper distance.

(6) Fill the tank completely with water only.

(7) Tie a quart container (graduated in ounces) to one nozzle on the sprayer to catch all of that nozzle's spray.

(8) Start a distance back from the beginning of the course to get up to operating speed, and turn the sprayer ON at the beginning of the course and OFF at the end.

(9) Remove the quart container, and read the volume collected IN OUNCES.

(10) OUNCES collected = GPA.

Pesticide Use Precautions

Herbicides, like all pesticides, should be handled with extreme caution and respect. There are three important reasons for using pesticides safely and wisely:

- To protect yourself and others from exposure.
- To avoid harming and polluting the environment.
- To avoid crop injury.

These three points cannot be emphasized enough.

Each herbicide label contains specific information on **personal protective equipment (PPE) and restricted entry interval (REI)**. Refer to **Table 16** for the **Restricted Entry Intervals** for an individual herbicide. This information is prominantly displayed under the heading of **Agricultural Use Requirements**.

Using more herbicide than is recommended on any label is illegal and can result in crop injury, herbicide carryover or other problems.

The ability of a herbicide to kill weeds without harming crop plants (selectivity) may be partially lost under unfavorable weather conditions. Herbicide drift to non-target crops often results in crop injury. Do not spray under windy conditions.

Herbicide Application

Herbicide Spray Volumes and Rates

The volume of water to use will vary with the herbicide, although generally 10 to 40 gal per acre and a spraying pressure of 30 to 40 PSI are recommended. With wettable powders, use nozzles that deliver at least 15 GPA.

Some contact-type postemergence herbicides (e.g., *Basagran, Ultra Blazer*) require a minimum of 20 GPA spray volume and 40 PSI spray pressure to ensure adequate coverage. Drift-reducing flat fan nozzles are effective for herbicide applications. Hollow cone nozzles can also give good results, especially for postemergence applications at higher pressures. If higher pressures are used, be sure the nozzles are designed to be operated at the increased pressure. Operating nozzles beyond the specified pressure range will result in a poor spray pattern, insufficient coverage and lack of weed control.

Band Application

In cultivated crops, spraying narrow bands of herbicide over the rows will take less material per acre, reducing the cost per acre for the chemical. Where chemical costs are high, band spraying may be justified. Timely cultivation of weeds in the unsprayed area between rows is necessary.

In seasons when the soil is too wet to cultivate, overall spraying has the advantage of controlling weeds between the rows.

When band spraying, be very careful to maintain the proper rate of application on the area sprayed. (If you lower the spray boom to narrow the area covered by a given nozzle, remember that each nozzle is still delivering the same amount of spray mixture as it did on the wider area.) Use nozzles designed for banding — the spray volume with these nozzles is the same across the entire band.

Cleaning Pesticide Sprayers

It is important to clean pesticide sprayers after each use, especially if they are used for more than one crop and for the application of insecticides and fungicides. The need for extensive cleaning can be minimized if one sprayer is dedicated to herbicide application only.

Do not use a sprayer to apply insecticides or fungicides if the sprayer has been used to apply 2,4-D-type herbicides.

In general, rinse the entire sprayer, inside and out, including the boom, hoses and nozzles. Partially fill the spray tank with water and keep the pump running so that the water is circulated throughout the entire system. Spray the water rinsate out through the nozzles. This process should be repeated when changing soil-applied herbicides and at the end of each day. Money can be saved and the environment protected if the water rinsing is done in the field using a water-filled nurse tank and if the water rinsate is applied to the crop according to label rates. Many herbicide labels have specific instructions for cleaning the spray system. Always read and follow these directions carefully.

Unless otherwise specified, thoroughly wash the entire spray system after all postemergence applications. Use 1 gallon of household ammonia in 100 gallons of water as a cleaning agent or commercially available tank cleaners.

Run the pump so that the cleaning solution is circulated throughout the entire system for at least 2 hours, and then pump it out through the nozzles. Do not dump this cleaning solution, and do not apply it to any crop or cropland. Discard the cleaning solution in an appropriate pesticide rinsate degradation pit. Rinse the entire system with water after all the cleaning solution has drained from the sprayer. Do not leave pesticide solutions or cleaning solutions in the tank overnight.

Corrosion and mechanical damage to pumps, tanks, nozzles, etc., may result from leaving water in the spray system over the winter. To prepare the spray equipment for storage, disconnect all the hoses and allow all water to drain out. Coat all bare metal parts with oil or a rust inhibitor. Disassemble metal nozzles and store them in oil. Prepare the spray pump for storage following the manufacturer's recommendations.

Pesticides and the Environment

Many people who live in rural Michigan get their drinking water from wells. Well water is groundwater, so it is easy to see why you should be concerned about keeping herbicides out of groundwater. Several processes determine the fate of herbicides and whether they will end up in your drinking supply. Sometimes these processes are beneficial and enhance weed control. For example, the leaching of a root-absorbed herbicide into the root zone can enhance weed control. The degradation of pesticides can remove non-essential pesticide residues from the environment. Often, however, these processes are detrimental. Runoff can move a herbicide away from target weeds. As a result, chemical is wasted, weed control is reduced and there is an increased chance of damage to non-target plants, hazard to human health, and pollution of nearby soil and water.

In this section we will examine the fate of pesticides and the various processes that affect their stability and persistence following an application, disposal, or spill.

Adsorption is the binding of chemicals to soil particles. (This term is sometimes confused with absorption, the process by which plants intake chemicals.) The amount and persistence of pesticide adsorption vary with pesticide properties, soil moisture content, soil pH and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils that lack organic matter or clay are much less adsorptive.

A soil-adsorbed herbicide is less likely to volatilize, leach or be degraded by microorganisms. When herbicides are tightly held by soil particles, they are less available for absorption by plants. Therefore, certain herbicides used on highly adsorptive soils may require higher rates or more frequent applications to compensate for the portion of the herbicide that binds to the soil particles and is unavailable for plant uptake.

Volatilization occurs when a solid or a liquid turns into a gas. Volatilization of pesticides increases with higher air temperature and air movement, higher temperature at the treated surface (soil, plant, etc.), low relative humidity and decreasing size of spray droplets. Pesticides also volatilize more readily from coarse-textured soils and from medium- to fine-textured soils with high moisture content.

A pesticide in a gaseous state can be carried away from the treated area by air currents. The movement of pesticide vapors in the atmosphere is called vapor drift. Unlike the drift of sprays and dusts that can sometimes be seen during an application, **vapor drift** is invisible.

Avoid applying volatile herbicides such as dicamba, 2,4-D ester, or EPTC (*Eptam*) when conditions favor volatilization. The vapor pressure rating of the herbicide may help indicate the volatility of the material. The higher the vapor pressure rating, the more volatile the pesticide. Herbicide labels usually mention the potential for volatility of the herbicides. Volatilization can sometimes be reduced through the use of low volatile formulations or soil incorporation of the herbicide (e.g., EPTC [*Eptam*]).

Photodegradation is the breakdown of herbicides, such as trifluralin, by the action of sunlight. Herbicides applied to foliage, the soil surface or structures vary considerably in their stability when exposed to natural light. Like other degradation processes, photo-degradation reduces the amount of chemical present, which can subsequently reduce the level of weed control. Soil incorporation by mechanical means during or after application, or by irrigation water or rainfall following application, can reduce herbicide exposure to sunlight.

Microbial degradation occurs when microorganisms such as fungi and bacteria use a herbicide as a food source. Microbial degradation can be rapid and thorough under soil conditions favoring microbial growth. These conditions include warm temperatures, favorable pH levels, and adequate soil moisture, aeration (oxygen) and fertility. The amount of adsorption also influences microbial degradation. Adsorbed herbicides are more slowly degraded because they are less available to some microorganisms.

Chemical degradation is the breakdown of a herbicide by soil processes not involving a living organism. The adsorption of herbicides to the soil, soil pH levels, soil temperature and moisture all influence the rate and types of chemical reactions that occur. Some herbicides are persistent at high soil pH while others are more persistent at low soil pH.

Absorption is the process by which plants and microorganisms take up chemicals. It is another process that can transfer herbicides in the environment. Once absorbed, most herbicides are degraded within plants. Residues may persist inside the plant or be released back into the environment as the plant tissues decay.

Crop removal is another herbicide transfer process. When treated crops are harvested, the herbicide residues are removed with them and transferred to a new location. After harvest, many agricultural commodities are washed or processed to remove or degrade much of the remaining residue.

Runoff moves herbicides in water. Runoff occurs as water moves over a sloping surface, carrying herbicides either mixed in the water or bound to eroding soil. The amount of herbicide runoff depends on the grade or slope of the field, the erodibility and texture of the soil, the soil moisture content, the amount and timing of irrigation or rainfall (especially in relation to the time of herbicide application), and properties of the herbicide. For example, a herbicide application made to a heavy clay soil already saturated with water is highly susceptible to runoff. Established vegetation or plant residues also influence runoff because of their ability to retain soil and moisture.

Herbicide losses from runoff are greatest when heavy rainfall occurs shortly after a herbicide application. If heavy rainfall is expected, delay applying pesticides. Some no-tillage and minimum-tillage cropping systems have been found to reduce herbicide runoff, as do soil incorporation application methods. Finally, surface grading, drainage ditches and dikes, and the use of border vegetation can help reduce the amount and control the movement of runoff waters.

Leaching is another process that moves herbicides in water. In contrast to runoff, which occurs as water moves on the surface of the soil, leaching occurs as water moves through the soil. Several factors influence the leaching of herbicides. These include the water solubility of the herbicide.

A herbicide dissolved in water can move readily with the water as it seeps through the soil. Soil structure and texture influence soil permeability (how fast the water moves through soil), as well as the amount and persistence of herbicide adsorption to soil particles. Adsorption is probably the most important factor influencing leaching of herbicides. If a herbicide is strongly adsorbed to soil particles, it is less likely to leach, regardless of its solubility, unless the soil particles themselves move with the water flow.

Groundwater and Surface Water Contamination

Groundwater is the water beneath the earth's surface occupying the saturated zone (the area where all the pores in the rock or soil are filled with water). It is stored in water-bearing geological formations known as **aquifers**. Groundwater moves through aquifers and can be obtained at points of natural discharge such as springs or streams, or by drilling a well into the aquifer.

The upper level of the saturated zone in the ground is called the **water table**. The water table depth below the soil surface fluctuates throughout the year, depending on the amount of water removed from the ground and the amount of water added by recharge and connected surface waters. **Recharge** is water that seeps through the soil from rain, melting snow or irrigation. **Surface waters** are visible bodies of water such as lakes, rivers and oceans.

Both surface water and groundwater are subject to contamination by **point-source and non-point-source pollution**. The key to preventing pesticides in groundwater and surface waters is identification of the source and its route to the water. Point-source contamination refers to situations where movement of a pesticide into water can be traced to a specific site. Non-point sources occur over a wide area. Most pesticides detected in groundwater and surface water can be traced to nonpoint sources. This type of pollution generally results from land runoff, precipitation, acid rain or percolation rather than from a discharge at a specific, single location, such as a single pipe or wellhead.

The potential for the pollution of groundwater and surface water from improper waste disposal is a major concern. Problems result from domestic waste (e.g., septic systems, landfills, waste treatment plants), industrial waste (e.g., landfills, brine and mine wastes, deep well disposal), and government-generated waste (e.g., radioactive wastes).

Improper agricultural practices are another concern. Inadequate handling of livestock waste storage facilities and improper application of manures and fertilizers can cause unacceptable levels of nitrate in groundwater. Pesticides in groundwater and surface water are receiving considerable national attention. Evidence suggests that, in certain areas, agriculture's relative contribution to groundwater and surface water contamination may be significant.

Herbicides in Groundwater

There are several herbicide breakdown processes that occur in the environment. These processes help determine whether herbicides reach groundwater or are degraded before reaching these underground waters. Geological characteristics, such as the depth of the water table and the presence of sinkholes, are also critical. If the water table is close to the soil surface, fewer opportunities may exist for adsorption and degradation to occur.

On the soil surface and within the first few inches of soil, herbicides can be volatilized, adsorbed to soil particles, taken up by plants, broken down by sunlight, or degraded by soil microorganisms and chemical reactions. The extent of herbicide leaching is affected by both pesticide and soil properties. Weather conditions and management practices also affect leaching of herbicides through the soil. Too much rain or irrigation water can leach herbicides beyond the zone where weeds are controlled. A herbicide that is not volatilized, absorbed by plants, bound to soil or degraded can potentially move through the soil to groundwater.

After herbicides reach groundwater, they may continue to break down but at a much slower rate because of less available light, heat and oxygen. The movement of groundwater is often slow and difficult to predict. Substances that enter the groundwater in one location can turn up years later in other locations. A major difficulty in dealing with groundwater contaminants is that the sources of pollution are not easily recognizable. The problem is occurring underground, out of sight.

Herbicides in Surface Water

Non-point-source contamination of surface water can occur in several ways. Pesticides can reach surface water through drift or volatilization or by wind erosion of dust particles carrying pesticides into the atmosphere followed by rainfall deposition in the water; from groundwater discharging into surface water; and in surface water runoff.

Pesticides have been detected in rainfall in many states in the Midwest, including Iowa, Indiana, Wisconsin and Ohio. The greatest number of detections and the highest concentrations were observed in May. When detected, most pesticide concentrations are below 1 part per billion (ppb).

The majority of pesticides detected in surface water are from surface runoff events. Either the pesticides are attached to the soil particles that are being transported in the runoff water or the pesticides are dissolved in the runoff water. The degree of pesticide loss to surface water is dependent on the degree of surface water runoff in the field. This is dependent on the slope of the field, the vegetative and/or residue cover on the field site, the soil texture and the soil moisture content at the time of the rainfall that produces the runoff event. Pesticide application methods have a strong influence on the potential for the pesticide to be carried in surface water runoff. Preemergence herbicide applications have a greater potential for surface loss than applications in which the herbicide is incorporated and applications in which the herbicide is applied postemergence. The pesticide application rate is important too. The higher the pesticide application rate, the greater the potential amount of pesticide that could be lost in runoff.

Once a pesticide reaches surface water it may or may not degrade. Some pesticides degrade by hydrolysis or by direct or indirect photodegradation. Our knowledge of which pesticides are degraded in surface waters is quite limited.

Keeping Herbicides Out of Groundwater and Surface Water

It is very difficult to purify or clean contaminated groundwater or surface water. Treatment is complicated, time consuming, expensive and often not feasible. The best solution to groundwater and surface water contamination is to prevent the problem in the first place. Management practices can be implemented to effectively reduce pesticide runoff and leaching and protect groundwater and surface water.

- **Use integrated pest management programs**—Minimize herbicide use by combining chemical control with other pest management practices such as tillage, cultivation, crop rotation and pest scouting.
- **Reduce compaction**—Surface water runoff increases when soils are compacted.
- **Rotate crops**—Crop rotation improves water infiltration, which reduces runoff. Crop rotations also may provide more surface crop residue and may reduce the application of specific pesticides repeatedly to a given field site.
- **Utilize conservation practices that reduce erosion and surface runoff**—These practices include but are not limited to no-till and other forms of conservation tillage, increasing crop residues or planting cover crops, planting grass waterways to retard soil and water runoff, and keeping buffer strips to protect surface water boundaries.
- **Consider the geology of your area**—When planning herbicide applications, be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater.
- **Consider soil and field characteristics**—The susceptibility of the soil or field site to leaching or runoff should be determined. Soil texture and organic matter content, in particular, influence chemical movement into groundwater; the slope of the field influences surface runoff.
- **Select herbicides carefully**—Remember, herbicides that are highly soluble, relatively stable and not readily adsorbed to soil tend to be the most likely to leach. Choose herbicides with the least potential for leaching into groundwater or for runoff into surface water. Read labels carefully and consult a specialist from MSU Extension or your pesticide dealer, if necessary.

Refer to **Table 16** for a complete listing of herbicides that contain **Groundwater Advisory** statements. Consult the herbicide label for individual instructions on how to protect groundwater and surface water from herbicide contamination.

Herbicides containing atrazine may not be mixed or loaded within 50 feet of perennial or intermittent streams and rivers, lakes or reservoirs. These herbicides may not be mixed or loaded within 50 feet of any well unless conducted on an impervious pad designed and maintained to contain any product spills, leaks or rinse water.

These herbicides cannot be applied within 66 feet of the points where field surface water runoff enters perennial or intermittent streams and rivers or within 200 feet of lakes or reservoirs.

These herbicides can be applied to HEL (highly erodible land) acres only if the 66-foot buffer or setback from runoff points is planted to a crop or seeded with grass.

• **Follow label directions**—The label carries crucial information about the proper rate, timing and placement of the herbicide.

• **Reduce herbicide application rates**—Use the lowest rate of the pesticide that provides adequate pest control. Band applications of preemergence herbicides reduce the potential of herbicides to leach or run off by 50% or more.

• **Incorporate pesticides**—On fields not considered highly erodible, incorporation of pesticides can be used to reduce runoff by moving some of the pesticide below the soil surface away from overland water flow. Incorporation of herbicides will not be compatible with surface residue requirements in some fields.

• **Calibrate accurately**—Equipment should be calibrated carefully and often. During calibration, check the equipment for leaks and malfunctions.

• **Measure accurately**—Concentrates need to be carefully measured before they are placed into the spray tank. Do not "add a little extra" to ensure the herbicide will do a better job. Such practices only increase the likelihood of injury to the treated crop, the cost of pest control, and the chance of groundwater and surface water contamination.

• **Avoid back-siphoning**—The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of chemical into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond or stream. These practices also reduce the likelihood of the hose becoming contaminated with herbicides.

• **Consider weather and irrigation**—If you suspect heavy or sustained rain, delay applying herbicides. Control the quantity of irrigation to minimize the potential for herbicide leaching and runoff.

• **Avoid spray drift and volatilization**—Preemergence herbicide applications have the greatest potential for volatilization and runoff.

• **Clean up spills**—Avoid spills. When they do occur, contain and clean them up quickly with an absorbent material such as cat litter. Chemicals spilled near wells and sinkholes can move directly and rapidly into groundwater. Chemicals spilled near ditches, streams or lakes can move rapidly into surface water.

• **Change the location of mixing areas**—Mix and load pesticides on an impervious pad, if possible. If mixing is done in the field, change the location of the mixing area regularly. Do not mix herbicides adjacent to the water source, and do not let the water run inadvertently on the soil near the mixing area. This will increase herbicide leaching and/or runoff.

• **Dispose of wastes properly**— All herbicide wastes must be disposed of in accordance with local, state and federal laws. Triple-rinse containers. Pour the rinsewater into the spray tank for use in treating the site or the crop. Do not pour rinsate on the soil, particularly repeatedly in the same location. This will saturate the soil and increase the potential for herbicide leaching.

• **Store herbicides away from water sources**—Herbicide storage facilities should be situated away from wells, cisterns, springs and other water sources.

Michigan's water resources currently provide a vast supply of clean water for agriculture, homes and industry. They can ensure high water quality for future needs only if they are protected now. Be sure to understand how your activities, including herbicide usage, can affect them.

Storing Pesticides

Pesticides must be stored in a facility that will protect them from temperature extremes, high humidity and direct sunlight. The storage facility should be heated, dry and well ventilated. It should be designed for easy containment and cleanup of pesticide spills and made of materials that will not absorb any pesticide material that leaks out of a container. Store only pesticides in such a facility, and always store them in their original containers.

Do not store any feed, seed, food or fertilizer with pesticides. Do not store any protective clothing or equipment in the pesticide storage facility. Store herbicides separately from insecticides and fungicides to avoid contamination of one material by another and accidental misuse.

Keep the facility locked at all times when not in use to prevent animals, children and irresponsible adults from entering and becoming poisoned. Post the facility as a Pesticide Storage Facility to warn others that the area is off-limits. Maintain an accurate inventory of the pesticides stored in the facility at all times in case of emergency.

Always read and follow the Storage and Disposal section of pesticide labels for specific storage and handling instructions.

Handling and Mixing Pesticides

Always wear the personal protective equipment (PPE) required by the label, when handling, mixing and applying pesticides, and during cleanup of application equipment.

Mix pesticides downwind and below eye level. Avoid excessive splashing and sloshing. If pesticides are spilled on you, wash them off immediately with lots of water and change clothing. Resume spraying only after cleaning up any spills. Try to use closed handling/mixing systems when appropriate.

Mix only what is required for the area to be sprayed according to label directions. Avoid mixing excessive amounts. To do otherwise will create a hazardous waste that is difficult and expensive to dispose of. Keep unauthorized persons out of the area in which you handle pesticides.

Handling and Disposing of Pesticide Containers

Pesticide containers are considered hazardous waste until they are cleaned or disposed of properly. When possible, reduce the number of pesticide containers by using bulk or returnable containers. Buy pesticides in larger volume containers, in containers that may be recycled, or in water-soluble bags to avoid disposal problems.

All pesticide containers can be rendered non-hazardous waste by triple rinsing (or equivalent). The rinsate should be added to the spray tank. After triple rinsing, perforate both ends so the container cannot be reused.

All metal and plastic triple-rinsed containers should be recycled, if possible. If this option is not available, dispose of them in a state-licensed sanitary landfill. Dispose of all paper containers in a sanitary landfill or a municipal waste incinerator. Do not bury or burn any pesticide containers. Do not reuse any empty pesticide containers for any purpose.

Protect Non-target Organisms

Applying pesticides carelessly can harm non-target organisms that are beneficial to agriculture and our environment. The best way to avoid injury of beneficial insects and microorganisms is to minimize pesticide use. Selective pesticides should be used whenever possible and applied only when necessary as part of a total pest management program.

Bees and other pollinating insects are essential for successful production of many crops, such as deciduous tree fruits, small fruits, most seed crops and certain vegetables. Many pesticides, particularly insecticides, are highly toxic to pollinating honeybees and wild bees. Check herbicide labels to identify those that are toxic to bees. *Gramoxone Inteon* (paraquat), for example, is a herbicide toxic to bees. Be aware of how bee poisonings can occur and how to prevent them.

The following precautions reduce the chance of bee poisoning:

- Do not apply herbicides (such as *Gramoxone Inteon*) that are toxic to bees during bloom. Even shade trees and weeds should not be sprayed during bloom. Mow cover crops and weeds to remove blooms before spraying.
- Reduce drift during application. Aerial applications usually are more hazardous to bees than ground applications.
- Time pesticide applications carefully. Evening applications are less hazardous than early morning ones; both are safer than midday application.
- Do not treat near hives. Bees may need to be moved or covered before you use insecticides near colonies.

Pesticides can be harmful to all kinds of vertebrates such as **fish and wildlife**. Most recognizable are the direct effects from acute poisoning. Fish kills often result from water pollution by a pesticide (usually insecticides). Pesticides can enter water via drift, surface runoff, soil erosion and leaching.

Bird kills from pesticides can occur when birds ingest the toxicant in granules, baits or treated seed; are exposed directly to the spray; consume a treated crop or drink and use contaminated water; or feed on pesticide-contaminated prey.

Worker Protection Standard

Federal rules for farm worker protection, issued in 1992, require farmers to provide additional training and notification to farm workers to prevent accidental or occupational exposure to pesticides. Farmers should contact Extension agents to learn the details of this standard and availability of training materials for education of workers and handlers.

Read and follow the label instructions on **restricted entry intervals (REI) (Table 16)** for every pesticide used. Some pesticide labels require both oral warning and posted signs to notify workers of pesticide applications. If the label doesn't require *both* forms of notification, notify workers *either* orally *or* by posting warning signs at entrances to treated areas. (Greenhouses *must* post warning signs for every application.) When using posted signs, post 24 hours or less before the pesticide application and remove signs within three days after the end of the restricted entry interval. Keep workers out during the entire time the signs are posted (except for early-entry workers wearing the proper personal protective equipment).

Record Keeping

The federal pesticide recordkeeping regulations and the federal worker protection standards require that all applicators who apply restricted-use pesticides (RUP) keep records and maintain them for at least three years, and preferably five years. Records to be kept include:

- Brand name or product name and the EPA registration number.
  Active ingredients
  Restricted-entry interval (REI)
- Total amount of the product used.
- Size of the area treated.
- Crop, commodity, stored product or site to which the pesticide was applied.
- Location of the application.
- Month, day, year, and time of the application.

- Name and certification number of the applicator or applicator's supervisor.

Any record form is acceptable as long as the required data are included. Penalties are costly and are increased for subsequent violations. Provisions for protecting the identity of the individual producers are included in the law. Commercial applicators must furnish a copy of the required records to the customer of the RUP application.

Restricted Use Pesticides

Several herbicides are currently classifed as restricted use pesticides and, as such, can be purchased and applied only by certified commercial or private pesticide applicators. Certification of pesticide applicators is administered by the Michigan Department of Agriculture and Rural Development. **Restricted use pesticides** are identified in **Table 16** of this guide.

Herbicide Resistance in Weeds

Herbicide-resistant weeds have become a major challenge in weed management systems in Michigan and throughout the Midwest. Herbicide resistance can be defined as the *inherent ability of a plant to survive and reproduce following exposure to a dose of herbicide(s) normally lethal to the wild type. In a plant, resistance may be naturally occurring or induced by such techniques as genetic engineering or selection of variants produced by tissue culture or mutagenesis*. In more simple terms, a herbicide-resistant weed is a weed that was once controlled by a certain herbicide and is no longer controlled by that herbicide. For example, atrazine is a very effective herbicide in controlling common lambsquarters; however with repeated use of atrazine or other triazine herbicides (atrazine, metribuzin, or *Princep*) common lambsquarters can no longer be controlled with or is resistant to triazine herbicides in several fields throughout Michigan. Herbicide resistance develops by using the same herbicide or herbicides with the same site of action year after year to control a particular weed species without other effective control measures. Repeated use of the herbicide allows for control of all of the susceptible plants of a population and allows for plants of that population that may be naturally resistant to survive and produce resistant offspring. In the case of triazine-resistant common lambsquarters, several resistant populations developed in fields where corn was grown continuously and atrazine was the primary herbicide used to control common lambsquarters.

While triazine-resistant common lambsquarters is the most widespread resistant weed in Michigan, there are currently 17 different weed species resistant to five different herbicide sites of action in Michigan. Common lambsquarters, common ragweed, common groundsel, common purslane, Powell amaranth, redroot pigweed, ladysthumb, horseweed, spreading orach, velvetleaf, late flowering goosefoot, and eastern black nightshade are all weeds where triazine-resistant biotypes have been identified in Michigan. Similar to triazine herbicides, herbicides belonging to the phenylurea chemical family disrupt photosynthesis in the plant. Biotypes of common purslane, Powell amaranth, redroot pigweed, and horseweed are all weeds that have developed resistance to herbicides in this family (*Linex, Lorox,* and *Karmex*). Resistance to the ALS-inhibiting herbicides is also common in Michigan. Biotypes of common ragweed, tall waterhemp, common lambsquarters, smooth pigweed, horseweed, kochia, eastern black nightshade and giant foxtail have been identified resistant to imidazolinone, sulfonylurea, and sulfonamide herbicides (ALS-inhibitors).

In the past, growers have dealt with herbicide-resistant weeds by incorporating other control measures for the resistant weed into their weed management program. Most of the time this has included using a herbicide with a different site of action. In recent years, the use of glyphosate in Roundup Ready crops has been the control measure of choice. While in many cases glyphosate has provided effective control of resistant weeds, there is a growing concern about the development of glyphosate-resistant weeds. In fact, glyphosate-resistant weeds are becoming a serious problem in several states in the United States, including Michigan. Glyphosate-resistant horseweed, common ragweed, giant ragweed, common waterhemp and Palmer amaranth have been identified in Michigan. In fact, some of these populations have been identified as resistant to both glyphosate and ALS-inhibiting herbicides. In order to limit the development of herbicide resistance, including glyphosate resistance, an understanding of the practices that lead to herbicide resistance is important.

Farmers should include weed control practices that delay or prevent the development of herbicide resistance. The following is a list of practices to reduce risk of herbicide resistant weeds. Some practices may be impractical in certain situations. No single practice is likely to be successful alone.

Practices to Reduce Risk of Herbicide Resistant Weeds

(1) Rotate herbicides using herbicides of differing sites of action. Do not make more than two consecutive applications of herbicides with the same site of action against the same weed unless other effective control practices are also included in the management system.

(2) Apply herbicides in tank-mixed, prepackaged or sequential mixtures that include multiple sites of action. Combining herbicides with different sites of action and similar persistence in soil will help prevent herbicide resistance.

(3) Scout fields regularly and identify weeds present.

(4) Rotate crops, particularly those with different life cycles.

(5) Combine mechanical control practices such as rotary hoeing and cultivation with herbicide treatments.

(6) Clean tillage and harvest equipment before moving from fields infested with resistant weeds to those that are not infested.

Herbicide Sites of Action

Herbicide site of action refers to the method by which the herbicide kills plants. An understanding of herbicide site of action is useful in developing herbicide programs that limit the development of herbicide-resistant weeds. The following list categorizes herbicides by general sites of action.

In fact, most herbicide labels now include a standardized system to inform users of the product's site of action (SOA). A box labeled 'Herbicide Group' is present near the top of the label. The number in the box is the SOA of the active ingredient of the herbicide. Individual herbicide families and herbicide examples are listed within each site of action. In addition, the site of action is listed for each herbicide on the weed response tables for each crop.

Herbicide Sites of Action

Site of Action	Herbicide Group Number	Chemical Family	Herbicide
ACCase inhibitors	1	Cyclohexanediones	Sethoxydim (*Poast, Poast Plus*) Clethodim (*Select, Select Max, Arrow*)
		Aryloxyphenoxypropionates	Fluazifop (*Fusilade DX*, component in *Fusion*) Fenoxaprop (*Puma*, component in *Fusion*) Quizalofop (*Assure II, Targa*)
		Phenylpyrazolins	Pinoxaden (*Axial XL*)
ALS inhibitors	2	Imidazolinones	Imazethapyr (*Pursuit*) Imazamox (*Raptor*)
		Sulfonylureas	Chlorimuron (*Classic*) Halosulfuron (*Permit, Sandea*) Iodosulfuron (component in *Autumn Super*) Mesosulfuron (*Osprey*) Nicosulfuron (*Accent Q*) Primisulfuron (*Beacon*) Prosulfuron (*Peak*) Rimsulfuron (*Matrix, Resolve*) Thifensulfuron (*Harmony*) Tribenuron (*Express*) Triflusulfuron (*UpBeet*)
		Triazolopyrimidine	Flumetsulam (*Python*) Cloransulam-methyl (*FirstRate*) Pyroxsulam (*PowerFlex HL*) Florasulam (component in *Quelex*)
		Sulfonylaminocarbonyltriazolinones	Propoxycarbazone (*Olympus*) Thiencarbazone-methyl (component in *Capreno*)
Microtubule inhibitors (root inhibitors)	3	Dinitroanilines	Trifluralin (many names) Ethalfluralin (*Sonalan*) Pendimethalin (*Prowl/Prowl H_20*)
		Benzamide	Pronamide (*Kerb*)
Synthetic auxins	4	Arylpicolinate	Halauxifen (*Elevore*, component in *Quelex*)
		Phenoxy acetic acids	2,4-D (*Enlist One*, others) 2,4-DB (*Butyrac 200, Butoxone 200*) MCPA
		Benzoic acids	Dicamba (*Banvel, Clarity, DiFlexx, Engenia, XtendiMax*; component in *Status*)
		Pyridines	Clopyralid (*Stinger*) Fluroxypyr (*Starane Ultra*)
Photosystem II inhibitors	5	Triazines	Atrazine Simazine (*Princep, Sim-Trol*)
		Triazinone	Metribuzin (*Metribuzin*, others) Hexazinone (*Velpar*)
		Phenyl-carbamates	Desmedipham (*Betenex*) Phenmedipham (component in *Betamix*)
		Uracils	Terbacil (*Sinbar*)
	6	Benzothiadiazoles	Bentazon (*Basagran*, others)
		Nitriles	Bromoxynil (*Buctril, Moxy*, others)
	7	Phenylureas	Linuron (*Lorox, Linex*)

(Continued on next page)

Herbicide Sites of Action *(continued)*

Site of Action	Herbicide Group Number	Chemical Family	Herbicide
Lipid synthesis inhibitor	8	Thiocarbamates	EPTC (*Eptam*)
EPSPS inhibitor	9	Organophosphorus	Glyphosate (See Table 10)
Glutamine synthetase inhibitor	10	Organophosphorus	Glufosinate (*Liberty, Rely*)
Diterpene biosynthesis inhibitor (bleaching)	13	Isoxazolidinone	Clomazone (*Command*)
Protoporphyrinogen oxidase inhibitors (PPO)	14	Diphenylether	Acifluorfen (*Ultra Blazer*) Fomesafen (*Flexstar, Reflex*) Lactofen (*Cobra, Phoenix*)
		N-phenylphthalimide	Flumiclorac (*Resource*) Flumioxazin (*Valor, Valor EZ, Rowel*)
		Aryl triazolinone	Sulfentrazone (*Authority, Spartan*) Carfentrazone (*Aim*) Fluthiacet-methyl (*Cadet*)
		Pyrazoles	Pyraflufen-ethyl (*Vida*)
		Pyrimidinedione	Saflufenacil (*Sharpen*)
Long-chain fatty acid inhibitors	15	Acetamides	Acetochlor (*Harness, Surpass NXT, Breakfree NXT, Warrant*) Dimethenamid-P (*Outlook*) Metolachlor (*Parallel*) Pyroxasulfone (*Zidua, Zidua SC*) s-metolachlor (*Dual Magnum, Dual II Magnum, Cinch*) Flufenacet (*Define*)
Specific site unknown	16	Benzofuranes	Ethofumesate (*Nortron*)
Auxin transport inhibitor	19	Semicarbazone	diflufenzopyr (component in *Status*)
Photosystem I inhibitors	22	Bipyridiliums	Paraquat (*Gramoxone, Parazone*) Diquat (*Reglone*)
4–HPPD inhibitors (bleaching)	27	Isoxazole Pyrazole Pyrazolone Triketone	Isoxaflutole (*Balance Flexx*) Pyrasulfotole (component in *Huskie*) Topramezone (*Armezon/Impact*) Bicyclopyrone (component in *Acuron*) Mesotrione (*Callisto*) Tembotrione (*Laudis*)

TABLE 1A – Weed Response to Soil-Applied Herbicides in Corn*

Soil Applied	SITE OF ACTION	CORN TOLERANCE**	ANNUAL BROADLEAVES												ANNUAL GRASSES								PERENNIALS				
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH[a]	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP[a]	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (Rhizome)
ATRAZINE	5	1	F	F	**E**	**E**	**G**	**G**	**E**	**G**	**G**	F	**G**	**E**	**G**	P	F	F	**G**	P	P	P	F	P	F	N	N
BALANCE FLEXX	27	2	P	**E**	**E**	**E**	F/**G**	**E**	**E**	F	**G**	**E**	**G**	**E**	**G**	F	**G**	**G**	F	P	P	F	P	P	P	**G**	F
BREAKFREE NXT/HARNESS/ SURPASS NXT	15	2	P	N	F	**G**	**G**	**G**	F	N	P	P	**G**	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F	P	N
CALLISTO	27	1	P	**G**	**E**	**E**	**G**	**E**	F	F	**E**	**E**	**G**	**G**	N	P	N	N	N	N	N	N	P	N	N	N	N
DUAL II MAGNUM/ CINCH/PARALLEL	15	1	N	N	P	F	F/**G**	**G**	P	N	P	N	**G**	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F	P	N
OUTLOOK	15	2	N	N	P	**G**	F	**G**	P	N	P	N	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	P	P	N
PRINCEP	5	1	F	F	**E**	**E**	F	**G**	**E**	F	**G**	F	F	**E**	**G**	F	F	F	**G**	P	P	P	P	F	F	N	N
PROWL H_2O[b] **(PRE only)**	3	3	N	N	**G**	P	P	F	P	N	P	F	P	P	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	P	N
PYTHON/ACCOLADE	2	3	F	F	**E**	**G**	N	**E**	F	P	**G**	**G**	N	**E**	P	P	P	P	P	P	P	P	N	N	N	N	N
RESOLVE SG	2	1	**G**	F	F	P	N	**E**	F	P	F	F	N	**E**	**G**	F	**G**	**G**	**G**	F	F	P	P	P	P	P	P	P
SHARPEN	14	2	**G**	**G**	**G**	**G**	P	**E**	**G**	F	**G**	**G**	**G**	**G**	N	N	N	N	N	N	N	N	P	N	N	N	N
VALOR[c]/ROWEL **(7d EPP or more)**	14	2	P	F	**G**	**G**	F/**G**	**G**	**G**	F	F	F	F/**G**	**G**	P	P	P	P	P	P	P	P	N	N	P	P	N
ZIDUA	15	2	P	F	F	**G**	**G**	**E**	F	N	F	F	**E**	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F	F	N
Premixes																											
ACURON	5/15/27/27	1	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	F	P	F	F	N
ACURON FLEXI	15/27/27	1	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**G**	**E**	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	F	N	F	P	N
ANTHEM MAXX	15/14	2	P	F	F	**G**	**G**	**E**	F	N	F	F	**G**	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F	F	N
ANTHEM ATZ	15/14/5	1	P	F	**G**	**E**	**G**	**E**	**G**	F	F	F	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F	F	N
ARMEZON PRO	15/27	2	N	N	P	**G**	F	**G**	P	N	P	N	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	P	P	N
BASIS BLEND	2/2	1	**G**	F	**G**	P	N	**E**	F	P	F	F	N	**E**	**G**	F	**G**	**G**	**G**	F	F	P	P	P	P	P	P
BICEP II LITE MAGNUM/ CINCH ATZ LITE	5/15	1	F	F	**G**	**E**	F/**G**	**G**	**G**	F	F	F	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	F	P	N
BICEP II MAGNUM/CINCH ATZ/ PARALLEL PLUS	5/15	1	F	F	**E**	**E**	**G**	**G**	**E**	**G**	**G**	F	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	F	P	F	P	N
BREAKFREE NXT LITE/DEGREE XTRA/ FULTIME NXT/ KEYSTONE LA NXT	5/15	2	F	F	**G**	**E**	**G**	**G**	**G**	F	F	F	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	F	P	N
BREAKFREE NXT ATZ/HARNESS XTRA/ KEYSTONE NXT	5/15	2	F	F	**E**	**E**	**G**	**G**	**E**	**G**	**G**	F	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	F	P	F	P	N
CORVUS	2/27	2	**G**	**E**	**E**	**E**	F/**G**	**E**	**E**	**G**	**E**	**E**	**G**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	P	F	P	**G**	F
FIERCE[c] **(7d EPP or more)**	14/15	2	P	F	**G**	**G**	**G**	**E**	**G**	F	F	F	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	F	N	N	F	F	N
HARNESS MAX	15/27	1	P	**G**	**E**	**E**	**G**	**E**	F	F	**E**	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	F	P	N
HORNET WDG/STANZA	2/4	3	**G**	F	**E**	**G**	N	**E**	**E**	**G**	**G**	**G**	N	**E**	N	N	N	N	N	N	N	N	F	N	N	N	N
INSTIGATE	2/27	2	**G**	**G**	**E**	**E**	F	**E**	F	F	**E**	**E**	F	**E**	**G**	F	**G**	**G**	**G**	F	F	P	P	P	P	P	P	P
LEXAR EZ/LUMAX EZ	5/27/15	1	F	**G**	**E**	**E**	**G/E**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	F	P	F	P	N
PREQUEL[d]	2/27	2	-	**G**	**E**	**G**	P	**G**	**G**	F	**G**	**E**	F	**G**	**G**	F	**G**	**G**	**G**	F	F	P	P	P	P	**G**	F

(continued)

TABLE 1A – Weed Response to Soil-Applied Herbicides in Corn* *(continued)*

Soil Applied	SITE OF ACTION	CORN TOLERANCE**	ANNUAL BROADLEAVES												ANNUAL GRASSES								PERENNIALS				
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH[a]	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP[a]	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (Rhizome)
RESICORE	4/15/27	2	**F**	**G**	**E**	**E**	**G/E**	**E**	**G**	F	**E**	**E**	**G/E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	F	P	N
SURESTART II/TRIPLEFLEX II[d]	2/4/15	3	**G**	F	**E**	**G**	F	**E**	**G**	F	**G**	**G**	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	F	P	N
VERDICT[d]	14/15	2	**G**	**G**	**G**	**G**	F	**E**	**G**	F	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	F	P	N	P	P	N
ZEMAX	27/15	1	P	**G**	**E**	**E**	**G**	**E**	F	F	**E**	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	F	P	N

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions; 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high.

[a] Almost all populations of Palmer amaranth and waterhemp found in Michigan are resistant to the ALS-inhibiting herbicides (Group 2). Refer to the factsheet on "Keys to Managing Multiple-Resistant Palmer amaranth" on pages 209-212.

[b] DO NOT incorporate Prowl H_2O and corn should be planted a minimum of 1.5-inches deep.

[c] Valor/Rowel or Fierce must be applied at least 7 day before planting, for use only in no-till corn.

[d] These herbicides are intended for use only in planned preemergence followed by postemergence programs. Ratings only reflect early-season weed control, not full-season control.

TABLE 1B – Weed Response to Postemergence Herbicides in Corn*

			ANNUAL BROADLEAVES												ANNUAL GRASSES								PERENNIALS				
Postemergence	SITE OF ACTION	CORN TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH[a]	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP[a]	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (Rhizome)
2,4-D	4	3	**G**	F	**G**	**G**	F/**G**	**G**	**G**	**G**	P	F	F/**G**	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
ACCENT Q	2	2	F	**G**	F	P	N[a]	**E**	P	N	**G**	F	N[a]	P	**E**	P	**E**	**E**	**E**	**E**	**E**	**G**	F	**G**	F	**E**	**G**
AIM	14	3	P	F	F	**G**	P	**G**	P	P	P	**E**	P	F	N	N	N	N	N	N	N	N	N	N	N	N	N
ARMEZON/IMPACT	27	1	**G**	**E**	**E**	**E**	**G**	**E**	**E**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	F	F	P	P	F	P
ATRAZINE	5	1	**G**	**G**	**E**	**G**	**G**	**E**	**E**	**G**	**G**	F	**G**	**E**	F	P	F	F	F	P	P	P	F	F	F	N	N
BANVEL/CLARITY	4	3	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	F	**G**	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
BASAGRAN/BROADLOOM	6	1	**E**	**G**	F	P	N	P	F	P	**G**	F	N	**E**	N	N	N	N	N	N	N	N	**G**	N	**G**	N	N
BEACON	2	2	**E**	**G**	F	**G**	N[a]	**E**	**E**	**E**	**G**	**G**	N[a]	F	P	P	F	F	F	**G**	**G**	F	F	**G**	F	**G**	F
BUCTRIL/MOXY	6	2	**G**	**G**	**E**	**G**	N	F	**G**	**G**	**G**	**G**	N	F	N	N	N	N	N	N	N	N	P	N	N	N	N
CADET	14	2	P	**G**	F	F	P	**G**	P	P	P	**E**	P	P	N	N	N	N	N	N	N	N	N	N	N	N	N
CALLISTO	27	1	F	**E**	**E**	**E**	F	**G**	**G**	**G**	**E**	**E**	**G**	**E**	N	F[b]	N	N	N	N	N	N	P	N	P	N	N
DIFLEXX	4	2	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	F	**G**	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
LAUDIS	27	1	**G**	**E**	**E**	**E**	**G**	**E**	**G**	**G**	**G**	**E**	**G**	F	**G**	F	**G**	**G**	**E**	N	P	F	P	P	P	F	P
PERMIT	2	1	**E**	**G**	N	P	N[a]	**E**	**G**	**G**	F	**G**	N[a]	**E**	N	N	N	N	N	N	N	N	P	N	**E**	N	N
RESOURCE	14	2	P	P	F	P	P	P	P	P	P	**E**	P	P	N	N	N	N	N	N	N	N	N	N	N	N	N
STINGER	4	1	**E**	**G**	P	F	P	P	**E**	**E**	F	P	P	P	N	N	N	N	N	N	N	N	**E**	N	N	N	N
Premixes																											
ANTHEM MAXX	14/15	2	P	**G**	F	F	P	**G**	P	P	P	**E**	P	P	N	N	N	N	N	N	N	N	N	N	N	N	N
ANTHEM ATZ	15/14/5	2	**G**	**G**	**E**	**G**	**G**	**E**	**E**	**G**	**G**	**E**	**G**	**E**	F	P	F	F	F	P	P	P	F	F	F	N	N
ARMEZON PRO	15/27	1	**G**	**E**	**E**	**E**	**G**	**E**	**E**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**E**	**E**	**G**	**G**	**G**	F	F	P	P	F	P
CALLISTO XTRA	5/27	1	**G**	**E**	**E**	**E**	**G**	**E**	**E**	**G**	**G**	**E**	**G**	**G**	N	F[b]	N	N	N	N	N	N	F	N	P	N	N
CAPRENO	2/27	2	**G**	**E**	**G**	**E**	F	**E**	**G**	**G**	**G**	**E**	F	**G**	**G**	**G**	**G**	**G**	**E**	**G**	**G**	F	P	F	P	**E**	**G**
DIFLEXX DUO	4/27	2	**G**	**E**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	P	F	F	**G**	N	N	P	F	P	P	P	P
HORNET WDG/STANZA	2/4	2	**E**	F	F	F	N[a]	P	**E**	**E**	**G**	**G**	N[a]	**G**	N	N	N	N	N	N	N	N	**E**	N	N	N	N
REALM Q	2/27	2	**G**	**E**	**E**	**E**	P	**E**	**G**	F	**E**	**E**	F	**E**	**G**	F	**G**	**G**	**G**	**G**	**G**	P	F	F	P	F	N
RESOLVE Q	2/2	2	**G**	P	**G**	F	N[a]	**E**	F	P	**G**	F	N[a]	**E**	**G**	F	**G**	**G**	**G**	**G**	**G**	P	F	F	P	F	N
REVULIN Q	2/27	2	F	**E**	**E**	**E**	P	**E**	**G**	F	**E**	**E**	F	**E**	**E**	F[b]	**E**	**E**	**E**	**E**	**E**	**G**	F	**G**	F	**E**	**G**
SOLSTICE	14/27	2	F	**E**	**E**	**E**	F	**E**	**G**	**G**	**E**	**E**	F	**E**	N	F[b]	N	N	N	N	N	N	P	N	P	N	N
STATUS	4/19	2	**E**	**G**	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	P	P	P	P	P	P	P	P	**G**	N	N	N	N
STEADFAST Q	2/2	2	F	**G**	F	P	N[a]	**E**	P	N	**G**	F	N[a]	**G**	**E**	F	**E**	**E**	**E**	**E**	**E**	**G**	F	**G**	F	**E**	**G**
YUKON	2/4	2	**E**	**G**	**G**	**G**	N[a]	**E**	**G**	**G**	**G**	**G**	N[a]	**E**	N	N	N	N	N	N	N	N	P	N	**E**	N	N
Glyphosate-Resistant Corn																											
GLYPHOSATE	9	1	**E**	**E**	**G**	**G**	N[a]	**E**	**G**	**G**	**G**	**G**	N[a]	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**
CALLISTO GT	9/27	1	**E**	**E**	**E**	**E**	F	**E**	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**
EXPERT	5/9/15	2	**E**	**E**	**E**	**G**	**G**	**E**	**E**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**
HALEX GT	9/15/27	1	**E**	**E**	**E**	**E**	F	**E**	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**
SEQUENCE	9/15	1	**E**	**E**	**G**	**G**	N[a]	**E**	**G**	**G**	**G**	**G**	N[a]	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**
WARRANT + GLYPHOSATE	9/15	1	**E**	**E**	**G**	**G**	N[a]	**E**	**G**	**G**	**G**	**G**	N[a]	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**
LibertyLink Corn																											
LIBERTY	10	1	**E**	**G**	F	**G**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**E**	F	F	**G**	**G**	F	F	F	P	P	P	P	**G**	F

(continued)

TABLE 1B – Weed Response to Postemergence Herbicides in Corn* *(continued)*

Soil Applied	SITE OF ACTION	CORN TOLERANCE**	ANNUAL BROADLEAVES												ANNUAL GRASSES								PERENNIALS				
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH[a]	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP[a]	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (Rhizome)
Enlist (2,4-D resistant) Corn																											
Enlist One	4	1	**G**	F	**G**	**G**	**G**	**G**	**G**	**G**	P	F	**G**	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
Enlist Duo	4/9	1	**E**	**E**	**G**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**E**	F	**E**	**E**

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions; 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high.

[a] Almost all populations of Palmer amaranth and waterhemp found in Michigan are resistant to the ALS-inhibiting herbicides (Group 2) and glyphosate (Group 9). Refer to the factsheet on "Keys to Managing Multiple-Resistant Palmer amaranth" on pages 209-212.

[b] Large crabgrass only.

TABLE 1C – Herbicide Premixes in Corn

Soil Applied

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE[a]	=	EQUIVALENT RATES
Acuron	Syngenta	3.44ZC	3 qt/A	=	1.68 pt Dual II Magnum + 0.75 qt Atrazine + 5.76 oz Callisto + 0.045 lb ai bicyclopyrone
Acuron Flexi	Syngenta	3.26ZC	2.25 qt/A	=	1.68 pt Dual II Magnum + 5.76 oz Callisto + 0.045 lb ai bicyclopyrone
Anthem MAXX	FMC	4.3SE	5 oz/A	=	0.75 oz Cadet + 3 oz Zidua
Anthem ATZ	FMC	4.5SC	2.5 pt/A	=	1.25 qt atrazine 4L + 0.625 oz Cadet + 2.85 oz Zidua
Armezon PRO	BASF	5.35EC	20 oz/A	=	0.71 oz Armezon + 17.5 oz Outlook
Basis Blend	DuPont	30WG	1.25 oz/A	=	1 oz Resolve SG + 0.25 oz Harmony SG
Bicep II Magnum	Syngenta	5.5F	2.1 qt/A	=	1.33 pt Dual II Magnum + 1.6 qt atrazine 4L
Bicep Lite II Magnum	Syngenta	6F	1.5 qt/A	=	1.33 pt Dual II Magnum + 1 qt atrazine 4L
Breakfree NXT ATZ	DuPont	5.6L	2.4 qt/A	=	2.2 pt Breakfree NXT + 1.5 qt atrazine 4L
Breakfree NXT Lite	DuPont	6L	2 qt/A	=	2.5 pt Breakfree NXT + 0.85 qt atrazine 4L
Cinch ATZ	DuPont	5.5F	2.1 qt/A	=	1.33 pt Cinch + 1.6 qt atrazine 4L
Cinch ATZ Lite	DuPont	6F	1.5 qt/A	=	1.33 pt Cinch + 1 qt atrazine 4L
Corvus	Bayer CropScience	2.63SC	5.6 oz/A	=	5.26 oz Balance Flexx + 0.033 lb ai thiencarbazone
Degree Xtra	Monsanto	4L	3 qt/A	=	2.3 pt Harness + 1 qt atrazine 4L
Fierce[b]	Valent	76WG	3 oz/A	=	1.97 oz Valor + 1.5 oz Zidua
FulTime NXT	Dow AgroSciences	4L	3 qt/A	=	2.3 pt Surpass + 1 qt atrazine 4L
Harness MAX	Monsanto	3.82L	75 fl oz/A	=	2.35 pt Harness + 6.18 oz Callisto
Harness Xtra 5.6L	Monsanto	5.6L	2.4 qt/A	=	2.2 pt Harness + 1.5 qt atrazine 4L
Hornet WDG/Stanza	Dow AgroSciences/FMC	68.5WG	3 oz/A	=	0.7 oz Python + 0.25 pt Stinger
Instigate	DuPont	45.8WG	6 oz/A	=	5 oz Callisto + 1 oz Resolve SG
Keystone NXT	Dow AgroSciences	5.6L	2.4 qt/A	=	2.2 pt Surpass NXT + 1.5 qt atrazine 4L
Keystone LA NXT	Dow AgroSciences	6L	2 qt/A	=	2.5 pt Suprass NXT + 0.85 qt atrazine 4L

See footnotes at the end of the chart.

(Continued on next page)

TABLE 1C – Herbicide Premixes in Corn *(continued)*

Soil Applied *(continued)*

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE[a]	=	EQUIVALENT RATES
Lexar EZ	Syngenta	3.7ZC	3 qt/A		5.34 oz Callisto + 1.36 pt Dual II Magnum + 1.3 qt atrazine 4L
Lumax EZ	Syngenta	3.67ZC	2.7 qt/A	=	5.38 oz Callisto + 1.76 pt Dual II Magnum + 0.63 qt atrazine 4L
Parallel Plus	MANA	5.5SL	2.3 qt/A	=	1.6 pt Parallel + 1.6 qt atrazine 4L
Prequel[b]	DuPont	45WG	1.66 oz/A	=	1 oz Balance PRO + 1 oz Resolve SG
Resicore	Dow AgroSciences	3.29SE	2.75 qt/A	=	2.2 pt Surpass NXT + 6.6 oz Callisto + 5.6 oz Stinger
SureStart II[b]	Dow AgroSciences	4.16SE	2 pt/A	=	1.07 pt Surpass NXT + 3 oz Stinger + 0.6 oz Python
TripleFLEX II[b]	Monsanto	4.16SE	2 pt/A	=	1.07 pt Harness + 3 oz Stinger + 0.6 oz Python
Verdict[b]	BASF	5.57EC	15 oz/A	=	3 oz Sharpen + 12.5 oz Outlook
Zemax	Syngenta	3.67ZC	2 qt/A	=	5.36 oz Callisto + 1.75 pt Dual II Magnum

Postemergence

Anthem MAXX	FMC	4.3SE	4 oz/A	=	0.6 oz Cadet + 2.45 oz Zidua
Anthem ATZ	FMC	4.5SC	1 qt/A	=	2.28 oz Zidua + 0.5 oz Cadet + 1 qt atrazine 4L
Armezon PRO	BASF	5.35EC	20 oz/A	=	0.71 oz Armezon + 17.5 oz Outlook
Callisto GT[c]	Syngenta	4.18L	2 pt/A	=	3 oz Callisto + 0.95 lb a.e. glyphosate
Callisto Xtra	Syngenta	3.7SC	24 oz/A	=	3 oz Callisto + 1.2 pt atrazine 4L
Capreno	Bayer CropScience	3.45SC	3 oz/A	=	2.5 oz Laudis + 0.01 lb ai thiencarbazone-methyl
DiFlexx DUO	Bayer CropScience	2.13SC	32 oz/A	=	2.46 oz Laudis + 10 oz DiFlexx
Enlist Duo[d]	Dow AgroSciences	3L	3.5 pt/A	=	0.7 lb a.e. 2,4-D + 0.74 lb a.e. glyphosate
Expert[c]	Syngenta	4.88SC	3 qt/A	=	1.37 pt Dual II Magnum + 1.6 qt atrazine 4L + 0.75 lb a.e. glyphosate
Halex GT[c]	Syngenta	4.38L	3.6 pt/A	=	1 pt Dual Magnum + 3 oz Callisto + 0.93 lb a.e. glyphosate

(Continued on next page)

See footnotes at the end of the chart.

TABLE 1C – Herbicide Premixes in Corn *(continued)*

Postemergence *(continued)*

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE[a]	=	EQUIVALENT RATES
Hornet WDG/Stanza	Dow AgroSciences/FMC	68.5WG	3 oz/A	=	0.7 oz Python + 0.25 pt Stinger
Realm Q	DuPont	38.75WG	4 oz/A	=	1.2 oz Resolve + 2.5 oz Callisto
Resolve Q	DuPont	22.4WG	1.25 oz/A	=	0.9 oz Resolve + 0.1 oz Harmony SG
Revulin Q	DuPont	51.2WG	3.4 oz/A	=	0.9 oz Accent Q + 2.5 oz Callisto
Sequence[c]	Syngenta	5.25L	2.5 pt/A	=	0.98 pt Dual Magnum + 0.7 lb a.e. glyphosate
Solstice	FMC	4L	3 oz/A	=	0.71 oz Cadet + 2.8 oz Callisto
Status	BASF	56WG	5 oz/A	=	4 oz Clarity + 0.05 lb ai diflufenzopyr
Steadfast Q	DuPont	37.7WG	1.5 oz/A	=	0.7 oz Accent Q + 0.75 oz Resolve
Yukon	Gowan	67.5WG	4 oz/A	=	4 oz Banvel + 0.66 oz Permit

[a] Rates recommended are for medium textured soils with 3% organic matter.

[b] These herbicides are intended for use only in planned preemergence followed by postemergence programs. Ratings only reflect early-season weed control, not full-season control.

[c] Postemergence applications should only be made to glyphosate-resistant corn.

[d] Postemergence applications should only be made to Enlist (2,4-D resistant) corn.

TABLE 1D – Corn Herbicides – Remarks and Limitations

Apply all agricultural chemicals in accordance with regulations and labels as to rate, timing and crops for which they may be used. Rates recommended in this bulletin are for medium-textured soils with 3% organic matter.

Corn — Soil Applied — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	pyroxasulfone + fluthiacet *(Anthem MAXX)*	0.168	5 oz 4.3SE	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • *Anthem MAXX* use rates are based on soil texture and organic matter. *Anthem MAXX* rates range from 2.5 to 6.5 oz/A (5 oz/A). Lower rates (4 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant corn, unless resistant weeds are present. • *Anthem MAXX* should be used as part of a planned preemergence followed by postemergence herbicide program. • May be applied postemergence. Refer to the post-emergence application section for *Anthem MAXX* and Table 1I. • Refer to Table 12 for crop rotation restrictions.
	topramezone + dimethenamid-P (*Armezon PRO*)	0.835	20 oz 5.35L	• **May be applied preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • *Atrazine* at 1 lb ai/A may be applied with *Armezon PRO* to increase the spectrum of weeds controlled. • Refer to label and Table 12 for crop rotation restrictions.
	s-metolachlor *(Dual II Magnum, Cinch)*	1.27	1.33 pt 7.64EC	• **May be applied preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • *Dual II Magnum* and *Cinch* contain a safener which increases corn tolerance to s-metolachlor. • Increase the rate to 1.66 pt/A for effective nutsedge control. • Nutsedge control is improved when s-metolachlor is incorporated. • May be applied postemergence on corn up to 40 inches tall, but this application alone will not control emerged weeds. Refer to Table 1H. • Refer to Table 12 for crop rotation restrictions.

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Corn — Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	acetochlor *(Harness, Breakfree NXT, Surpass NXT)*	1.97	2.25 pt 7EC	• **May be applied preplant, preplant incorporated or preemergence**. • Refer to Table 1A for weed control and crop tolerance ratings. • *Harness, Breakfree NXT*, and *Surpass NXT* use rates are based on soil texture and organic matter. Use rates of these products range from 1.25 to 3 pt/A (2.25 pt/A). Lower rates (1.8 pt/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant corn, unless resistant weeds are present. • DO NOT apply acetochlor within 50 feet of any well where the depth to groundwater is 30 feet or less: sands with less than 3% organic matter, loamy sands with less than 2% organic matter, or sandy loams with less than 1% organic matter. • All commercial acetochlor products contain a safener that increases corn tolerance. • Application rate varies by soil type. • EC formulations of acetochlor require less rainfall for incorporation compared with s-metolachlor or pendimethalin. • May be applied postemergence on corn up to 11 inches tall, but this application alone will not control emerged weeds. Refer to Table 1H. • Refer to Table 12 for crop rotation restrictions.
	dimethenamid-P *(Outlook)*	0.84	18 oz 6EC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • Increase the rate to 21 oz/A for effective nutsedge control. • Nutsedge control is improved when incorporated. • *Outlook* rates vary with soil texture and organic matter from 12 to 21 oz/A.. • May be applied postemergence on corn up to 12 inches tall, but this application alone will not control emerged weeds. Refer to Table 1H. • Refer to Table 12 for crop rotation restrictions.
	metolachlor *(Parallel,* others*)*	1.3	1.33 pt 7.8L	• **May be applied preplant, preplant incorporated or preemergence.** • *Parallel* is a mix of the R and S-isomers of metolachlor. Limited research has shown that 1.33 pt/A of these products provide similar initial activity to s-metolachlor products at 1.33 pt/A. However, Parallel may not provide the consistency, length of control or performance on more difficult to control weeds. Rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) in the 1.33 pt/A rate of *Dual IIMagnum/ Cinch* (s-metolachlor). • Refer to Table 1A for weed control and crop tolerance ratings. • *Parallel* contains a safener which increases corn tolerance to metolachlor. • May be applied postemergence on corn up to 40 inches tall, but this application alone will not control emerged weeds. Refer to Table 1H. • Refer to Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	pendimethalin *(Prowl)* OR *(Prowl H_2O)*	 1.5 OR 1.4	 3.6 pt 3.3EC OR 3 pt 3.8AS	• **DO NOT apply preplant incorporated.** • Refer to Table 1A for weed control and crop tolerance ratings. • Extreme care must be taken to assure complete closure of the seed furrow. If the seed furrow remains open (even partially open), severe injury will occur. • Apply after planting. • Plant at least 1.5 inches deep. • Adjust rate according to soil type. • DO NOT use on sandy soil with less than 1.5% organic matter. • May be applied postemergence on corn up to 30 inches tall or 8 collars, but this application alone will not control emerged weeds. Refer to Table 1H. • Refer to Table 12 for crop rotation restrictions.
	rimsulfuron *(Resolve SG)*	0.016	1 oz 25WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • DO NOT apply to seed corn. • DO NOT apply preemergence to coarse-textured soils (sand, loamy sand or sandy loam) with less than 1% organic matter. • Atrazine at 1 lb a.i./A tank mixed with *Resolve* will improve control of broadleaf weeds. • Insecticide interaction. Allow at least 60 days between a preemergence *Resolve SG* application and application of an organophosphate insecticide. • The rotation restriction intervals need to be extended to 18 months for alfalfa and sugar beets unless there is 15 inches of rainfall between application and planting or if 2 oz/A of *Resolve* is applied. • Refer to Table 12 for crop rotation restrictions.
	pyroxasulfone *(Zidua)* OR *(Zidua SC)*	0.133	2.5 oz 85WG OR 4 oz 4.17SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • Application rate varies with soil texture and application timing from 1.5 to 4 oz/A. • DO NOT apply more than 2.75 oz/A on course; 3 oz/A on medium; or 4 oz/A on fine textured soils of *Zidua WG;* or more than 4.5 oz/A on course textured; 5 oz/A on medium textured soil; or 6.5 oz/A on fine textured soils of *Zidua SC*. • DO NOT use on peat or muck soils with 10% or more organic matter. • May be applied postemergence up to 4 collar (V4) corn, but this application alone will not control emerged weeds. Refer to Table 1H. • Rotation restrictions are dependent on use rate. If *Zidua* is applied at 4 oz/A or 6.5 oz/A of *Zidua SC*, the rotation restrictions are extended to 4 months for soybean, 6 months for wheat, and 18 months for other small grains. Refer to Table 12 for crop rotation restrictions.

Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	atrazine (*AAtrex*, others)	1	1 qt 4L OR 1.1 lb 90WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • Mixing, loading, and application setbacks are required for atrazine. See page 12 or label for details. • DO NOT exceed an application rate of 2 lb a.i. of atrazine per acre per application and the total pounds of atrazine applied must not exceed 2.5 lb a.i. per acre per year. • May be applied postemergence on corn up to 12 inches tall. Refer to Table 1H and the postemergence application section for atrazine. • Refer to Table 12 for crop rotation restrictions.
	mesotrione *(Callisto)*	0.188	6 oz 4SC	• **May be applied preplant or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • Mesotrione can be applied preemergence to field corn, seed corn, sweet corn, and yellow popcorn. • Tank mixes with atrazine (1 a.i. lb/A) will improve control of common ragweed, giant ragweed, and cocklebur. • DO NOT apply *Callisto* with an emulsifiable concentrate herbicide or liquid fertilizer if corn has already emerged. • DO NOT exceed a total of 7.7 oz/A of *Callisto* per season. • Mesotrione preemergence is generally applied in a premix. Mesotrione premixes include ***Acuron, Acuron Flexi, Instigate, Lumax EZ, Lexar EZ,*** and ***Zemax***. Refer to Table 1C for premix use rates and components. May be applied postemergence on corn up to 30 inches tall or through 8 collars. Refer to Table 1H and the postemergence application section for *Callisto*. • Refer to Table 12 for crop rotation restrictions.
	flumetsulam + clopyralid *(Hornet WDG, Stanza)*	0.128	3 oz 68.5WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Corn should be planted at least 1.5 inches deep. • Adjust application rate according to soil type and organic matter. • DO NOT apply to soils with less than 1.5% organic matter, a pH > 7.8, or soils with >5% organic matter and low soil pH (5.9). • DO NOT follow this treatment with a postemergence application of an ALS-inhibiting herbicide if plants are under stress. • Tank mixes with atrazine (1 a.i. lb/A) will improve control of heavy populations of jimsonweed. • Insecticide interaction. Consult label for organophosphate insecticide restrictions. • May be applied postemergence on corn up to 20 inches tall or through 6 collars. Refer to Table 1H and the postemergence application section for *Hornet WDG/Stanza*. • Requires a 26-month rotation interval and a successful field bioassay before planting sugar beets, cucumbers or tomatoes. • Refer to Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	simazine (*Princep*, others)	1	1 qt 4L OR 1.1 lb 90WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • May be substituted for atrazine for slightly better grass control. • DO NOT apply after corn emergence. • *Princep* has similar carryover risk as atrazine. • When *Princep* and atrazine are both applied to corn, carryover risk is additive. • Refer to Table 12 for crop rotation restrictions.
	flumetsulam *(Python, Accolade)*	0.05	1 oz 80WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • Corn should be planted at least 1.5 inches deep. • Adjust application rate according to soil type and organic matter. • DO NOT apply to soils with less than 1.5% organic matter – severe injury may occur. • DO NOT apply to areas where soil pH is greater than 7.8 or to soils with greater than 5% organic matter and pH less than 5.9. • DO NOT follow this treatment with a postemergence application of an ALS-inhibiting herbicide if plants are under stress. • Tank mixes with atrazine (1 a.i. lb/A) will improve control of heavy populations of common ragweed, cocklebur, and jimsonweed. • Insecticide interaction. Consult label for organophosphate insecticide restrictions. • May be applied postemergence on corn up to 20 inches tall or through 6 collars, rates should be reduced. Refer to Table 1H. • Refer to Table 12 for crop rotation restrictions.
	saflufenacil *(Sharpen)*	0.056	2.5 oz 2.85SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • *Sharpen* can be applied to field corn, silage corn, seed corn and popcorn. Refer to seed company recommendations for use on inbred lines. • Application rates vary by soil type; on coarse textured soils 2-2.5 oz/A, medium textured soils 2.5-3 oz/A, and fine textured soils 3-3.5 oz/A can be applied. • The maximum *Sharpen* rate for coarse textured soils is 2.5 oz per acre per application. • DO NOT apply *Sharpen* after corn emergence or severe crop injury will occur. • Insecticide interactions. Consult label for organophosphate and carbamate insecticide restrictions. • DO NOT exceed an application rate of 3.5 oz of *Sharpen* per acre per application or 6 oz/A of *Sharpen* per year. • *Sharpen* is an effective burndown herbicide in no-till corn. Consult Table 1K for more information. • Refer to Table 12 for crop rotation restrictions. • Refer to label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	flumioxazin *(Valor, Rowel)*	0.064	2 oz 51WG	• **Apply a minimum of 7 day or more prior to planting corn on no-till or minimum tillage fields.** • Refer to Table 1A for weed control and crop tolerance ratings. • If there is less than 25% of the soil surface covered with residue from the previous crop or less than 0.25 inch of rainfall has occurred between application and the planting interval should be extended to 14 days. • *Valor/Rowel* can be used as part of the burndown program in no-till corn. Refer to Table 1K. • DO NOT apply after corn emergence. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves **Annual grasses**	bicyclopyrone + mesotrione + atrazine + s-metolachlor *(Acuron)*	2.85	3 qt 3.44ZC	• **May be applied preplant or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • If the soil organic matter is <3% apply 2.5 qt/A of *Acuron*. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • *Acuron* at 2 qt/A may be applied as part of a planned 2-pass program. • May be applied postemergence on corn up to 12 inches tall. Refer to Table 1H. • *Acuron* can be split between preemergence and early postemergence application timings. • Tank-mixtures with glyphosate can be applied postemergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Refer to label and Table 12 for crop rotation restrictions.
	bicyclopyrone + mesotrione + s-metolachlor *(Acuron Flexi)*	1.83	2.25 qt 3.26ZC	• **May be applied preplant or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • If the soil organic matter is <3% apply 2.0 qt/A of *Acuron Flexi*. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • May be applied postemergence on corn up to 30 inches tall or up to the 8 leaf stage. Refer to Table 1H. • *Acuron Flexi* can be split between preemergence (1/2 to 2/3 rate) and postemergence (1/2 to 1/3 rate) application timings. • Tank-mixtures with glyphosate can be applied postemergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Refer to label and Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves **Annual grasses**	pyroxasulfone + fluthiacet + atrazine *(Anthem ATZ)*	1.4	2.5 pt 4.5SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • *Anthem ATZ* use rates are based on soil texture and organic matter. *Anthem ATZ* rates range from 1.75 to 4 pt/A (2.5 pt/A). Lower rates (2 pt/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant corn, unless resistant weeds are present. • *Anthem ATZ* should be used as part of a planned preemergence followed by postemergence herbicide program. • May be applied postemergence. Refer to the postemergence application section for *Anthem ATZ* and Table 1I. • Refer to Table 12 for crop rotation restrictions.
	isoxaflutole *(Balance Flexx)*	0.0937	6 oz 2SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • *Balance Flexx* can be applied to field corn, silage, and seed corn. Refer to seed company recommendations for use on inbred lines. • Tank-mixes with atrazine (1 a.i. lb/A) will improve control giant ragweed and cocklebur. • Application rates vary by soil type; on coarse textured soils 3-4 fl oz/A, medium textured soils 5-6 fl oz/A, and fine textured soils 6 fl oz/A can be applied. • DO NOT apply on coarse-textured soils with less than 2% organic matter where the water table is less than 25 feet below the ground surface. • Lower rates of *Balance Flexx* (4 fl oz/A) can be used as part of a planned 2-pass program or when tank-mixed with grass herbicide-atrazine premixtures. • Add crop oil concentrate at 1% v/v to control existing weeds prior to corn emergence. • Insecticide interaction. Consult label for organophosphate or carbamate insecticide interactions. • May be applied postemergence from spike through V2 corn. Refer to Table 1H. • Atrazine may be tank-mixed with postemergence applications of *Balance Flexx*. DO NOT add an adjuvant. • 15 inches of precipitation is needed for a 10 month rotation interval to alfalfa or sugarbeet. If this criteria is not met the rotation interval is increased to 18 months. Dry beans should not be planted until 18 months after *Balance Flexx* applications – planting the following year after application has resulted in dry bean injury. • Refer to Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves **Annual grasses**	rimsulfuron + thifensulfuron *(Basis Blend)*	0.023	1.25 oz 30WG	• **May be applied preplant or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • *Basis Blend* is best used as part of a burndown program in no-till corn. Refer to Table 1K. • DO NOT apply on course textured soils with less than 1% organic matter. • DO NOT apply to popcorn, sweet corn or corn grown for seed. • May be applied postemergence on corn up to 6 inches or 2 collar, rates need to be reduced to 0.825 oz of *Basis Blend*. • Rotation restrictions to soybean are dependent on use rate. Soybean can be planted 10 months after 1.25 oz of *Basis Blend* is applied. The rotation interval to planting soybean is reduced to 15 days if 0.825 oz of *Basis Blend* is applied. • Refer to label and Table 12 for crop rotation restrictions.
	atrazine + s-metolachlor *(Bicep Lite II Magnum, Cinch Lite ATZ)* OR *(Bicep II Magnum, Cinch ATZ)*	2.25 2.9	1.5 qt 6F 2.1 qt 5.5F	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Lower rates may be applied as part of a 2-pass program in glufosinate or glyphosate-resistant corn, unless resistant weeds are present. • May be applied postemergence on corn up to 12 inches tall. Refer to Table 1H. • Tank-mixtures with glyphosate can be applied post-emergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Refer to label and Table 12 for crop rotation restrictions.
	atrazine + metolachlor (*Parallel Plus*, others)	2.9	2.3 qt 5.5F	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • *Parallel Plus* may be applied at lower rates as part of a planned 2-pass program where glyphosate is used post-emergence in glyphosate-resistant corn. • May be applied postemergence on corn up to 12 inches tall. Refer to Table 1H. • Tank-mixtures with glyphosate can be applied post-emergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Refer to label and Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves **Annual grasses**	atrazine + acetochlor (*Breakfree NXT Lite*, *Keystone LA NXT*) OR (*Degree Xtra, Fultime NXT*) OR (*Breakfree ATZ NXT*, *Harness Xtra*, *Keystone NXT*)	3 3 3.4	2 qt 6L 3 qt 4L 2.4 qt 5.6L	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • *Degree Xtra* and *Fultime NXT* contain encapsulated formulations of acetochlor. • Use rates of these products are based on soil texture and organic matter. *Breakfree NXT Lite/Keystone LA NXT* rates range from 1.8 to 2.3 qt/A (2 qt/A); *Degree Xtra/Fultime NXT* rates range from 2.9 to 3.7 qt/A (3 qt/A); *Breakfree ATZ NXT/ Harness Xtra/Keystone NXT* rates range from 1.4 to 3 qt/A (2.4 qt/A). • Lower rates can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant corn, unless resistant weeds are present. • May be applied postemergence on corn up to 11 inches tall. Refer to Table 1H. • Tank-mixtures with glyphosate can be applied post-emergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Refer to label and Table 12 for crop rotation restrictions.
	isoxaflutole + thiencarbazone-methyl *(Corvus)*	0.115	5.6 oz 2.63SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • *Corvus* can be applied to field corn, silage, and seed corn. Refer to seed company recommendations for use on inbred lines. • Tank-mixes with atrazine (1 a.i. lb/A) will improve control giant ragweed and cocklebur. • Application rates vary by soil type from 3.33 to 5.6 fl oz/A. On coarse-textured soils with 2% or less organic matter use 3.33 fl oz/A of *Corvus*. • DO NOT apply on coarse-textured soils with less than 2% organic matter where the water table is less than 25 feet below the ground surface. • Add crop oil concentrate at 1% v/v to control existing weeds prior to corn emergence. • Insecticide interaction. Consult label for organophosphate or carbamate insecticide interactions. • May be applied postemergence from spike through V2 corn. Refer to Table 1H. • Atrazine may be tank-mixed with postemergence applications *Corvus*. DO NOT add an adjuvant. • 15 inches of precipitation is needed for a 9 month rotation interval to soybean and barley. • When soil pH is 7.5 or above the rotation interval should be extended to 24 months for alfalfa, dry bean, oat, potato, sugarbeet, tomato, and cucumber. • Refer to Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves **Annual grasses**	pyroxasulfone + flumioxazin *(Fierce)*	0.133	3 oz 76WG	• **Apply a minimum of 7 days up to 30 days prior to planting corn on no-till or minimum tillage fields.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Use only on no-till or minimum tillage fields where last year's crop residue has not been incorporated into the soil. • DO NOT use on soils with less than 1% organic matter unless an incorporating rainfall has occurred between herbicide application and planting. • DO NOT use on seed corn. • *Fierce* can be used as part of the burndown program in no-till corn. Refer to Table 1K. • DO NOT apply after corn emergence. • The rotation restriction for no-till field corn is 7 days and for conventional till field corn is 30 days. Refer to Table 12 for additional crop rotation restrictions.
	acetochlor + mesotrione *(Harness MAX)*	2.26	75 fl oz/A 3.82L	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • DO NOT apply to popcorn or sweet corn. • DO NOT apply more than a total of 3 lb ai/A of acetochlor (equivalent to 3.4 pt/A *Harness*) or 0.24 lb ai/A of mesotrione (equivalent to 7.7 fl oz/A *Callisto*). • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • DO NOT graze, feed forage, grain or fodder within 60 days of application. • May be applied postemergence on corn up to 11 inches tall. Refer to Table 1H. • *Harness MAX* can be tank mixed with glyphosate in glyphosate-resistant corn or with *Liberty* in LibertyLink corn and applied at rates as low as 40 oz/A. • Refer to Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued) **Annual broadleaves** **Annual grasses**	mesotrione + rimsulfuron *(Instigate)*	0.82	6 oz 45.8WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • DO NOT apply preemergence to course textured soils with less than 1% organic matter. • DO NOT apply to seed corn. • Instigate can be tank-mixed with other soil-applied herbicides or used as part of a planned 2-pass weed control program. • DO NOT apply more than a total of 3.85 oz ai/A of mesotrione (equivalent to 7.7 oz/A *Callisto*) or 1 oz ai/A of rimsulfuron (equivalent to 4 oz/A *Resolve SG*) per year. • May be applied early postemergence through 2 leaf collar (V2) corn, at 5.25 to 5.4 oz/A with a crop oil concentrate and ammonium sulfate. Refer to Table 1H. • DO NOT tank-mix with *Basagran* – severe crop injury. • DO NOT graze, feed forage, grain or fodder within 45 days of application. • Refer to Table 12 for crop rotation restrictions.
	mesotrione + atrazine + s-metolachlor *(Lexar EZ)* OR *(Lumax EZ)*	2.8 2.5	3 qt 3.7ZC 2.7 qt 3.67ZC	• **May be applied preplant or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • *Lexar EZ* at 2.25 qt/A or *Lumax EZ* at 2 qt/A may be applied as part of a planned 2-pass program where glyphosate is used postemergence in glyphosate-resistant corn. • May be applied postemergence on corn up to 12 inches tall. Refer to Table 1H. • *Lexar EZ* or *Lumax EZ* can be split between preemergence and early postemergence application timings. • Tank-mixtures with glyphosate can be applied postemergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Refer to label and Table 12 for crop rotation restrictions.
	rimsulfuron + isoxaflutole *(Prequel)*	0.046	1.66 oz 45WG	• **May be applied preplant, preplant incorporated or preemergence**. • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Use rates are based on soil texture; ranging from 1.66 to 2.5 oz/A. • DO NOT apply to coarse-textured soils with less than 1% organic matter. • DO NOT to corn grown for seed, popcorn or sweet corn. • *Prequel* should be used as part of a planned preemergence followed by postemergence herbicide program. This premix alone will not provide full-season weed control. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • Refer to label and Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves **Annual grasses**	acetochlor + mesotrione + clopyralid *(Resicore)*	2.26	2.75 qt 3.29SE	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Use rates are based on soil texture and organic matter; ranging from 2.25 to 3 qt/A (2.75 qt/A). • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • *Resicore* may be applied at rates as low as 1.8 qt/A as part of a planned 2-pass program where glyphosate is used postemergence in glyphosate-resistant corn or *Liberty* is applied postemergence in LibertyLink corn. • May be applied postemergence on corn up to 11 inches tall. Refer to Table 1H. • *Resicore* can be tank-mixed with glyphosate in glyphosate-resistant corn or *Liberty* in LibertyLink corn and applied postemergence at rates as low as 1.25 qt/A. • *Resicore* can be split between preemergence (1/2 rate) and postemergence (1/2 rate) application timings. • Refer to label and Table 12 for crop rotation restrictions.
	flumetsulam + clopyralid + acetochlor *(SureStart II, TripleFLEX II)*	1.04	2 pt 4.16SE	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Use rates are based on soil texture and organic matter; ranging from 1.5 to 3 pt/A (2 pt/A). • Corn should be planted at least 1.5 inches deep. • DO NOT apply to soils with less than 1.5% organic matter, a pH > 7.8, or soils with >5% organic matter and low soil pH (5.9). • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • *SureStart II/TripleFLEX II* should be used as part of a planned preemergence followed by postemergence herbicide program. These premixes alone will not provide full-season weed control. • May be applied postemergence on corn up to 11 inches tall. Refer to Table 1H. • Tank-mixtures with glyphosate can be applied postemergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Requires a 26-month rotation interval and a successful field bioassay before planting sugar beets, cucumbers or tomatoes. • Refer to label and Table 12 for crop rotation restrictions.

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Corn – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves **Annual grasses**	saflufenacil + dimethenamid-P + *(Verdict)*	0.65	15 oz 5.57EC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Use rates are based on soil texture; ranging from 10 to 18 oz/A (15 oz/A). • *Verdict* should be used as part of a planned preemergence followed by postemergence herbicide program. This premix alone will not provide full-season weed control. • *Verdict* can be used as part of a burndown program in no-till corn. Refer to Table 1K. • DO NOT apply after corn emergence. • *Verdict* can be used on seed corn at use rates ranging from 5 to 10 oz/A; DO NOT exceed 5 oz/A on course soils. • Crop rotation to soybean ranges between 0-4 months depending on soil type and application rate. • Refer to label and Table 12 for crop rotation restrictions.
	mesotrione + s-metolachlor *(Zemax)*	1.9	2 qt 3.67L	• **May be applied preplant or preemergence.** • Refer to Table 1A for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • *Zemax* may be applied at 1.6 qt/A as part of a planned 2-pass program where glyphosate is used postemergence in glyphosate-resistant corn. • May be applied postemergence on corn up to 30 inches tall or up to the 8 leaf stage. Refer to Table 1H. • Tank-mixtures with glyphosate can be applied postemergence to glyphosate-resistant corn. • Tank-mixtures with *Liberty* can be applied postemergence to LibertyLink corn. • Refer to label and Table 12 for crop rotation restrictions.

Corn – Postemergence – All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	nicosulfuron + safener *(Accent Q)* + crop oil concentrate + ammonium sulfate	0.031	0.9 oz 54.5WG + 1% + 2 lb	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to field corn up to 20 inches tall or 6 leaf collars (V6), whichever is more restrictive. • For corn 20-36 inches tall, use drop nozzles. • Refer to Table 1I for maximum crop and weed heights. • DO NOT apply more than 1.8 oz/A per season. • *Accent Q* may be applied to seed corn, however maximum corn height for application is 20 inches or 5 leaf collars (V5). • DO NOT tank-mix with 2,4-D containing products – grass antagonism. • DO NOT tank-mix with *Basagran* – severe crop injury. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • Consult label for preferred adjuvants for specific tank mixtures. • Rotation restrictions for sugarbeet, potatoes, cucumbers, and tomatoes are increased to 18 months when soil pH >6.5. • Refer to label and Table 12 for crop rotation restrictions.
	rimsulfuron + thifensulfuron *(Resolve Q)* + crop oil concentrate + ammonium sulfate	0.017	1.25 oz 22.4WG + 1% + 2.5 lb	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to 20 inches tall or 6 leaf collars (V6), whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • DO NOT apply to seed corn. • DO NOT tank-mix with *Basagran* – severe crop injury. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • Consult label for preferred adjuvants for specific tank mixtures. • Refer to label and Table 12 for crop rotation restrictions.
	nicosulfuron + rimsulfuron + safener *(Steadfast Q)* + crop oil concentrate + ammonium sulfate	0.035	1.5 oz 37.7WG + 1% + 2 lb	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to 20 inches tall or 6 leaf collars (V6), whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • DO NOT tank-mix with 2,4-D containing products – grass antagonism. • DO NOT tank-mix with *Basagran* – severe crop injury. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • Consult label for preferred adjuvants for specific tank mixtures. • Rotation restrictions for sugarbeet, potatoes, cucumbers, and tomatoes are increased to 18 months when soil pH >6.5. • Refer to label and Table 12 for crop rotation restrictions.

Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	2,4-D amine OR 2.4-D ester	0.5 0.25	1 pt 4L OR 0.5 pt 4L	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn less than 8 inches tall. Drop nozzles can be used after this stage. • Refer to Table 1I for maximum crop and weed heights. • DO NOT apply to corn from tasseling to the dough stage. • Ester formulations have a greater potential for crop injury and vapor drift. • CAUTION should be taken to avoid spray drift, many broadleaf plants are sensitive to 2,4-D. • Not effective on smartweed or wild buckwheat. • DO NOT apply with adjuvant – crop injury. • Corn hybrids vary in sensitivity to 2,4-D. Consult seed company for details. • Refer to Table 12 for crop rotation restrictions.
	atrazine (*AAtrex*, others) + crop oil concentrate	2	2 qt 4L OR 2.2 lb 90DG + 1 qt	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to 12 inches tall. • Refer to Table 1I for maximum crop and weed heights. • Lower rates of atrazine are often tank-mixed with other herbicides. • Consult label for preferred adjuvants for specific tank mixtures. • DO NOT exceed 2 lb ai/A for any single application or 2.5 lb ai/A per season. • DO NOT apply after June 10 – carryover concerns to rotational crops. • Mixing, loading, and application setbacks are required for atrazine. See page 12 or label for details. • Refer to Table 12 for crop rotation restrictions.
	carfentrazone *(Aim)* + surfactant	0.008	0.5 oz 2EC + 0.25%	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to 8 leaf collars. Drop nozzles can be used up to 14 collar corn. • Refer to Table 1I for maximum crop and weed heights. • Applications should not be made within 6–8 hours of rain or irrigation — severe crop injury. • Avoid applications into the corn whorls. DO NOT tank-mix with *Basagran*, or *Buctril* – severe crop injury. • Consult label for preferred adjuvants for specific tank mixtures. • Refer to Table 12 for crop rotation restrictions.
	pyroxasulfone + fluthiacet *(Anthem MAXX)* + surfactant	0.134	4 oz 4.3SE + 0.25%	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply from emergence through the V4 (4 visible collars) stage. • Refer to Table 1I for maximum crop and weed heights. • Crop oil concentrate or methylated seed oil at 1% may be used instead of surfactant. • The addition of ammonium sulfate (2 lb/A) may improve control of certain weeds. • The pyroxasulfone component of *Anthem MAXX* will provide residual control of grass and small seeded broadleaf weeds. • Avoid applications when the crop foliage is wet – increased crop response. • DO NOT harvest corn forage or grain until 30 or 70 days, respectively, after *Anthem MAXX* application. • Insecticide interaction: DO NOT tank-mix with chlorpyrifos containing insecticides. • Refer to Table 12 for crop rotation restrictions.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	pyroxasulfone + fluthiacet + atrazine *(Anthem ATZ)* + surfactant	1.125	1 qt 4.5SC + 0.25%	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply from emergence up to V4 (4 visible collars) stage. • Refer to Table 1I for maximum crop and weed heights. • Crop oil concentrate or methylated seed oil at 1% may be used instead of surfactant. • The addition of ammonium sulfate (2 lb/A) may improve control of certain weeds. • The pyroxasulfone component of *Anthem ATZ* will provide residual control of grass and small seeded broadleaf weeds. • Avoid applications when the crop foliage is wet – increased crop response. • DO NOT harvest corn forage or grain until 60 or 70 days, respectively, after *Anthem ATZ* application. • Insecticide interaction: DO NOT tank-mix with chlorpyrifos containing insecticides. • Refer to Table 12 for crop rotation restrictions.
	dicamba *(Banvel, Clarity)*	0.5	1 pt 4SL	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to the 5-leaf stage or 8 inches tall, whichever comes first. • *Banvel/Clarity* may be applied at 0.5 pt/A to corn up to 36 inches tall or 15 days before tassel emergence. Drop nozzles are recommended for corn over 8 inches tall. • Refer to Table 1I for maximum crop and weed heights. • AMS or 28% liquid nitrogen fertilizer may be added for improved control of larger velvetleaf. See label for details. • Consult label for preferred adjuvants for specific tank mixtures. • Corn hybrids vary in sensitivity to dicamba. Consult seed company for details. • CAUTION should be taken to avoid vapor and particle spray drift. • DO NOT apply when temperature is expected to exceed 85º F or if soybeans in the vicinity are over 10 inches tall or have begun to bloom. • Refer to label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.
	bentazon *(Basagran, Broadloom)* + crop oil concentrate	1	2 pt 4SL + 1 qt	• Refer to Table 1B for weed control and crop tolerance ratings. • Refer to Table 1I for maximum crop and weed heights. • The addition of 2.5 lb/A of ammonium sulfate (AMS) is recommended if velvetleaf is the targeted weed. • Rates can be reduced if weeds are small – consult label. • DO NOT use AMS if common lambsquarters is present. • Refer to Table 12 for crop rotation restrictions.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	primisulfuron *(Beacon)* + crop oil concentrate	0.036	0.76 oz 75WG + 1%	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn between 4 and 20 inches tall. • Drop nozzles can be used up to tassel emergence. • Refer to Table 1I for maximum crop and weed heights. • Surfactant (0.25%) may be used instead of crop oil concentrate. The addition of ammonium sulfate at 2 lb/A may improve control of certain weeds. • Corn inbreds and a small number of corn hybrids are sensitive to *Beacon*. Consult seed companies for lists of sensitive inbreds and hybrids. • *Beacon* may be tank mixed with other postemergence herbicides for control of a broader spectrum of weeds. • Consult label for preferred adjuvants for specific tank mixtures. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • The rotation restriction to potatoes is 8 months at the 0.38 oz/A, and is increased to 18 months at the 0.76 oz/A. • Refer to Table 12 for crop rotation restrictions.
	bromoxynil (*Buctril, Moxy*, others)	0.375	1 pt 2EC	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to tassel emergence. • Refer to Table 1I for maximum crop and weed heights. • The minimum corn stage is 4 leaves if the rate of *Buctril* is increased to 1.5 pt/A. • Good spray coverage is important. • DO NOT mix with spray additives or liquid fertilizers unless specified for tank mixes. • *Atrazine* at 0.5 lb a.i./A is a common tank mix partner • For ground applications, use minimum of 20 gal of water/A and 30 psi. • Refer to Table 12 for crop rotation restrictions.
	fluthiacet *(Cadet)* + surfactant	0.006	0.9 oz 0.91EC + 0.25%	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to 48 inches tall, but before tassel emergence. • Refer to Table 1I for maximum crop and weed heights. • Crop oil concentrate at 1% may be used instead of surfactant. • The addition of ammonium sulfate (2 lb/A) may improve control of certain weeds. • *Cadet* can be applied at 0.5 oz/A when tank-mixed with other herbicides for additional broadleaf weed control. • Use drop nozzles when corn canopy will prevent complete spray coverage of the weeds. • DO NOT apply more than 1.25 oz/A of *Cadet* per cropping season. • Refer to label and Table 12 for crop rotation restrictions.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	mesotrione *(Callisto)* + crop oil concentrate + ammomium sulfate	0.094	3 oz 4SC + 1% + 8.5 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to 30 inches tall or 8-collar, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • DO NOT use methylated seed oil (MSO) or MSO blends. • Atrazine at 0.25-0.5 lb a.i./A tank mixed with *Callisto* will improve control of broadleaf weeds. Note: Tank mixtures of *Callisto* with atrazine can be applied to corn up to 12 inches tall only. • Consult label for preferred adjuvants for specific tank mixtures. • DO NOT exceed 7.7 fl oz/A of *Callisto* (0.24 lb a.i./A of mesotrione) in one growing season, including premixes that contain *Callisto*. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • Refer to Table 12 for crop rotation restrictions.
	mesotrione + atrazine *(Callisto Xtra)* + crop oil concentrate + ammonium sulfate	0.69	24 oz 3.7SC + 1% + 8.5 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to 12 inches tall. • Refer to Table 1I for maximum crop and weed heights. • Consult label for preferred adjuvants for specific tank mixtures. • DO NOT exceed 7.7 fl oz/A of *Callisto* (0.24 lb a.i./A of mesotrione) in one growing season, including premixes that contain *Callisto*. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	dicamba + safener *(DiFlexx)* + surfactant + ammonium sulfate	0.25	8 oz 4SC + 0.25% + 17 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn from spike up to 36 inches tall or V6 (6 visible collars), whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • *DiFlexx* will likely be tank-mixed with other postemergence herbicides for an integrated weed management program. • Crop oil concentrate at 1% v/v or methylated seed oil at 1% v/v can be used instead of a non-ionic surfactant for certain tank-mixtures. • *DiFlexx* can be applied up to 16 oz/A for weeds with known resistance to tank-mix partners, weeds not controlled with tank-mix partners, heavy weed populations, biennial/perennial weeds, and annual weeds taller than 6 inches. • DO NOT apply when soybeans are growing nearby and corn is more than 24 inches tall, soybean are more than 10 inches tall, or soybean have begun to bloom. • Insecticide interaction: Consult label for insecticide interactions. • DO NOT harvest or feed corn forage, silage or fodder within 45 days of application. • Refer to label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	tembotrione + dicamba + safener (*DiFlexx DUO*) + methylated seed oil + ammonium sulfate	0.53	32 oz 2.13SC + 1% + 8.5-17 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply from corn emergence up to, but not including, V7 (7 visible collars) corn or 36 inches tall, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • Apply *DiFlexx DUO* at rates ranging from 24 to 40 oz/A (32 oz/A). Higher use rates should be used when Group 4 or 27 weeds are present. • *DiFlexx DUO* will likely be tank-mixed with other postemergence herbicides for an integrated weed management program. • Use a methylated seed oil or crop oil concentrate at 1% v/v for improved weed control. • DO NOT apply when there is a possibility of off-target movement to sensitive crops. Wind speeds, nozzle selection, spray pressure, sprayer operating speed, boom height and proximity to sensitive crops all influence off-target movement. Drift potential is lowest when wind speed are between 2 and 10 mph. • DO NOT apply into areas of temperature inversions. • Insecticide interaction: Consult label for insecticide interactions. • DO NOT graze or harvest corn forage within 45 days of application. • Refer to label and Table 12 for crop rotation restrictions. Cumulative precipitation between *DiFlexx DUO* application and planting sugarbeets of dry beans must total 20 inches for the 10 month rotation restriction. Through tillage should be used preceding rotation to sugarbeets. The rotation restriction for kidney beans and cranberry beans is 18 months.
	flumetsulam + clopyralid *(Hornet WDG, Stanza)* + surfactant + ammonium sulfate	0.128	3.0 oz 68.5WG + 0.25% + 2 lb	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to 20 inches tall or 6 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • Crop oil concentrate at 1% may be used instead of surfactant. • DO NOT tank mix with *Basagran* — severe crop injury. • Consult label for preferred adjuvants for specific tank mixtures. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • CAUTION should be taken to avoid spray drift. • Requires a 26-month rotation interval and a successful field bioassay before planting sugar beets, cucumbers or tomatoes. • Refer to Table 12 for crop rotation restrictions.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	halosulfuron *(Permit)* + surfactant	0.03	0.67 oz 75DF + 0.25%	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn from spike up to canopy closure. • Refer to Table 1I for maximum crop and weed heights. • *Permit* provides excellent control of yellow nutsedge. • *Permit* does NOT control common lambsquarters. • Crop oil concentrate at 1% may be used instead of surfactant. • Include ammonium sulfate (2 lb/A) for improved velvetleaf and pigweed control. • Refer to Table 12 for crop rotation restrictions.
	flumiclorac *(Resource)* + crop oil concentrate	0.027	4 oz 0.86EC + 1 pt	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn between 2 and 10 collars. • Refer to Table 1I for maximum crop and weed heights. • Very effective on velvetleaf. • Use drop nozzles when corn canopy will prevent • complete spray coverage of the weeds. • Consult label for preferred adjuvants for specific tank mixtures. • Refer to Table 12 for crop rotation restrictions.
	fluthiacet + mesotrione *(Solstice)* + crop oil concentrate + ammonium sulfate	0.094	3 oz 4L + 1% + 8.5 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to 30 inches tall or V8 (8 visible collars), whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • DO NOT use methylated seed oil (MSO) or MSO blends. • Consult label for preferred adjuvants for specific tank mixtures. • DO NOT tank mix with emulsifiable concentrate grass herbicides, unless specifically addressed in the label – severe injury can occur. • Avoid applications when the crop foliage is wet – increased crop response. • DO NOT harvest or feed corn forage within 45 days or harvest or feed grain or stover within 70 days of application. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • Refer to Table 12 for crop rotation restrictions.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	dicamba + diflufenzopyr + safener *(Status)* + surfactant + ammonium sulfate	0.18	5 oz 56WG + 0.25% + 17 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn between 4 (V2) and 36 (V8) inches tall. DO NOT make applications when corn is within 15 days of tassel emergence. • Refer to Table 1I for maximum crop and weed heights. • *Status* use rates range between 5 and 10 oz/A. *Status* may be applied at 2.5 oz/A when tank-mixed with other broadleaf herbicides. • Consult label for preferred adjuvants for specific tank mixtures. • Postemergence applications of *Status* are not recommended for use in tank mixes with plant growth regulator herbicides (e.g., dicamba, 2,4-D, or clopyralid). • Provides limited suppression of annual grasses. • CAUTION should be taken to avoid vapor and particle spray drift. • DO NOT apply when temperature is expected to exceed 85º F or if soybeans in the vicinity are over 10 inches tall or have begun to bloom. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • In the event of crop failure, corn may be replanted within 7 or more days of application. • Soybean, alfalfa, grain sorghum, or cereals may be planted 30 days after a rainfall event of 1 or more inches if *Status* was applied at 5 oz/A or less. • Refer to Table 12 for crop rotation restrictions.
	clopyralid *(Stinger)*	0.094	0.25 pt 3SL	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to field corn up to 24 inches tall. • Refer to Table 1I for maximum crop and weed heights. • Treat ragweed, cocklebur, jimsonweed and Jerusalem artichoke up to the 5-leaf stage. • Increase the rate to 0.5 pt/A to control Canada thistle and perennial sowthistle. • DO NOT apply more than 0.66 pt/A per year. • CAUTION should be taken to avoid spray drift. • Refer to Table 12 for crop rotation restrictions.
	halosulfuron + dicamba *(Yukon)* + surfactant + ammonium sulfate	0.169	4 oz 67.5WG + 0.25% + 17 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply from spike to 36 inch tall corn, drop nozzles are recommended for corn greater than 20 inches. • Refer to Table 1I for maximum crop and weed heights. • Corn hybrids vary in their sensitivity to dicamba. Consult seed company for details. • *Yukon* provides excellent control of yellow nutsedge. • Consult label for preferred adjuvants for specific tank mixtures. • CAUTION should be taken to avoid vapor and particle spray drift. • DO NOT apply when temperature is expected to exceed 85°F or if soybeans in the vicinity are over 10 inches tall or have begun to bloom. • Refer to label and Table 12 for crop rotation restrictions.

Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	topramezone *(Armezon/Impact)* + methylated seed oil + ammonium sulfate	0.016	0.75 oz 2.8SC + 1% + 17 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • *Armezon/Impact* may be applied to corn up to 45 days prior to harvest. • Refer to Table 1I for maximum crop and weed heights. • Atrazine at 0.25-0.5 lb a.i./A tank mixed will improve control of broadleaf and grass weeds. Note: Tank mixtures of *Armezon/Impact* with atrazine can be applied to corn up to 12 inches tall only. • Crop oil concentrate can be used instead of methylated seed oil in certain tank mixes. • When *Armezon/Impact* is applied at 0.5 oz/A, dry bean (excluding cranberry beans) or snap bean may be planted after nine months. • *Armezon/Impact* may be applied at maximum rate of 1 oz/A to provide greater control of certain grass species, however rotational crop restrictions are increased, refer to label. • Refer to label and Table 12 for crop rotation restrictions.
	topramezone + dimethenamid-P *(Armezon PRO)* + methylated seed oil + ammonium sulfate	0.835	20 oz 5.35L + 1% + 8.5 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to 30 inches tall or V8 (8 visible collars), whichever is more restrictive. • *Armezon PRO* can be applied at rates ranging from 16 - 20 fl oz/A, use the lower rates on lighter textured and/or lower organic matter soils. • Refer to Table 1I for maximum crop and weed heights. • The dimethenamid-P component of *Armezon PRO* will provide residual control of grass and small seeded broadleaf weeds. • Atrazine at 0.25-0.5 lb a.i./A tank mixed will improve control of broadleaf weeds. Note: Tank mixtures of *Armezon PRO* with atrazine can be applied to corn up to 12 inches tall only. • Methylated seed oil is the preferred additive when *Armezon PRO* is applied alone. A non-ionic surfactant at 0.25% v/v is recommended for most tank-mixtures. Oil adjuvants including crop oil concentrates may be used in tank mixtures, however these combinations can cause crop injury. • *Armezon PRO* can be applied at 16 fl oz/A on lighter textured and/or lower organic matter soils. • DO NOT apply on sand-textured soils with less than 3% organic matter where the groundwater depth is 30 feet or less. • DO NOT harvest or feed corn forage, silage or fodder within 45 days of application. • Refer to label and Table 12 for crop rotation restrictions.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves**	tembotrione + thiencarbazone-methyl *(Capreno)* + crop oil concentrate + ammonium sulfate	0.081	3.0 oz 3.45SC + 1% + 8.5 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn from 1 (V1) to 5 collars (V5). • Refer to Table 1I for maximum crop and weed heights. • DO NOT exceed a total of 6 oz/A of *Capreno* in a year. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • If soil pH is 7.5 or greater crop rotation intervals are extended for all crops, except field corn, soybean, wheat, and barley. • Alfalfa and oats can be planted the following spring if the total amount of *Capreno* applied in a 365 day period does not exceed 3 oz/A and the soil pH is not 7.5 or above. • Refer to label and Table 12 for crop rotation restrictions.
	tembotrione *(Laudis)* + methylated seed oil + ammonium sulfate	0.082	3 oz 3.5SC + 1% + 8.5 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • Apply to corn up to 8 collars (V8). • Refer to Table 1I for maximum crop and weed heights. • Atrazine at 0.25-0.5 lb a.i./A tank mixed will improve control of broadleaf weeds. Note: Tank mixtures of *Laudis* with atrazine can be applied to corn up to 8 collars or 12 inches tall, whichever is more restrictive. • Crop oil concentrate can be used instead of methylated seed oil in certain tank mixes. • Consult label for preferred adjuvants for specific tank mixtures. • Thorough tillage and 20 inches of cumulative precipitation is needed for a 10 month rotation interval to sugarbeet. If these criteria are not met the rotation interval is increased to 18 months. The rotation restriction is 18 months for the red kidney and cranberry classes of dry edible beans. All other commercial dry bean classes can be planted 10 months after *Laudis* application if cumulative precipitation exceeds 20 inches. • Refer to label and Table 12 for crop rotation restrictions.
	rimsulfuron + mesotrione + safener *(Realm Q)* + crop oil concentrate + ammonium sulfate	0.097	4 oz 38.75WG + 1% + 17 lb/100 gal	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to the 20 inches tall or 6 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • A spray solution pH of 6.0 – 8.0 is needed for product stability. • DO NOT tank-mix with *Basagran* – severe crop injury. • Consult label for preferred adjuvants for specific tank mixtures. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • Refer to label and Table 12 for crop rotation restrictions.

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Corn – Postemergence – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves**	nicosulfuron + mesotrione *(Revulin Q)* + crop oil concentrate + ammonium sulfate	0.109	3.4 oz 51.2WG + 1% + 2 lb	• Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to 20 inches tall or V6 (6 visible collars), whichever is more restrictive. Drop nozzles can be used for directed applications up to 30 inch tall or V8 corn. • Refer to Table 1I for maximum crop and weed heights. • *Revulin Q* can be applied up to 4 oz/A. • DO NOT tank-mix with *Basagran* – severe crop injury. • Consult label for preferred adjuvants for specific tank mixtures. • Insecticide interaction: Consult label for organophosphate insecticide interactions. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 1E – Weed Control in Glyphosate-Resistant Corn

RECOMMENDATIONS: One application of glyphosate alone will not consistently provide season-long weed control. One of the three following strategies is recommended:

1) Soil-applied residual herbicide applied preemergence followed by glyphosate postemergence.
   a) Preemergence herbicide options can be found in Tables 1A and 1C.
   b) Glyphosate should be applied when weeds are 2-4 inches tall.

2) Postemergence tank-mixtures with glyphosate when weeds are 2-4 inches tall.
   a) Several soil-applied residual herbicides can be tank-mixed with glyphosate and applied postemergence. Refer to Tables 1H and 1C for options. Tank-mixtures with some residual herbicides may cause temporary burn or discoloration.
   b) There are many postemergence products that can be tank-mixed with glyphosate for additional weed control. Refer to Tables 1I and 1C for options.
   c) There are several premixtures containing glyphosate that can be applied postemergence to glyphosate-resistant corn. Refer to Table 1B and the following section for options.

3) Split-applications of soil-applied residual herbicides with glyphosate.
   a) Apply one-half to two-thirds of the soil-applied herbicide preemergence.
   b) Apply the remainder of the soil-applied herbicide postemergence with glyphosate.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves** **Suppression of perennials**	glyphosate + ammonium sulfate	0.75–1.13 a.e.	See Table 10 + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT CORN ONLY. See above recommendations for appropriate use of glyphosate in glyphosate-resistant corn.** • Corn hybrids that are glyphosate-resistant are designated as *Roundup Ready Corn, Roundup Ready 2 Corn,* or *Glyphosate Tolerant (GT)*. • Refer to Table 1B for weed control and crop tolerance ratings. • Many glyphosate products are registered for application to glyphosate-resistant corn. Read the label and see Table 10 to determine application rates and additives needed for different products. • Addition of ammonium sulfate (17 lb/100 gal) will minimize antagonism from hard water and improve weed control if weeds are under stress or large. • Apply to corn up to 30 inches tall or 8 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • Glyphosate applications to corn from 30 to 48 inches tall can be made with drop nozzles only – avoid application into the whorls. • Use a minimum rate of 0.75 lb a.e./A; however, a use rate 1.13 lb a.e./A of glyphosate should be applied for more consistent weed control.. • Glyphosate application rate can be increased to 1.13 lb a.e./A to control larger weeds or weeds that are under stress. • DO NOT apply more than 2.25 lb a.e./A of glyphosate in-crop per season. • Allow a minimum of 50 days between postemergence application and harvest of forage. • Use extreme caution to avoid spray drift to sensitive crops. • Higher glyphosate rates and second application of glyphosate will improve control of perennial weeds. • Refer to label and Table 12 for crop rotation restrictions.

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Glyphosate-Resistant Corn *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves** **Suppression of perennials**	mesotrione + glyphosate *(Callisto GT)* + surfactant + ammonium sulfate	1.045	2 pt 4.18L + 0.25% + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT CORN ONLY.** • Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply from corn emergence up to 30 inches tall or 8 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • DO NOT tank-mix with emulsifiable concentrate grass herbicides – severe crop injury. • Insecticide interaction: Consult label for organophosphate and carbamate insecticide restrictions. • Refer to Table 12 for crop rotation restrictions.
	atrazine + s-metolachlor + glyphosate *(Expert)* + ammonium sulfate	3.66	3 qt 4.88SC + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT CORN ONLY.** • Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to 12 inches tall. • Refer to Table 1I for maximum crop and weed heights. • *Expert* applications may cause some minor leaf burn. • *Expert* can be applied preplant or preemergence for all corn types in no-till production. • Refer to label and Table 12 for crop rotation restrictions.
	mesotrione + s-metolachlor + glyphosate *(Halex GT)* + surfactant + ammonium sulfate	1.97	3.6 pt 4.38L + 0.25% + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT CORN ONLY.** • Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply from corn emergence up to 30 inches tall or 8 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. *Halex GT* does not contain a safener for preemergence applications. • DO NOT tank-mix with emulsifiable concentrate grass herbicides – severe crop injury. • Insecticide interaction: Consult label for organophosphate insecticide restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	s-metolachlor + glyphosate *(Sequence)* + ammonium sulfate	1.64	2.5 pt 5.25L + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT CORN ONLY.** • Refer to Table 1B for weed control and crop tolerance ratings. • See Table 1C for individual product rate equivalents for the premix. • Apply to corn up to 30 inches tall or 8 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • *Sequence* can be applied preplant or preemergence for all corn types in no-till production. • Refer to label and Table 12 for crop rotation restrictions.

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Glyphosate-Resistant Corn *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves** **Suppression of perennials**	acetochlor *(Warrant)* + glyphosate + ammonium sulfate	1.125	3 pt 3CS + See Table 10 + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT CORN WHEN TANK-MIXED WITH GLYPHOSATE.** • Refer to Table 1B for weed control and crop tolerance ratings. • Apply from corn emergence up to 30 inches tall or 8 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • *Warrant* does not contain a safener for preemergence applications. • *Warrant* applied alone will not control emerged weeds, but will provide residual control of annual grasses and small seeded broadleaf weed species. Therefore, it is recommended *Warrant* be applied with postemergence weed control products (e.g., glyphosate). • Refer to label and Table 12 for crop rotation restrictions.

TABLE 1F – Weed Control in LibertyLink (Glufosinate-Resistant) Corn

RECOMMENDATIONS: One application of *Liberty* (glufosinate) alone will not consistently provide season-long weed control.

One of the two following strategies is recommended:

1) Soil-applied residual herbicide applied preemergence followed by *Liberty* postemergence.
   a) Preemergence herbicide options can be found in Tables 1A and 1C.
   b) *Liberty* should be applied when weeds are 2-4 inches tall.

2) Postemergence tank-mixtures with *Liberty* when weeds are 2-4 inches tall.
   a) Several soil-applied residual herbicides can be tank-mixed with *Liberty* and applied postemergence. Refer to Tables 1H and 1C for options. Tank-mixtures with some residual herbicides may cause temporary burn or discoloration.
   b) There are many postemergence products that can be tank-mixed with *Liberty* for additional weed control. Refer to Tables 1I and 1C for options.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	glufosinate *(Liberty)* + ammonium sulfate	0.58	32 oz 2.34L + 17 lb/100 gal	• **APPLY TO LIBERTYLINK OR GLUFOSINATE-RESISTANT CORN ONLY.** • **See above recommendations for appropriate use of *Liberty* in LibertyLink corn.** • Refer to Table 1B for weed control and crop tolerance ratings. • Always add ammonium sulfate at 8.5–17 lb/100 gal. • Apply from emergence up to V6 corn. • Refer to Table 1I for maximum crop and weed heights. • Drop nozzles can be used to apply *Liberty* until 36 inch tall LibertyLink corn. Avoid spraying into the corn whorl. • DO NOT apply more than 87 oz/A of *Liberty* on corn per growing season. • Use a minimum carrier volume of 15 gallons per acre. • DO NOT use drift control agents — this reduces spray coverage and may result in reduced weed control. • DO NOT apply *Liberty* within 60 days of harvesting corn forage or within 70 days of harvesting corn grain. • *Liberty* is a contact herbicide that may provide some top growth control of perennial weeds. • Application should be made between dawn and 2 hours before sunset to avoid the risk of reduced control of lambsquarters and velvetleaf, optimum control is between 10:00 a.m. and 5:00 p.m. • Refer to Table 12 for crop rotation restrictions.

TABLE 1G – Weed Control in Enlist (2,4-D-Resistant) Corn

RECOMMENDATIONS: One application of 2,4-D choline containing herbicides alone will not consistently provide season-long weed control. One of the two following strategies is recommended:

1) Soil-applied residual herbicide applied preemergence followed by *Enlist One/Duo* postemergence.
   a) Preemergence herbicide options can be found in Tables 1A and 1C.
   b) *Enlist One/Duo* should be applied when weeds are 2-4 inches tall. Additional tank mix partners can be applied with these herbicides. Refer to EnlistTankMix.com for options.

2) Postemergence tank-mixtures with *Enlist One/Duo* when weeds are 2-4 inches tall.
   a) Several soil-applied residual herbicides can be tank-mixed with *Enlist One/Duo* and applied postemergence. Refer to EnlistTankMix.com for options. Tank-mixtures with some residual herbicides may cause temporary burn or discoloration.
   b) There are many postemergence products that can be tank-mixed with *Enlist One/Duo* for additional weed control. Refer to EnlistTankMix.com for options.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	2,4-D choline *(Enlist One)*	0.71 a.e.	1.5 pt 3.8L	• **APPLY PREPLANT, PREEMERGENCE, AND/OR POSTEMERGENCE TO ELIST TRAITED CORN.** • Can be applied as a preplant burndown or used preemergence in non-Enlist traited corn. • Enlist traited corn is resistant to 2,4-D choline, glyphosate and aryloxyphenoxypropionate (FOPs) herbicides. • DO NOT mix any other herbicides or additives with *Enlist One* unless they are approved on the following website: **EnlistTankMix.com** • See label for proper nozzle selection. • See label for protection of sensitive areas via buffer. • Apply to corn up to 30 inches tall or 8 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • *Enlist One* applications to corn from 30 to 48 inches tall can be made with drop nozzles only – avoid application into the whorls. • Refer to Table 1B for weed control and crop tolerance ratings. • Maximum in-season use is one preemergence and two postemergence applications in Enlist traited corn. • Allow 12 days between sequential postemergence applications in Enlist traited corn. • DO NOT apply more than 4 pt/A in non-Enlist traited corn per growing season. • DO NOT apply more than 6 pt/A in Enlist traited corn per growing season. • DO NOT apply within 24 hours of predicted rainfall. • Refer to Table 1K for spring burndown applications. • Clethodim herbicides such as *Select* or *Select Max* may be used to control volunteer Enlist corn in the following soybean, sugarbeet, or dry bean crop. • Refer to Table 12 for crop rotation restrictions.

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Weed Control in Enlist (2,4-D-Resistant) Corn *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	2,4-D choline + glyphosate *(Enlist Duo)*	1.44 a.e.	3.5 pt 3.3L	• **APPLY PREPLANT, PREEMERGENCE, AND/OR POSTEMERGENCE TO ELIST TRAITED CORN.** • Can be applied as a preplant burndown or used preemergence in non-Enlist traited corn. • Enlist traited corn is resistant to 2,4-D choline, glyphosate and aryloxyphenoxypropionate (FOPs) herbicides. • DO NOT mix any other herbicides or additives with *Enlist Duo* unless they are approved on the following website: **EnlistTankMix.com** • The use of ammonium sulfate (17 lb/100 gal) is currently approved, check **EnlistTankMix.com** prior to making application to verify. • See label for proper nozzle selection. • See label for protection of sensitive areas via buffer. • Apply to corn up to 30 inches tall or 8 collars, whichever is more restrictive. • Refer to Table 1I for maximum crop and weed heights. • *Enlist Duo* applications to corn from 30 to 48 inches tall can be made with drop nozzles only – avoid application into the whorls. • Refer to Table 1B for weed control and crop tolerance ratings. • Maximum in-season use is one preemergence and two postemergence applications in Enlist traited corn. • Allow 12 days between sequential postemergence applications in Enlist traited corn. • DO NOT apply more than 9.5 pt/A in non-Enlist traited corn per growing season. • DO NOT apply more than 14.25 pt/A in Enlist traited corn per growing season. • DO NOT apply within 24 hours of predicted rainfall. • Refer to Table 1K for spring burndown applications. • Clethodim herbicides such as *Select* or *Select Max* may be used to control volunteer Enlist corn in the following soybean, sugarbeet, or dry bean crop. • Refer to Table 12 for crop rotation restrictions.

Table 1H – Delayed Applications of Soil Applied Herbicides in Corn

Preemergence herbicides should be applied as soon after planting as possible. Delayed application increases the risk of poor herbicide performance, especially for grass control. This table lists herbicides commonly applied preemergence that are also labeled for application after corn emergence. All the herbicide treatments should be applied with water as the carrier. Applying herbicides to emerged corn with 28% liquid nitrogen fertilizer as the carrier poses a risk of severe crop injury. Refer to the herbicide labels for information on application rates and specific restrictions for tank mixtures.

Herbicide	**Maximum Corn Stage**
Princep, Sharpen, Verdict	Before corn emergence
Balance Flexx	2 collars
Corvus	2 collars
Instigate	2 collars
Basis Blend	6 inches or 2 collars
Anthem MAXX, Anthem ATZ, Zidua	4 collars
Breakfree NXT, Breakfree NXT ATZ, Breakfree NXT Lite, Degree Xtra, FulTime NXT, Harness, Harness Xtra 5.6L, Keystone NXT, Keystone LA NXT, Surpass NXT, SureStart II, TripleFLEX II	11 inches
Harness MAX	11 inches
Resicore	11 inches
Atrazine	12 inches
Bicep II Magnum, Bicep Lite II Magnum, Cinch ATZ, Cinch ATZ Lite, Parallel Plus	12 inches
Acuron, Lexar EZ, Lumax EZ	12 inches
Outlook	12 inches
Resolve SG	12 inches or 5 collars
Accolade, Hornet WDG, Python, Stanza	20 inches or 6 collars
Acuron Flexi, Callisto, Zemax	30 inches or 8 collars
Prowl, Prowl H_2O	30 inches or 8 collars
Dual II Magnum, Cinch, Parallel	40 inches

TABLE 1I – Weed and Crop Heights for Postemergence Herbicide Applications in Corn*

		ANNUAL BROADLEAVES												ANNUAL GRASSES								CORN	
		COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH[c]	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP[c]	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	MINIMUM[a] HEIGHT	MAXIMUM[a] HEIGHT
HERBICIDE[b]	**RATE/A**	**MAXIMUM HEIGHT[a]**												**MAXIMUM HEIGHT[a]**									
2,4-D amine/ester	1 pt/0.5 pt	4"	NR	4"	4"	3"	4"	4"	4"	NR	NR	3"	4"	NR	NR	NR	NR	NR	NR	NR	NR	None	8"
Accent Q	0.9 oz	NR	3"	NR	NR	NR	4"	NR	NR	4"	NR	NR	NR	4"	NR	4"	4"	4"	4"	4"	3"	None	20" or 6 collars
Aim	0.5 oz	NR	NR	NR	4"	2"	4"	NR	NR	NR	36"	2"	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	8 collars
Anthem ATZ	1 qt	NR	3"	2"	3"	–	3"	NR	NR	2"	36"	4"	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	4 collars
Anthem MAXX	4 oz	NR	2"	2"	2"	–	2"	NR	NR	2"	36"	2"	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	4 collars
Armezon/Impact	0.75 oz	8"	6"	6"	6"	6"	6"	6"	8"	3"	8"	6"	6"	4"	3"	4"	3"	3"	3"	3"	NR	None	45 day PHI
Armezon PRO	20 oz	5"	4"	4"	4"	4"	4"	4"	5"	2"	4"	4"	4"	4"	3"	4"	3"	3"	3"	NR	NR	None	30" or 8 collars
Atrazine 4L	2 qt	4"	4"	6"	4"	1.5"	6"	4"	4"	4"	NR	1.5"	4"	NR	NR	NR	1½"	1½"	NR	NR	NR	None	12"
Banvel/Clarity	1 pt	4"	4"	4"	4"	3"	4"	4"	4"	6"	NR	3"	2"	NR	NR	NR	NR	NR	NR	NR	NR	None	8" or 5 lf
Basagran/Broadloom	2 pt	10"	10"	2"	NR	NR	NR	3"	6"	10"	5"	NR	8"	NR	NR	NR	NR	NR	NR	NR	NR	None	None
Beacon	0.76 oz	4"	4"	NR	4"	NR	4"	9"	9"	4"	4"	NR	4'	NR	NR	NR	NR	NR	2"	2"	NR	4"	20"
Buctril, Moxy, others	1 pt	8"	4"	6"	6"	NR	NR	6"	6"	4"	3"	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	d
Cadet	0.9 oz	NR	2"	2"	2"	–	4"	NR	NR	2"	36"	2"	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	48"[d]
Callisto	3 oz	NR	NR	5"	5"	3"	5"	3"	3"	5"	5"	3"	NR	NR	2"	NR	NR	NR	NR	NR	NR	None	30" or 8 collars
Callisto Xtra	24 oz	10"	10"	10"	10"	3"	10"	10"	10"	10"	10"	5"	10"	NR	2"	NR	NR	NR	NR	NR	NR	None	12"
Capreno	3 oz	6"	6"	6"	6"	3"	6"	6"	6"	6"	6"	3"	6"	5"	3"	3"	2"	3"	5"	3"	2"	1 collar	5 collars
DiFlexx	8 oz	3"	3"	3"	3"	3"	3"	3"	3"	3"	NR	3"	2"	NR	NR	NR	NR	NR	NR	NR	NR	spike	36" or 6 collars
DiFlexx Duo	32 oz	6"	6"	6"	6"	4"	6"	6"	6"	6"	6"	4"	6"	5"	3"	3"	2"	3"	-	-	2"	None	36" or 6 collars
Hornet WDG/Stanza	3 oz	6"	NR	NR	NR	NR	NR	6"	6"	6"	6"	NR	6"	NR	NR	NR	NR	NR	NR	NR	NR	None	20" or 6 collars
Laudis	3 oz	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	5"	3"	3"	2"	3"	NR	NR	2"	None	8 collars
Permit	0.67 oz	9"	4"	NR	NR	NR	3"	9"	3"	2"	9"	NR	4"	NR	NR	NR	NR	NR	NR	NR	NR	Spike	canopy closure
Realm Q	4 oz	4"	4"	4"	4"	3"	4"	4"	4"	4"	4"	3"	4"	2"	½"	2"	2"	2"	2"	2"	NR	None	20" or 6 collars
Resolve Q	1.25 oz	3"	NR	3"	NR	NR	3"	3"	NR	3"	3"	NR	3"	2"	0.5"	2"	2"	2"	2"	NR	NR	None	20" or 6 collars
Resource	4 oz	NR	NR	NR	NR	NR	NR	NR	NR	NR	5 lf	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	2 lf	10 collars
Revulin Q	3.4 oz	4"	4"	4"	4"	3"	4"	3"	3"	4"	4"	3"	4"	4"	2"	4"	4"	4"	4"	6"	3"	None	20" or 6 collars
Solstice	3 oz	NR	2"	5"	5"	3"	5"	3"	3"	3"	36"	3"	5"	NR	3"	NR	NR	NR	NR	NR	NR	None	30" or 8 collars
Steadfast Q	1.5 oz	NR	4"	NR	NR	NR	4"	NR	NR	NR	NR	NR	4"	4"	NR	4"	4"	4"	4"	4"	2"	None	20" or 6 collars
Status	5 oz	6"	6"	6"	6"	3"	6"	6"	6"	6"	6"	3"	2"	NR	NR	NR	NR	NR	NR	NR	NR	4"(V2)	36"(V8)
Stinger	0.25 pt	5 lf	5 lf	NR	NR	NR	NR	5 lf	5 lf	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	None	24"
Yukon	4 oz	14"	4"	6"	6"	NR	12"	12"	NR	3"	12"	NR	6"	NR	NR	NR	NR	NR	NR	NR	NR	spike	36"
GLYPHOSATE-RESISTANT CORN																							
glyphosate	0.75-1.13 lb a.e.	6"	6"	3"	4"	NR	4"	4"	6"	4"	4"	NR	6"	6"	4"	6"	6"	6"	6"	6"	6"	None	30" or 8 collars
Callisto GT	2 pt	4"	4"	4"	4"	3"	4"	4"	4"	4"	4"	3"	4"	4"	4"	4"	4"	4"	4"	4"	4"	None	30" or 8 collars
Expert	3 qt	6"	6"	3"	4"	3"	4"	4"	6"	4"	4"	3"	6"	6"	4"	6"	6"	6"	6"	6"	6"	None	12"
Halex GT	3.6 pt	4"	4"	4"	4"	3"	4"	4"	4"	4"	4"	3"	4"	4"	4"	4"	4"	4"	4"	4"	4"	spike	30" or 8 collars
Sequence	2.5 pt	12"	12"	6"	6"	NR	12"	12"	12"	6"	6"	NR	12"	6"	12"	18"	18"	18"	6"	12"	12"	None	30" or 8 collars
Warrant + glyphosate	3 pt + 0.75 lb a.e.	6"	6"	3"	4"	NR	4"	4"	6"	4"	4"	NR	6"	6"	4"	6"	6"	6"	6"	6"	6"	spike	30" or 8 collars
LIBERTYLINK CORN																							
Liberty[e]	32 oz	6"	6"	2"	6"	2"	3"	6"	6"	6"	3"	2"	4"	3"	3"	6"	6"	3"	3"	4"	NR	None	24" or 7 collars
ENLIST CORN																							
Enlist One	1.5 pt	6"	6"	6"	6"	3"	6"	6"	6"	6"	6"	3"	6"	6"	4"	6"	6"	6"	6"	6"	6"	None	30" (V8)
Enlist Duo	3.5 pt	6"	6"	6"	6"	3"	6"	6"	6"	6"	6"	3"	6"	6"	4"	6"	6"	6"	6"	6"	6"	None	30" (V8)

(Continued on next page)

TABLE 1I – Weed and Crop Heights for Postemergence Herbicide Applications in Corn* *(continued)*

[a] NR = not recommended; – = not enough information to rank; lf=leaf stage.

[b] Consult label for recommended additives.

[c] Almost all populations of Palmer amaranth and waterhemp found in Michigan are resistant to the ALS-inhibiting herbicides (Group 2) and glyphosate (Group 9).

[d] Before tassel emergence.

[e] The inclusion of atrazine is beneficial for control of herbicide-resistant Palmer amaranth and waterhemp.

* The weed heights and growth stages listed in this table are estimates of the maximum size where consistent control is expected. The maximum height for effective control in any specific situation is dependent on environment conditions, including soil moisture, temperature, and relative humidity.

TABLE 1J – Plant Response to Fall or Spring Herbicides in Sod

	Alfalfa	Red Clover	Hairy Vetch	Dandelion	Curled Dock	Bromegrass	Timothy	Bluegrass	Orchardgrass	Quackgrass
Fall Application[a]										
glyphosate (0.75 lb a.e.)[c]	F-**G**	F-**G**	F-**G**	**G**	–	**G**	**G**	**G**	**G**	**G-E**
glyphosate (1.5 lb a.e.)[c]	**G-E**	**G-E**	**G-E**	**G**	–	**E**	**E**	**E**	**E**	**E**
2,4-D ester (1 qt)	F-**G**	F-**G**	F	F	–	N	N	N	N	N
glyphosate (0.75 lb a.e.) + 2,4-D ester (1 qt)	**G**	**G**	**G**	**G**	–	**G**	**G**	**G**	**G**	**G-E**
glyphosate (1.5 lb a.e.)[c] + 2,4-D ester (1 qt)	**G-E**	**G-E**	**G-E**	**G**	–	**E**	**E**	**E**	**E**	**E**
Spring Application[b]										
glyphosate (0.75 lb a.e.)	F	F	F	F	P	F	F	**G**	P	**G**
glyphosate (1.5 lb a.e.)	F-**G**	F-**G**	F-**G**	F	F	**G**	**G**	**G**	F	**E**
2,4-D ester (1 qt)	F-**G**	**G**	F-**G**	P	P	N	N	N	N	N
glyphosate (0.75 lb a.e.)[c] + 2,4-D ester (1 qt)	F-**G**	F-**G**	F-**G**	F	P-F	F	F	**G**	P	**G**
glyphosate (1.5 lb a.e.)[c] + 2,4-D ester (1 qt)	**G**	**G**	**G**	F	F	**G**	**G**	**G**	F	**E**

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

[a] Ideal timing is 4-6 weeks after mowing. Mow in late August–early September and treat in early to mid-October in central or southern Michigan.

[b] Treat when plants reach at least 6 inches tall.

[c] See Table 10 for glyphosate products, formulations and rates. Always include 17 lb/100 gal of ammonium sulfate (AMS) with glyphosate applications.

TABLE 1K – Effectiveness of Herbicides for Spring Burndown in Corn*

	ANNUAL BROADLEAVES										ANNUAL GRASSES								WINTER ANNUALS/ PERENNIALS							COVER CROPS			
	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CHICKWEED (COMMON)	YELLOW ROCKET	SHEPHERD'S PURSE	PENNYCRESS	MARESTAIL (HORSEWEED)	DANDELION	QUACKGRASS	RYE	WHEAT	CLOVER	HAIRY VETCH
	Maximum Weed Height (inches)																		Herbicide Effectiveness										
atrazine (1 lb a.i.)[a]	2	2	2	2	2	2	2	2	2	2	NR	NR	NR	NR	NR	NR	NR	NR	–	**G**	**E**	**G**	**G**	P	P	P	P	P	P
atrazine (2 lb a.i.)[a]	3	3	3	3	3	3	3	3	3	3	NR	NR	NR	1.5	1.5	NR	NR	NR	–	**E**	**E**	**E**	**E**	F	F	F	F	F	F
2,4-D ester (1 pt)	3	NR	3	3	3	3	3	NR	2	3	NR	NR	NR	NR	NR	NR	NR	NR	P	F	**G**	F	**E**	N	N	N	N	F	F
2,4-D ester (1 qt)	6	3	6	6	6	6	6	3	5	6	NR	NR	NR	NR	NR	NR	NR	NR	F	**G**	**E**	**G**	**E**	P	N	N	N	**G**	**G**
glyphosate (0.75 lb a.e.)[bc]	16	10	10	10	16	10	5	5	5	16	5	–	16	16	16	–	–	–	**E**	**E**	**E**	**E**	**E**	F	F	**E**	**E**	F	F
Gramoxone (2.0 pt)[d]	3	3	3	3	3	3	3	NR	3	3	3	3	3	3	3	3	3	3	**E**	**G**	**G**	**G**	P	P	P	F	F	P	P
Gramoxone (2.5 pt)[d]	6	6	6	6	6	6	6	NR	6	6	6	6	6	6	6	6	6	6	**E**	**E**	**E**	**E**	P	P	P	**G**	**G**	F	F
Liberty (29 oz)[c]	14	10	6	8	4	10	12	14	4	6	5	5	12	12	4	5	6	NR	**E**	**G**	**G**	**G**	**G**	F	N	P	F	P	**G**
Basis Blend (1.25 oz) + 2,4-D ester (1 pt) + atrazine (1 lb a.i.)[a]	3	2	3	3	3	3	3	3	3	3	2	NR	2	2	2	2	–	–	**E**	**G**	**E**	**G**	**E**	**G**	F	P	P	F	F
Fierce (3 oz)[f]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P	**G**	**E**	**G**	P	F	N	N	N	P	P
Resolve SG (1 oz) + 2,4-D ester (1 pt) + atrazine (1 lb a.i.)[a]	3	2	3	3	3	3	3	3	3	3	2	NR	2	2	2	2	–	–	**E**	**G**	**E**	**G**	**E**	**G**	F	P	P	F	F
Resolve Q (1.25 oz) + 2,4-D ester (1 pt) + atrazine (1 lb a.i.)[a]	3	2	3	3	3	3	3	3	3	3	2	NR	2	2	2	2	–	–	**E**	**G**	**E**	**G**	**E**	**G**	F	P	P	F	F
Sharpen (1 oz)[e]	6	6	6	6	6	6	6	6	6	6	NR	NR	NR	NR	NR	NR	NR	NR	F	**G**	**G**	**G**	**E**	F	NR	NR	NR	–	–
Sharpen (1 oz) + glyphosate (0.75 lb a.e.)[be]	16	10	10	10	16	10	6	6	6	16	5	–	16	16	16	–	–	–	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Valor/Rowel (2 oz)[f]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	P	**G**	**E**	**G**	P	F	N	N	N	P	P
Vida (1 oz) + glyphosate (0.75 lb ae)[bc]	4	–	4	4	4	4	4	4	4	–	NR	NR	NR	NR	NR	NR	NR	NR	**E**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; NR = Not Recommended; – = Not enough information to rank

** Burndown effectiveness varies, depending on several factors. This table is intended as a guide to relative effectiveness of burndown herbicide options.

[a] Always add crop oil concentrate at 1 qt/A to maximize foliar activity.

[b] See Table 10 for glyphosate products, formulations and rates.

[c] Always include 8.5-17 lb/100 gal of ammonium sulfate (AMS).

[d] Always add either a non-ionic surfactant (0.25%) or a crop oil concentrate (1%) with *Gramoxone*.

[e] Must be applied with a methylated seed oil (MSO) at 1% and ammonium sulfate at (17 lb/100 gal).

[f] Apply 7 to 30 days before planting on no-till or minimum tillage fields. Provides additional residual control of annual broadleaves. Do not irrigate corn from emergence to 2-leaf. Apply with 2,4-D, *Gramoxone*, glyphosate or other herbicides (see label).

TABLE 2A – Weed Response to Soil-Applied Herbicides in Soybean*

			ANNUAL BROADLEAVES													ANNUAL GRASSES								PERENNIALS			
Soil Applied	SITE OF ACTION	SOYBEAN TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP	WILD MUSTARD	HORSEWEED (MARESTAIL)[c]	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD & HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
BROADAXE XC	14/15	2	P	P	**E**	**E**	**G**	**E**	F	P	F	F	**G**	P	F	**E**	**E**	**E**	**E**	**G**	**G**	**G**	P	N	N	N	**G**
COMMAND 3ME	13	1	F	F	**G**	P	P	P	**G**	P	**G**	**E**	P	P	–	**G**	**E**	**E**	**E**	**G**	**G**	**G**	F	N	N	N	N
DUAL MAGNUM/ EVERPREX/ PARALLEL	15	1	N	N	P	F	F/**G**	**G**	P	N	P	N	**G**	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F
FIRSTRATE	2	2	**G**	**G**	**G**	P	N[b]	**E**	**E**	**G**	**E**	**G**	N[b]	**E**	**G**	F	F	F	F	F	F	P	P	N	N	N	P
LOROX/LINEX	7	2	P	P	**G**	F	P	**G**	**G**	F	**G**	F	P	**G**	P	F	F	F	F	F	F	F	P	N	N	N	N
METRIBUZIN	5	2	F	F	**G**	N	F	**E**	**G**	F	**E**	**G**	F	**E**	**G**	P	F	**G**	**G**	**G**	F	F	P	N	N	N	N
OUTLOOK	15	1	N	N	P	**G**	F	**G**	P	N	P	N	F	P	N	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F
PROWL H2O/PROWL	3	2	N	N	**G**	P	P	F	P	N	P	F	P	P	P	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	N
PURSUIT	2	1	F	F	**G**	**E**	N[b]	**E**	F	F	**G**	**G**	N[b]	**E**	P	F	F	**G**	**G**	**G**	P	P	P	P	N	N	F
PYTHON/ACCOLADE	2	1	F	F	**E**	**G**	N[b]	**E**	F	F	**G**	**G**	N[b]	**E**	**G**	P	P	F	P	P	P	P	P	N	N	N	N
SONALAN **(PPI ONLY)**	3	1	N	N	**G**	F	F	**G**	P	N	P	N	F	P	–	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N
SPARTAN	14	2	P	P	**E**	**E**	**G**	**E**	F	P	F	F	**G**	P	F	N	N	P	P	P	N	N	N	N	N	N	**G**
TRIFLURALIN **(PPI ONLY)**	3	1	N	N	**G**	F	F	**G**	P	N	P	N	F	P	–	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N
VALOR/ VALOR EZ/ ROWEL	14	2	P	F	**G**	**G**	**G**	**G**	**G**	F	F	F	**G**	**G**	**G**	N	N	P	P	P	N	N	N	N	N	N	P
WARRANT	15	1	P	N	F	**G**	F/**G**	**G**	F	N	P	P	**G**	P	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	N	F
ZIDUA	15	1	P	F	F	**G**	**G**	**E**	F	N	F	F	**G**	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	N	F
Premixes																											
AFFORIA	2/2/14	2	P	F	**G**	**G**	**G**	**G**	**G**	F	F	F	**G**	**G**	**G**	N	N	P	P	P	N	N	N	N	N	N	P
ANTHEM MAXX	14/15	1	P	F	F	**G**	**G**	**E**	F	N	F	F	**G**	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	N	F
AUTHORITY ASSIST	2/14	2	F	F	**E**	**E**	**G**	**E**	F	F	**G**	**G**	**G**	**E**	F	F	F	F	F	F	P	P	P	P	N	N	**G**
AUTHORITY FIRST/SONIC	2/14	2	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**G**	**G**	**G**	**G**	**E**	**G**	F	F	F	F	F	F	P	P	N	N	N	**G**
AUTHORITY MAXX	2/14	2	P	F	**E**	**E**	**G**	**E**	F	P	**G**	**G**	**G**	**G**	**G**	P	P	F	P	P	P	P	P	N	N	N	**G**
AUTHORITY MTZ	5/14	2	F	F	**E**	**E**	**G**	**E**	**G**	F	**E**	**G**	**G**	**E**	**G**	P	F	F	P	P	F	P	P	N	N	N	F
AUTHORITY XL	2/14	2	F	F	**E**	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	**E**	**G**	F	F	F	F	F	F	P	P	P	N	N	F
BOUNDARY	5/15	2	F	F	**G**	F	F/**G**	**E**	**G**	F	**E**	**G**	**G**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	F
CANOPY/ CANOPY BLEND	2/5	2	**G**	**G**	**E**	N	P	**E**	**G**	**G**	**E**	**G**	P	**E**	**G**	F	F	F	F	F	F	F	P	P	N	N	P
CANOPY EX [a]	2/2	1	**G**	**G**	**G**	N	N[b]	**G**	**G**	F	**G**	**G**	N[b]	**E**	**G**	P	P	F	F	F	P	P	P	P	N	N	P
ENVIVE	2/2/14	2	**G**	**G**	**E**	**G**	**G**	**E**	**E**	F	**E**	**G**	**G**	**E**	**G**	F	F	F	F	F	F	F	P	P	N	N	F
FIERCE	14/15	3	P	F	**G**	**G**	**G/E**	**G**	**G**	F	F	F	**G/E**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	N	F
FIERCE XLT	2/14/15	3	**G**	**G**	**E**	**G**	**G/E**	**E**	**G**	F	**E**	**G**	**G/E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	N	F
FLEXSTAR GT 3.5	9/14	2	P	P	**G**	**E**	P	**E**	**G**	F	**G**	P	P	**E**	F	N	N	N	N	N	N	N	N	N	N	N	N
OPTILL	2/14	1	F	F	**G**	**E**	P	**E**	F	F	**G**	**G**	P	**E**	F	F	F	**G**	**G**	**G**	P	P	P	P	N	N	F
OPTILL PRO	2/14/15	1	F	F	**G**	**E**	F	**E**	F	F	**G**	**G**	F	**E**	F	**G**	**G**	**G**	**G**	**G**	F	F	N	P	N	N	F
PREFIX	14/15	2	P	P	**G**	**E**	**G**	**E**	**G**	F	**G**	P	**G**	**E**	F	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	P
SPARTAN CHARGE	14/14	2	P	P	**E**	**E**	**G**	**E**	F	P	F	F	**G**	P	F	N	N	P	P	P	N	N	N	N	N	N	F
SURVEIL	2/14	2	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**G**	**E**	**G**	**G**	**E**	**G**	F	F	F	F	F	F	P	P	N	N	N	P
SYNCHRONY XP	2/2	2	**G**	**G**	**E**	N	N[b]	**E**	**G**	F	**E**	**G**	N[b]	**E**	**G**	F	F	F	F	F	F	F	P	P	N	N	F
TRIVENCE	2/5/14	2	**G**	**G**	**E**	**G**	**G**	**E**	**G**	**G**	**E**	**G**	**G**	**E**	**G**	F	F	F	F	F	F	F	P	P	N	N	P
VALOR XLT/ROWEL FX	2/14	2	**G**	**G**	**E**	**G**	**G**	**E**	**G**	F	**E**	**G**	**G**	**E**	**G**	F	F	F	F	F	F	F	P	P	N	N	F
VERDICT	14/15	1	P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P	P	P	P	N	N	N	N	N
WARRANT ULTRA	14/15	2	P	P	**G**	**E**	**G**	**E**	**G**	F	**G**	P	**G**	**E**	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	N	F
ZIDUA PRO	2/14/15	1	F	F	**G**	**E**	**G**	**E**	F	F	**G**	**G**	**G**	**G**	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	P	N	N	F

(Continued on next page)

TABLE 2A – Weed Response to Soil-Applied Herbicides in Soybean*

Herbicide Site of Action: The site of action key is located on pages 15-16. Herbicide Effectiveness: P=Poor; F=Fair; **G**=Good; **E**=Excellent; N=None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (cold, wet); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high.

[a] For more information on *Canopy EX* applications consult Table 2N – Weed Management in No-Till Soybean.

[b] Almost all populations of Palmer amaranth and waterhemp found in Michigan are resistant to the ALS-inhibiting herbicides (Group 2). Refer to the factsheet on "Keys to Managing Multiple-Resistant Palmer amaranth" on pages 209-211.

[c] Several horseweed populations in Michigan are resistant to ALS-inhibiting herbicides (Group 2), glyphosate (Group 9), or both herbicide site of action groups. Herbicides that have these site of action groups will not control these resistant horseweed populations. Refer to the "Controlling Horseweed" factsheet on page 213.

TABLE 2B – Weed Response to Postemergence Herbicides in Soybean*

Postemergence	SITE OF ACTION	SOYBEAN TOLERANCE**	ANNUAL BROADLEAVES													ANNUAL GRASSES								PERENNIALS			
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP	WILD MUSTARD	HORSEWEED (MARESTAIL)[c]	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD & HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
ANTHEM MAXX	14/15	2	P	**G**	F	**G**	P	**G**	P	P	P	**E**	P	P	P	N	N	N	N	N	N	N	N	N	N	N	N
ASSURE II/TARGA	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	N	N	**E**	N
BASAGRAN/BROADLOOM	6	2	**E**	**G**	**G**	P	N	P	F	F	**E**	**G**	N	**E**	F	N	N	N	N	N	N	N	N	N	**G**	N	F
CADET	14	2	P	**G**	F	F	P	**G**	P	P	P	**E**	P	P	P	N	N	N	N	N	N	N	N	N	N	N	N
CLASSIC	2	2	**E**	**G**	N	N	N[a]	**E**	**G**	**G**	**E**	**G**	N[a]	**E**	**G**	N	N	P	P	P	N	N	N	N	F	N	**E**
COBRA	14	3	**G**	**G**	P	**G**	**G**	**E**	**E**	**E**	P	F	**G**	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
FIRSTRATE	2	1	**E**	**E**	N	N	N	P	**E**	**E**	**E**	**G**	N	**G**	**G**	N	N	N	N	N	N	N	N	P	F	N	F
FLEXSTAR	14	2	F	**G**	F	**G**	**G**	**E**	**E**	**E**	**G**	F	**G**	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
FUSILADE DX	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	**G**	N
FUSION	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**E**	N	N	**G**	N
HARMONY SG	2	3	F	F	**G**	N	N[a]	**E**	P	P	**E**	**G**	N[a]	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N
MARVEL	14/14	3	F	F	F	**G**	F	**E**	**G**	F	F	**E**	F	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
PHOENIX	14	2	**G**	**G**	P	**G**	F	**E**	**E**	**E**	P	F	F	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
POAST/POAST PLUS	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	F	N
PREFIX	14/15	2	P	F	P	**G**	**G**	**E**	**G**	**G**	P	P	**G**	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
PURSUIT	2	2	**E**	F	P	**E**	N[a]	**E**	F	**G**	**G**	**G**	N[a]	**G**	P	F	F	**G**	**G**	**G**	F	F	P	P	P	N	F
RAPTOR	2	2	**G**	**G**	**G**	**E**	N[a]	**E**	F	**G**	**G**	**G**	N[a]	**E**	–	F	F	**E**	**G**	**G**	F	F	N	P	F	N	P
REFLEX	14	1	P	F	P	**G**	**G**	**E**	**G**	**G**	P	P	**G**	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
RESOURCE	14	2	P	P	F	P	P	P	P	P	P	**E**	P	P	P	N	N	N	N	N	N	N	N	N	N	N	N
SELECT MAX/ ARROW/SELECT	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	**G**	N
SYNCHRONY XP	2/2	2	**E**	**G**	**G**	N	N[a]	**E**	**G**	**G**	**E**	**G**	N[a]	**E**	**G**	N	N	N	N	N	N	N	N	N	F	N	**G**
ULTRA BLAZER	14	2	F	**G**	P	**G**	F	**E**	**E**	F	**G**	P	**G**	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
WARRANT ULTRA	14/15	2	P	F	P	**G**	**G**	**E**	**G**	**G**	P	P	**G**	**E**	P	N	N	N	N	N	N	N	N	N	N	N	N
GLYPHOSATE-RESISTANT SOYBEAN																											
GLYPHOSATE	9	1	**E**	**E**	**G**	**G**	N[b]	**E**	**G**	**G**	**G**	**G**	N[b]	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	F
EXTREME	2/9	2	**E**	**E**	**G**	**E**	N[b]	**E**	**G**	**G**	**G**	**G**	N[b]	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	**E**	F
FLEXSTAR GT 3.5	9/14	2	**E**	**E**	**G**	**E**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	F
SEQUENCE	9/15	2	**E**	**E**	**G**	**G**	N[b]	**E**	**G**	**G**	**G**	**G**	N[b]	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	F
WARRANT + GLYPHOSATE	9/15	2	**E**	**E**	**G**	**G**	N[b]	**E**	**G**	**G**	**G**	**G**	N[b]	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	F
LIBERTYLINK (GLUFOSINATE-RESISTANT) SOYBEAN																											
LIBERTY/CHEETAH	10	1	**E**	**E**	**G**	**G**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	F	**G**	F	F	P	P	P	P
CHEETAH MAX	10/14	2	**E**	**E**	**G**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	F	**G**	F	F	P	P	P	P
ROUNDUP READY 2 XTEND (DICAMBA-RESISTANT) SOYBEAN																											
ENGENIA	4	1	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	F	**G**	**G**	**G**	N	N	N	N	N	N	N	N	**G**	F	N	N
XTENDIMAX/FEXAPAN	4	1	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	F	**G**	**G**	**G**	N	N	N	N	N	N	N	N	**G**	F	N	N

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TABLE 2B – Weed Response to Postemergence Herbicides in Soybean*

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (cold, wet); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high.

[a] Almost all populations of Palmer amaranth and waterhemp found in Michigan are resistant to the ALS-inhibiting herbicides (Group 2). Refer to the factsheet on "Keys to Managing Multiple-Resistant Palmer amaranth" on pages 209-211.

[b] Most populations of Palmer amaranth and waterhemp found in Michigan are resistant to glyphosate (Group 9). Refer to the factsheet on "Keys to Managing Multiple-Resistant Palmer amaranth" on pages 209-211.

[c] Several horseweed populations in Michigan are resistant to ALS-inhibiting herbicides (Group 2), glyphosate (Group 9), or both herbicide site of action groups. Herbicides that have these site of action groups will not control these resistant horseweed populations. Refer to the "Controlling Horseweed" factsheet on page 213.

TABLE 2C – Herbicide Premixes in Soybean

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE[a]	=	EQUIVALENT RATES
Afforia	DuPont	50.8WG	2.5 oz/A	=	0.25 oz Harmony SG + 0.25 oz Express + 2 oz Valor
Anthem MAXX	FMC	4.3SE	4 oz/A	=	0.6 oz Cadet + 2.45 oz Zidua
Authority Assist	FMC	4L	10 oz/A	=	8.3 oz Spartan + 3.34 oz Pursuit L
Authority First/Sonic	FMC/Dow	70DF	6.4 oz/A	=	8 oz Spartan + 0.6 oz FirstRate
Authority MAXX	FMC	66WG	5 oz/A	=	6.2 oz Spartan + 0.8 oz Classic
Authority MTZ	FMC	45DF	16 oz/A	=	5.76 oz Spartan + 5.76 oz Metribuzin
Authority XL	FMC	70WG	4 oz/A	=	5 oz Spartan + 1.25 oz Classic
Autumn Super	Bayer	51WG	0.5 oz/A	=	0.0019 lb ai iodosulfuron + 0.014 lb ai thiencarbazone-methyl
Boundary 6.5EC	Syngenta	6.5EC	2 pt/A	=	1.33 pt Dual Magnum + 6.67 oz Metribuzin
BroadAxe XC	Syngenta	7L	32 oz/A	=	5.6 oz Spartan + 1.65 pt Dual Magnum
Canopy	DuPont	75WG	4.5 oz/A	=	1.92 oz Classic + 3.86 oz Metribuzin
Canopy Blend	DuPont	58.3WG	5.75 oz/A	=	1.9 oz Classic + 3.83 oz Metribuzin
Canopy EX	DuPont	29.5WG	2.2 oz/A	=	2 oz Classic + 0.3 oz Express SG
Cheetah Max	NuFarm Inc	3L	1 qt/A	=	1 pt Reflex + 27 oz Cheetah
Envive[b]	DuPont	41.3WG	3.5 oz/A	=	2 oz Valor + 1.28 oz Classic + 0.192 oz Harmony SG
Extreme	BASF	2.17L	3 pt/A	=	0.56 lb a.e. glyphosate + 4 oz Pursuit L
Fierce	Valent	76WG	3 oz/A	=	1.97 oz Valor + 1.5 oz Zidua
Fierce XLT	Valent	62.41WG	4 oz/A	=	1 oz Classic + 1.9 oz Valor + 1.5 oz Zidua
Flexstar GT 3.5	Syngenta	2.82L	3.5 pt/A	=	0.99 lb a.e. glyphosate + 1 pt Flexstar

(Continued on next page)

[a] Typical use rates recommended are for medium textured soils with 3% organic matter. Lower rates can be used in planned preemergence followed by postemergence programs in glufosinate or glyphosate-resistant soybeans. These rates can be found in the Remarks and Limitations section for each herbicide.

[b] DO NOT apply more than 2.5 oz/A of *Envive* if you are located north of I-96 or have a composite pH between 7.1 and 7.6.

[c] DO NOT apply more than 6 oz/A of *Trivence* is you are located north of State Road 46 or have a composite soil pH between 7.1 and 7.6.

TABLE 2C –Herbicide Premixes in Soybean *(continued)*

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE[a]	=	EQUIVALENT RATES
Fusion	Syngenta	2.56EC	0.5 pt/A	=	8 oz Fusilade DX + 4.8 oz Puma
Marvel	FMC	3L	7.25 oz/A	=	0.9 oz Cadet + 11 oz Flexstar
OpTill	BASF	68WG	2 oz/A	=	1 oz Sharpen + 4 oz Pursuit L
OpTill PRO	BASF	co-pack	2 oz/A 10 oz/A	of of	OpTill Outlook
Prefix	Syngenta	5.29L	2 pt/A	=	1 pt Dual Magnum + 1 pt Reflex
Rowel FX	Monsanto	40.3WG	4 oz/A	=	1.65 oz Classic + 2.34 oz Rowel
Sequence	Syngenta	5.25L	2.5 pt/A	=	0.98 pt Dual Magnum + 0.7 lb a.e. glyphosate
Spartan Charge	FMC	3.5SC	8 oz/A	=	1.33 oz Aim + 6.27 oz Spartan
Surveil	Dow AgroSciences	48WG	3.5 oz/A	=	2.47 oz Valor + 0.5 oz FirstRate
Synchrony XP	DuPont	28.4WG	0.75 oz/A	=	0.64 oz Classic + 0.105 oz Harmony SG
Trivence[c]	DuPont	61.3WG	8 oz/A	=	1.28 oz Classic + 4.75 oz Metribuzin + 2 oz Valor
Valor XLT	Valent	40.3WG	4 oz/A	=	1.65 oz Classic + 2.34 oz Valor
Verdict	BASF	5.57L	5 oz/A	=	1 oz Sharpen + 4.2 oz Outlook
Warrant Ultra	Monsanto	3.45CS	50 oz/A	=	3 pt Warrant + 1 pt Reflex
Zidua PRO	BASF	4.09SC	6 oz/A	=	4 oz Pursuit + 1 oz Sharpen + 2 oz Zidua

[a] Typical use rates recommended are for medium textured soils with 3% organic matter. Lower rates can be used in planned preemergence followed by postemergence programs in glufosinate or glyphosate-resistant soybeans. These rates can be found in the Remarks and Limitations section for each herbicide.

[b] DO NOT apply more than 2.5 oz/A of *Envive* if you are located north of I-96 or have a composite pH between 7.1 and 7.6.

[c] DO NOT apply more than 6 oz/A of *Trivence* is you are located north of State Road 46 or have a composite soil pH between 7.1 and 7.6.

TABLE 2D – Soybean Herbicides – Remarks and Limitations

Soybean – Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	trifluralin *(many)*	0.75	1.5 pt 4EC	• Refer to Table 2A for weed control and crop tolerance ratings. • Incorporate in top 2 or 3 inches of soil within 24 hr. after application. • On sandy and sandy loam soils low in organic matter, use 0.5 lb a.i./A (1 pt/A). • Most effective control if application is made 10 days to 2 weeks ahead of planting and field is reworked just prior to planting. • Sugar beets may be planted 12 months after application. Moldboard plowing to a depth of 12 inches is recommended to reduce the risk of crop inury. • Refer to label and Table 12 for crop rotation restrictions.
	ethalfluralin *(Sonalan HFP)*	0.9	2.5 pt 3EC	• Refer to Table 2A for weed control and crop tolerance ratings. • Incorporate in top 2 or 3 inches of soil within 2 days of application. • Sugar beets may be planted 8 months after application only if the *Sonalan* is applied at 3 pt/A or less and the treated soil is moldboard-plowed to a depth of 12 inches. • Refer to label and Table 12 for crop rotation restrictions.

Soybean – Soil Applied – All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	s-metolachlor *(Dual Magnum, EverpreX)* OR *(Dual II Magnum, Cinch)*	1.27	1.33 pt 7.62EC OR 1.33 pt 7.64EC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • *Dual Magnum, EverpreX, Dual II Magnum* or *Cinch* rate should be increased to 1.66 pt/A for effective nutsedge control. • Nutsedge control is improved when s-metolachlor is incorporated. • DO NOT exceed 2.4 lbs. a.i./A of S-metolachlor per season. • May be applied postemergence on soybeans, but this application will not control emerged weeds. If applied postemergence, there is a 90 day preharvest interval and soybean should not be used for forage or hay. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	dimethenamid-P *(Outlook)*	0.84	18 oz 6EC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • *Outlook* rate should be increased to 21 oz/A for effective nutsedge control. • Nutsedge control is improved when *Outlook* is incorporated. • *Outlook* rates vary with soil texture and organic matter. • *Outlook* may be applied early postemergence on soybeans from the first to fifth trifoliate, but this application will not control emerged weeds. • Refer to label and Table 12 for crop rotation restrictions.
	metolachlor *(Parallel)* OR *(Parallel PCS)*	1.3	1.33 pt 7.8L OR 1.33 pt 8.0L	• **May be applied preplant, preplant incorporated or preemergence.** • *Parallel/Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that 1.33 pt/A of these products provide similar activity to s-metolachlor products at 1.33 pt/A. However, *Parallel/Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds. Rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) in the 1.33 pt/A rate of *Dual Magnum* (s-metolachlor). • Refer to Table 2A for weed control and crop tolerance ratings. • Refer to label and Table 12 for crop rotation restrictions.
	pendimethalin *(Prowl)* OR *(Prowl H_2O)*	1 0.95	2.4 pt 3.3EC OR 2.0 pt 3.8SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • Preemergence applications may be made up to 2 days after planting. • DO NOT apply after soybean cracking or emergence. • Applications close to or after planting may result in soybean injury, including stem swelling and brittleness. Early preplant or preplant incorporated applications reduce the risk of injury. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	saflufenacil + dimethenamid-P *(Verdict)*	0.22	5 oz 5.57L	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • The 5 oz/A application rate of *Verdict* labeled for use in soybean will not provide much residual weed control. This product is best used as part of a burndown program in no-till soybean (see Table 2O). • For additional residual control and enhanced burndown activity, higher rates of *Verdict* can be applied. However, longer intervals are required between *Verdict* application and soybean planting; a minimum of 14 days for 7.5 oz/A and 30 days for 10 oz/A of *Verdict*. • DO NOT apply after soybean emergence or severe crop injury will occur. • DO NOT apply within 30 days of planting if an at-plant organophosphate or carbamate insecticide is planned or severe injury will occur. • DO NOT apply to coarse textured soils with less than 2% organic matter, unless soybean is planted 30 days after application. • DO NOT tank-mix or apply *Verdict* within 30 days of soil-applied applications of flumioxazin *(Valor)*, sulfentrazone (*Authority* or *Spartan*), or fomesafen *(Reflex, Flexstar)* containing products. However, fomesafen *(Flexstar, Reflex)* and other POST PPO-inhibiting herbicides can be used 14 days after soybean emergence. • Refer to label and Table 12 for crop rotation restrictions.
	acetochlor *(Warrant)*	1.125	3 pt 3CS	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • Crop injury may result when soil conditions are cold and wet, or waterlogged. • *Warrant* can be applied postemergence up to R2 soybean; this application will not control emerged weeds. • DO NOT apply more than 4 qt/A of *Warrant* per season. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	pyroxasulfone *(Zidua)* OR *(Zidua SC)*	0.133	2.5 oz 85WG OR 4 oz 4.17SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • Application rate varies with soil texture and application timing. • DO NOT apply more than 2.1 oz/A on course; 3 oz/A on medium; or 3.5 oz/A on use on fine textured soils of *Zidua WG*; or more than 3.5 oz/A on course textured; 5 oz/A on medium textured soil; or 5.75 oz/A fine textured soils of *Zidua SC*. • DO NOT use on peat or muck soils with 10% or more organic matter. • May be applied early postemergence from the first- to the third-trifoliate leaf stage, but this application alone will not control emerged weeds. • DO NOT apply from soybean emergence through the unifoliate stage or injury may occur. • The maximum cumulative amount of *Zidua WG* that can be applied per cropping season is 2.1 oz/A on course textured soils and 3.5 oz/A on all other soils; or more than 3.5 oz/A on course textured or 5.75 oz/A on all other soils of *Zidua SC*. • Rotation restrictions are dependent on use rate. If *Zidua* is applied at 4 oz/A or 6.5 oz/A of *Zidua SC* (corn only), the rotation restrictions are extended to 4 months for soybean, 6 months for wheat, and 18 months for other small grains. Refer to Table 12 for crop rotation restrictions.
Annual broadleaves	thifensulfuron + tribenuron + flumioxazin *(Afforia)*	0.08	2.5 oz 50.8WG	• **Apply preplant or preemergence; depending on *Afforia* rate.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Afforia* at 2.5 oz/A can be applied preemergence up to 3 days after planting, but prior to soybean emergence; at rates greater than 2.5 to 3.75 oz/A 7 days is needed prior to planting. • Crop injury may occur from applications made to poorly drained soils under cool, wet conditions. • DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)*, or acetochlor *(Warrant)* products within 14 days of planting, unless soybeans are planted under no-till or minimum tillage conditions on wheat stubble or no-till field corn stubble or crop injury will occur. • Refer to label and Table 12 for crop rotation restrictions. Rotation restrictions under reduced tillage systems are the longer of the two listed in Table 12.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	pyroxasulfone + fluthiacet *(Anthem MAXX)*	0.134	4 oz 4.3SE	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Application rates vary by soil type and organic matter. *Anthem MAXX* rates range from 2.5 to 5.5 oz/A (4 oz/A). • *Anthem MAXX* should be used as part of a planned pre-emergence followed by postemergence herbicide program. • May be applied postemergence. Refer to the postemergence application section for *Anthem MAXX*. • Refer to Table 12 for crop rotation restrictions.
	sulfentrazone + imazethapyr *(Authority Assist)*	0.312	10 oz 4L	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Authority Assist* use rates are based on soil texture, organic matter, and pH. *Authority Assist* rates range from 6 to 12 oz/A (10 oz/A). Reduced rates ranging from 4 to 6 oz/A (5 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • DO NOT apply more than 3 days after planting — soybean injury may occur. • DO NOT apply to sands with less than 1% organic matter. • DO NOT apply to soils with pH of 7.5 or higher. • Soybean stunting may occur if excessive rainfall occurs after application but before soybean emergence, especially at higher rates. • Soybean varieties vary in their tolerance to sulfentrazone. Consult your local seed dealer for more information. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Forty months and a successful bioassay are required prior to planting sugar beets, cucumbers and tomatoes. • Refer to label and Table 12 for crop rotation restrictions.
	sulfentrazone + cloransulam-methyl *(Authority First/Sonic)*	0.26	6.4 oz 70DF	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply *Authority First/Sonic* at 6.4 oz/A. Reduced rates ranging from 3.2 to 6 oz/A (4 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • DO NOT apply after soybean emergence or death or severe injury may occur. • DO NOT apply to sands with less than 1% organic matter. • Soybean stunting may occur if excessive rainfall occurs after application but before soybean emergence. • Soybean varieties vary in their tolerance to sulfentrazone. Consult you local seed dealer for more information. • Tank mixtures or sequential herbicide programs can be used to improve the weed control spectrum. • Rotation to sugar beets, cucumbers, and tomatoes requires 30 months and a successful bioassay. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	sulfentrazone + chlorimuron *(Authority MAXX)*	0.206	5 oz 66WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply *Authority MAXX* at 5 oz/A as part of a 2-pass program. Higher rates lengthen the crop rotation restrictions. • DO NOT apply to cracking or emerged soybean – severe injury will occur. • DO NOT apply to soils with pH greater than 7.6. • Soybean stunting may occur if excessive rainfall occurs after application but before soybean emergence. • Soybean varieties vary in their tolerance to sulfentrazone. Consult your local seed dealer for more information. • DO NOT tank-mix or follow with another chlorimuron containing product in the same season. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Soil pH strongly affects crop rotation. Corn can be planted 10 months after *Authority MAXX* application if the soil pH is ≤6.8. Refer to Table 12 for crop rotation restrictions.
	sulfentrazone + metribuzin *(Authority MTZ)*	0.45	16 oz 45DF	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Authority MTZ* use rates are based on soil texture, organic matter, and pH. *Authority MTZ* rates range from 12 to 20 oz/A (16 oz/A). Reduced rates ranging from 8 to 14 oz/A (12 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • DO NOT apply *Authority MTZ* at rates greater than 12 oz/A if the soil pH is greater than 7.5. • DO NOT apply after soybean emergence or death or severe injury may occur. • DO NOT apply to sands with less than 1% organic matter. • Soybean varieties vary in their tolerance to sulfentrazone and metribuzin. Consult your local seed dealer for more information. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Corn may be replanted 4 months after *Authority MTZ* if the application rate is less than 14 oz/A. • The rotation interval to sugarbeets is 24 months if a successful bioassay is completed. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	sulfentrazone + chlorimuron-ethyl *(Authority XL)*	0.175	4 oz 70WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply *Authority XL* at 3 to 5 oz/A as part of a 2-pass program. • DO NOT apply more than 3 days after planting as soybean injury may occur. • DO NOT apply to soils with pH greater than 7.6. • Soybean stunting may occur if excessive rainfall occurs after application but before soybean emergence, especially at higher rates. • Soybean varieties vary in their tolerance to sulfentrazone. Consult your local seed dealer for more information. • DO NOT tank-mix or apply within 14 days of an organophosphate insecticide. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Soil pH strongly affects crop rotation restrictions. Rotation restrictions are lengthened to 18 months for all crops, except small grains and those with rotation restrictions of 36 months, if the soil pH is greater than 6.8. Refer to label and Table 12 for additional crop rotation restrictions.
	chlorimuron-ethyl + metribuzin *(Canopy)*	0.21	4.5 oz 75WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Canopy* use rates are based on soil texture, organic matter, and pH. *Canopy* rates range from 4 to 7 oz/A (4.5 oz/A). Reduced rates ranging from 2.25 to 4 oz/A (3 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • DO NOT apply *Canopy* at rates greater than 2.25 oz/A to soils with a composite pH greater than 7.0; use of higher rates may result in unacceptable injury to this year's crop and the following crop. • DO NOT apply *Canopy* to soils with a composite pH exceeding 7.6. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Tomatoes may be transplanted 10 months after *Canopy* application. • Rotation intervals are dependent on soil pH and rate. Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	chlorimuron-ethyl + metribuzin *(Canopy Blend)*	0.21	5.75 oz 58.3WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Canopy Blend* use rates are based on soil texture, organic matter, and pH. *Canopy Blend* rates range from 5 to 9 oz/A (5.75 oz/A). Reduced rates ranging from 2.9 to 5 oz/A (4 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • DO NOT apply *Canopy Blend* at rates greater than 2.9 oz/A to soils with a composite pH greater than 7.0; use of higher rates may result in unacceptable injury to this year's crop and the following crop. • DO NOT apply *Canopy Blend* to soils with a composite pH exceeding 7.6. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Tomatoes may be transplanted 10 months after *Canopy Blend* application. • Rotation intervals are dependent on soil pH and rate. Refer to label and Table 12 for crop rotation restrictions.
	flumioxazin + chlorimuron-ethyl + thifensulfuron-methyl *(Envive)*	0.09	3.5 oz 41.3WG	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Envive* use rates range between 2.5 and 5.3 oz/A for portions of Michigan south of highway I-96. The maximum use rate of *Envive* for portions of the Michigan north of I-96 is 2.5 oz/A. • DO NOT apply *Envive* at rates greater than 2.5 oz/A to soils with a composite pH between 7.1 and 7.6. • DO NOT apply to soils with a composite pH exceeding 7.6. • DO NOT apply after soybean emergence or death or severe injury may occur. • DO NOT tank mix with Group 15 herbicides such as metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products within 14 days of planting, unless soybeans are planted under no-till or minimum till conditions on wheat stubble or no-till field corn stubble. • Envive can be tank mixed with pendimethalin *(Prowl)* for annual grass control. • Tomatoes may be transplanted 12 months after *Envive* application. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	cloransulam-methyl *(FirstRate)*	0.031	0.6 oz 84WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • Excellent common and giant ragweed control. • Product rate depends on soil organic matter. If soil organic matter is greater than 3.0%, *FirstRate* can be applied at 0.75 oz/A. • The cumulative application rate may not exceed 1.05 oz/A per season. • Tank mixtures or prepackaged herbicide mixes are needed for eastern black nightshade and annual grass control. • *FirstRate* will not control ALS-resistant weed species. • Thirty months and a successful bioassay are required prior to planting sugar beets, cucumbers, and tomatoes. • Refer to label and Table 12 for crop rotation restrictions.
	linuron *(Lorox DF)* OR *(Linex)*	0.75	1.5 lb 50DF OR 1.5 pt 4L	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings • If heavy rainfall occurs soon after application, injury to the crop may result. • DO NOT use on coarse-textured sandy or sandy loam soils or on soils with less than 1% organic matter. • Plant soybeans at least 1.75 inches deep. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Refer to label and Table 12 for crop rotation restrictions.
	metribuzin *(Metribuzin, others)*	0.375	8 oz 75DF	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • *Metribuzin* use rates are dependent on soil texture, organic matter, and pH. A lower rate of 5.33 oz/A can be applied in tank mixtures or as part of a 2-pass program in glufosinate or glyphosate-resistant soybean. • DO NOT use if soil pH is greater than 7.5, or if soil organic matter is less than 0.5%, or on course-textured soils with less than 2% organic matter. • Some soybean varieties have low tolerance to metribuzin and should not be planted. Consult product labels, MSUE or agribusiness for a listing of varieties. • Tank mixtures or prepackaged herbicide mixes are needed for eastern black nightshade and annual grass control. • *Metribuzin* will not control triazine-resistant weed species. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	saflufenacil + imazethapyr *(OpTill)*	0.085	2 oz 68WG	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • DO NOT apply after soybean emergence or severe crop injury will occur. • Tank mixtures with organophosphate or carbamate insecticides can cause temporary injury. • DO NOT apply to coarse-textured soils with less than 2% organic matter unless soybean is planted 1 month after application. • DO NOT tank mix or apply *OpTill* within 30 days of products containing flumioxazin *(Valor)*, sulfentrazone *(Authority or Spartan)* or fomesafen *(Reflex)*. • DO NOT tank mix with products containing clomazone *(Command)*. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • Applying a full rate of products containing chlorimuron, chloransulam, flumetsulam, imazaquin or imazethapyr the same year as *OpTill* may increase the risk of injury to sensitive follow crops. • Forty months and a successful bioassay are required before planting sugar beets, cucumbers and tomatoes. • Refer to label and Table 12 for additional crop rotation restrictions.
	imazethapyr *(Pursuit)*	0.063	4 oz 2L	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • Common ragweed may only be suppressed; tank mixtures or a sequential herbicide program is needed to improve ragweed control. • Pursuit will not control ALS-resistant weed species. • Pursuit is very persistent and can limit rotational crops. • Forty months and a successful bioassay are required prior to planting sugar beets, cucumbers, and tomatoes. • Refer to label and Table 12 for crop rotation restrictions.
	flumetsulam *(Python, Accolade)*	0.057	1.14 oz 80WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • Adjust application rate according to soil type and organic matter. • DO NOT apply to areas where soil pH is greater than 7.8 or to soils with greater than 5% organic matter and pH less than 5.9. • Tank mixtures or sequential herbicide programs are needed to improve control of ragweed, cocklebur and jimsonweed. • *Python*/Accolade will not control ALS-resistant weed species. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	sulfentrazone *(Spartan)*	0.25	8 oz 4L	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • *Spartan* use rates are based on soil texture, organic matter, and pH. *Spartan* rates range from 4.5 to 12 oz/A (8 oz/A). Reduced rates of 4.5 to 6 oz/A can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • Apply within 3 days of planting. DO NOT apply after soybean cracking or emergence — severe injury or death may occur. • Soybean stunting may occur if excessive rainfall occurs after application but before soybeans emerge. • Some soybean varieties are sensitive to sulfentrazone. Consult your local seed dealer for information. • DO NOT apply to soils with pH of 7.5 or greater or on sands with less than 1% organic matter. • Tank mixtures or sequential herbicide programs can be used to improve the weed control spectrum. • Refer to label and Table 12 for crop rotation restrictions.
	carfentrazone + sulfentrazone *(Spartan Charge)*	0.22	8 oz 3.5SC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Spartan Charge* use rates are based on soil texture, organic matter, and pH. *Spartan Charge* rates range from 5.75 to 8.5 oz/A (8 oz/A). A reduced rate of 6 oz/A can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • This product is best used as part of burndown program in no-till soybean (see Table 2O). • DO NOT apply after soybean cracking or emergence – severe injury or death may occur. • DO NOT apply to soils with pH of 7.5 or greater or on sands with less than 1% organic matter. • Soybean stunting may occur if excessive rainfall occurs after application but before soybean emergence. • Some soybean varieties are sensitive to sulfentrazone. Consult your local seed dealer for information. • Tank mixtures or sequential herbicide programs can be used to improve the weed control spectrum. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	flumioxazin + cloransulam-methyl *(Surveil)*	0.105	3.5 oz 48WG	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Surveil* use rates range from 2.1-4.2 oz/A. A lower rate of 2.8 oz/A can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • Apply within 3 days of planting. DO NOT apply after soybean cracking or emergence – severe injury or stand reduction may occur. • Sequential herbicide programs are needed to increase the spectrum of weed control and for season-long control. • Crop injury may occur when applied to poorly drained soils and/or under cool, wet conditions. • DO NOT tank mix with Group 15 herbicides such as metolachlor *(Dual)*, dimethenamid *(Outlook)*, acetochlor *(Warrant)*, or pyroxasulfone *(Zidua)* products within 14 days of planting, unless soybeans are planted under no-till or minimum till conditions on wheat stubble or no-till field corn stubble. • Refer to label and Table 12 for crop rotation restrictions.
	chlorimuron-ethyl + thifensulfuron-methyl *(Synchrony XP)*	0.027	1.5 oz 28.4WG	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Synchrony XP* use rates range between 1 and 3 oz/A; use a minimum of 1.25 oz/A for residual control or suppression of labeled weeds. • DO NOT apply *Synchrony XP* at rates greater than 1 oz/A to soils with a composite pH between 7.1 and 7.6; use of higher rates may result in unacceptable injury to the following crop. • DO NOT apply to soils with a composite pH exceeding 7.6. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • *Synchrony XP* will not control ALS-resistant weed species. • Rotation intervals are dependent on soil pH and rate. Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	chlorimuron + flumioxazin + metribuzin *(Trivence)*	0.31	8 oz 61.3WG	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Trivence* use rates range between 6 and 8 oz/A for portions of Michigan south of State Road 46. The maximum use rate of *Trivence* for portions north of State Road 46 is 6 oz/A. • If soil pH is greater than 7, do not exceed 6 oz/A of *Trivence*. • DO NOT use *Trivence* if soil pH exceeds 7.6. • Crop injury may occur from applications made to poorly drained soils under cool, wet conditions. • DO NOT apply after soybean emergence or death or severe injury may occur. • DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products within 14 days of planting, unless soybeans are planted under no-till or minimum tillage conditions on wheat stubble or no-till field corn stubble or crop injury will occur. • Refer to label and Table 12 for crop rotation restrictions.
	flumioxazin *(Valor, Rowel)* OR *(Valor EZ)*	0.08	2.5 oz 51WG OR 2.5 oz 4L	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • *Valor/Valor EZ/Rowel* use rates range from 2 to 3 oz/A (2.5 oz/A). A reduced rate of 2 oz/A can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • Soils with high organic matter and/or high clay content may require 3 oz/A. • Apply within 3 days of planting. DO NOT apply after soybean cracking or emergence — severe injury or death may occur. • Crop injury may occur when applied to poorly drained soils and/or under cool, wet conditions. • DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products – crop injury will occur. Under no-till or reduced till conditions these tank mixtures can be made if there is 14 days between application and planting or if there is 14 days between application of *Valor/Valor EZ/Rowel* and applications of these other products. • Can be tank mixed with pendimethalin *(Prowl)* for annual grass control. • Crop rotation restrictions are dependent on rainfall, use rate and tillage. • Rotation restrictions for 2 oz or less are 1 month with 1 inch of rain for corn and winter wheat. Dry bean and barley may be planted after 3 months, and alfalfa, oats and sugar beets may be planted after 4 months if the ground is tilled prior to planting or 8 months if no tillage is performed. • Rotation restrictions for the higher use rates (3 oz or less) can be found in Table 12. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	flumioxazin + chlorimuron-ethyl *(Valor XLT, Rowel FX)*	0.1	4 oz 40.3WG	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Valor XLT/Rowel FX* use rates range from 3 to 5 oz/A (4 oz/A). A reduced rate of 3 oz/A can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • DO NOT apply at rates greater than 2.5 oz/A to soils with a composite pH greater than 6.8. Weeds will only be suppressed at this rate. • DO NOT apply to soils with a composite pH exceeding 7.6. • DO NOT apply after soybean emergence or death or severe injury may occur. • DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products – crop injury will occur. Under no-till or reduced till conditions these tank mixtures can be made if there is 14 days between application and planting or if there is 14 days between application of *Valor XLT/Rowel FX* and applications of these other products. • Can be tank mixed with pendimethalin *(Prowl)* for annual grass control. • Tomatoes may be transplanted 12 months after *Valor XLT/ Rowel FX* application. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses **Annual broadleaves**	s-metolachlor + metribuzin *(Boundary 6.5EC)*	1.625	2 pt 6.5EC	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Boundary 6.5EC* use rates are based on soil texture, organic matter, and pH. *Boundary 6.5EC* rates range from 1.2 to 2.4 pt/A (2 pt/A). A reduced rate of 1.5 pt/A can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. • DO NOT use *Boundary 6.5EC* at rates greater than 1.5 pt/A on soils with pH above 7. • DO NOT use on sands or soils with less than 0.5% organic matter. DO NOT use on loamy sand soils with less than 2% organic matter. • Some soybean varieties have low tolerance to metribuzin and should not be planted. Consult product labels, MSUE, or agribusiness for a listing of varieties. • *Boundary* will provide 3-6 weeks of weed control. Increase application rate, use tank mixtures or use in a sequential herbicide program to increase the length of control. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves**	s-metolachlor + sulfentrazone *(BroadAxe XC)*	1.75	32 oz 7L	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *BroadAxe XC* use rates are based on soil texture, organic matter, and pH. Use rates range from 19 to 25 oz/A for course textured soils; 25 to 32 oz/A for medium textured soils; and 25 to 38.7 oz/A for fine textured soils. For soils with pH greater than 7.2 use the lowest rate for that specific soil texture and organic matter. • DO NOT apply on soils classified as sands, which have less than 1% organic matter. • Apply within 3 days of soybean planting. DO NOT apply after soybean cracking or emergence – severe injury or death may occur. • Some soybean varieties are sensitive to sulfentrazone. Consult your local seed dealer for information. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • *BroadAxe XC* can be tank-mixed with 1 oz/A of *Sharpen* in reduced and no-till soybean if it is applied 14 days prior to planting. DO NOT apply this tank-mixture to course textured soils with 2% organic matter or less. • Refer to label and Table 12 for crop rotation restrictions.
	clomazone *(Command 3ME)*	0.75	2 pt 3ME	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • Poor weed control will result if *Command 3ME* is incorporated. • Several ornamental, horticultural and agronomic crops are sensitive to *Command* spray drift and volatilization. • Precautions should be taken to avoid spray drift. • DO NOT apply *Command* within 1,200 ft. of housing developments, commercial fruit and vegetable production, and greenhouses. • DO NOT apply in winds above 10 mph or at pressures above 30 PSI. • **Special precaution:** A special sprayer clean-out procedure is required for *Command 3ME*. See label for specific instructions. • Tomatoes may be transplanted 9 months after *Command* application, but the rotation restriction for tomatoes grown from seed is 12 months. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves**	pyroxasulfone + flumioxazin *(Fierce)*	0.133	3 oz 76WG	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply *Fierce* at 3 or 3.75 oz/A depending on soil type and application timing. • DO NOT apply after soybean cracking or emergence – severe injury or death may occur. • Crop injury may occur when *Fierce* is applied to poorly drained soils and/or under cool, wet conditions. • DO NOT tank mix or apply with metolachlor *(Dual)* or dimethenamid *(Outlook)* products – crop injury will occur. • The rotation restriction for *Fierce* at 3 oz/A is 7 days for no-till field corn and 30 days for conventional till field corn or if *Fierce* is applied at 3.75 oz/A. Refer to Table 12 for additional crop rotation restrictions.
	chlorimuron + flumioxazin + pyroxasulfone *(Fierce XLT)*	0.16	4 oz 62.41WG	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply *Fierce XLT* at 4 oz/A as part of a 2-pass program. • DO NOT apply *Fierce XLT* to soils with a composite pH greater than 6.8. • DO NOT apply after soybean cracking or emergence – severe injury or death may occur. • Crop injury may occur when Fierce XLT is applied to poorly drained soils and/or under cool, wet conditions. • DO NOT tank mix or apply with metolachlor *(Dual)* or dimethenamid *(Outlook)* products – crop injury will occur. • Refer to Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves**	saflufenacil + imazethapyr + dimethenamid-P *(OpTill PRO)*	0.085 + 0.47	2 oz 68WG + 10 oz 6EC	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • DO NOT apply after soybean emergence or severe crop injury will occur. • The lower use rate of *Outlook* (dimethenamid-P) in *OpTill PRO* will likely only provide early-season annual grass control. • Tank-mixtures with organophosphate or carbamate insecticides can cause temporary injury. • DO NOT apply to coarse textured soils with less than 2% organic matter, unless soybean is planted 1 month after application. • DO NOT apply more than 21 oz/A of the liquid component (dimethenamid-P) of *OpTill PRO* per season. • DO NOT tank-mix or apply *OpTill PRO* within 30 days of flumioxazin *(Valor)*, sulfentrazone *(Authority* or *Spartan)*, or fomesafen *(Reflex)* containing products. • DO NOT tank-mix with clomazone *(Command)* containing products. • Tank mixtures or sequential herbicide programs are needed to increase the spectrum of weed control. • One month is required before planting soybean if *OpTill PRO* is applied to course textured soils with less than 2% organic matter. • Applying a full rate of products containing chlorimuron, cloransulam, flumetsulam, imazaquin, or imazethapyr the same year as *OpTill PRO* may increase the risk of injury to sensitive follow crops. • Forty months and a successful bioassay are required prior to planting sugar beets, cucumbers, and tomatoes. • Refer to label and Table 12 for additional crop rotation restrictions.
	s-metolachlor + fomesafen *(Prefix)*	1.32	2 pt 5.29L	• **May be applied preplant, preplant incorporated or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Prefix* will provide 4-5 weeks of control and/or suppression of both broadleaf and grass weeds. • Sequential herbicide programs are needed to increase the spectrum of weed control and for season-long control. • May be applied postemergence on soybeans, but there is a 90 day preharvest interval. Refer to Table 2B and the postemergence application section for more information. • DO NOT apply more than 0.24 lb ai/A of fomesafen (from any fomesafen containing product) (i.e., 1 pt/A of Reflex) to the same field in CONSECUTIVE years. • Refer to Table 12 for crop rotation restrictions.

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Soybean – Soil Applied – All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves**	acetochlor + fomesafen *(Warrant Ultra)*	1.3	50 oz 3.45CS	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Warrant Ultra* will provide 4-5 weeks of control and/or suppression of both broadleaf and/or suppression of both broadleaf and grass weeds. • Sequential herbicide programs are needed to increase the spectrum of weed control and for season-long control. • Crop injury may result when soil conditions are cold and wet, or waterlogged. • *Warrant Ultra* can be applied postemergence up to R2 soybean. Refer to Table 2B and the postemergence application section for more information. • DO NOT apply more than 3 lb ai/A of acetochlor (i.e., 4 qt/A of Warrant) per season. • DO NOT apply more than 0.24 lb ai/A of fomesafen (from any fomesafen containing product) (i.e., 1 pt/A of Reflex) to the same field in CONSECUTIVE years. • Refer to label and Table 12 for crop rotation restrictions.
	saflufenacil + imazethapyr + pyroxasulfone *(Zidua PRO)*	0.19	6 oz 4.09SC	• **May be applied preplant or preemergence.** • Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • *Zidua PRO* can be applied at rates from 4.5 to 6 oz/A. • DO NOT apply on course textured soils with ≤ 2% organic matter, unless soybean is planting 1 month after application. • DO NOT apply after soybean emergence or severe crop injury will occur. • DO NOT tank-mix or apply *Zidua PRO* within 30 days of flumioxazin (*Valor*), sulfentrazone (*Authority* or *Spartan*), or fomesafen (*Reflex*) containing products. • Applying a full rate of products containing chlorimuron, cloransulam, flumetsulam, imazaquin, or imazethapyr the same year as *Zidua PRO* may increase the risk of injury to sensitive follow crops. • Forty months and a successful bioassay are required prior to planting sugar beets, cucumbers, and tomatoes. • Refer to Table 12 for crop rotation restrictions.

Soybean – Postemergence Grass and Volunteer Corn Control

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Grasses **Volunteer corn**	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate	0.044	7 oz 0.88L + 1%	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2L for application rates and maximum weed sizes. • Apply with crop oil concentrate (1% v/v) for best results. • A non-ionic surfactant (0.25% v/v) may be used to replace crop oil concentrate with certain tank mixes. • Allow 80 days between application and soybean harvest. • For perennial grass control, higher rates and sequential applications may be needed (Table 2L). • Tank mix 5 oz/A of *Assure II/Targa* with glyphosate products (Table 10) to control glyphosate-resistant corn in glyphosate-resistant soybean. Include ammonium sulfate (17 lb/100 gal) and a minimum of 0.125% v/v of non-ionic surfactant with glyphosate products with built-in adjuvant systems. • Refer to Table 2M and the label for rates and additives for tank mixes with various postemergence broadleaf herbicides. • Tank mixes with *Pursuit* and *Raptor* are not recommended – grass antagonism will occur. • Grass antagonism can occur with tank mixes of postemergence broadleaf herbicides. Increasing the rate by 2 oz/A will improve grass control in certain tank mixes. Sequential applications are more effective. Apply the postemergence grass herbicide 1 day prior to the broadleaf herbicide(s) — if the broadleaf herbicide is applied first, wait 7 days or until the grasses are actively growing before applying the grass herbicide. • Refer to label and Table 12 for crop rotation restrictions.
	fluazifop-P-butyl *(Fusilade DX)* + crop oil concentrate	0.188	12 oz 2L + 0.5-1%	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2L for application rates and maximum weed sizes. • Tank mix 4-6 oz/A of *Fusilade DX* with glyphosate products (Table 10) to control glyphosate-resistant corn in glyphosate-resistant soybean. Include ammonium sulfate (17 lb/100 gal). DO NOT add crop oil concentrate. • DO NOT apply more than 24 oz/A to soybeans prebloom or 6 oz/A from bloom through post-bloom. • Two applications 7-14 days apart are usually needed for control of perennial grasses. • Refer to Table 2M and the label for rates and additives for tank mixes with various postemergence broadleaf herbicides. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Grass antagonism can occur with tank mixes with post-emergence broadleaf herbicides. Sequential applications are more effective. Apply the postemergence grass herbicide 3 days prior to the broadleaf herbicide(s) — if the broadleaf herbicide is applied first, wait 7 days or until the grasses are actively growing before applying the grass herbicide. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean — Postemergence Grass and Volunteer Corn Control *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Grasses **Volunteer corn**	fluazifop-P-butyl + fenoxaprop *(Fusion)* + crop oil concentrate	0.166	8 oz 2.56EC + 0.5–1%	• Refer to Table 2B for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Refer to Table 2L for application rates and maximum weed sizes. • A non-ionic surfactant (0.25-0.5% v/v) may be used to replace crop oil concentrate with certain tank mixes; 28% liquid nitrogen or ammonium sulfate may also be added to improve control. • Apply before soybeans bloom. • For perennial grass control, two applications 14-21 days apart may be needed, depending on target weed (Table 2L). • Tank mix 4-6 oz/A of *Fusion* with glyphosate products (Table 10) to control glyphosate-resistant corn in glyphosate-resistant soybean. Include ammonium sulfate (17 lb/100 gal). DO NOT add crop oil concentrate. • Refer to Table 2M and the label for rates and additives for tank mixes with various postemergence broadleaf herbicides. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Grass antagonism can occur with tank mixes of postemergence broadleaf herbicides. Sequential applications are more effective. Apply the postemergence grass herbicide 1 day prior to the broadleaf herbicide(s) — if the broadleaf herbicide is applied first, wait 7 days or until the grasses are actively growing before applying the grass herbicide. • Refer to label and Table 12 for crop rotation restrictions.
	sethoxydim *(Poast)* OR *(Poast Plus)* + crop oil concentrate + ammonium sulfate	0.19	 16 oz 1.5SC OR 24 oz 1SC + 1 qt + 2.5 lb	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2L for application rates and maximum weed sizes. • Allow 75 days between application and soybean harvest. • *Poast* and *Poast Plus* are not as effective for control of volunteer corn or perennial grasses as the other post-emergence grass herbicides. • Two applications 7-14 days apart are usually needed for control of perennial grasses. • Refer to Table 2M and the label for rates and additives for tank mixes with various postemergence broadleaf herbicides. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Grass antagonism can occur with tank mixes with post-emergence broadleaf herbicides. Sequential applications are more effective. Apply the postemergence grass herbicide 1 day prior to the broadleaf herbicide(s) — if the broadleaf herbicide is applied first, wait 7 days or until the grasses are actively growing before applying the grass herbicide. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence Grass and Volunteer Corn Control *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Grasses **Volunteer corn**	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + surfactant + ammonium sulfate	0.094 0.068	6 oz 2EC + 1% OR 9 oz 0.97EC + 0.25% + 2.5 lb	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2L for application rates and maximum weed sizes. • Use only crop oil concentrate with applications of *Select/Arrow*. • Allow 60 days between application and soybean harvest. • For perennial grass control, higher rates and sequential applications may be needed (Table 2L). • Tank mix 4 oz/A of *Select/Arrow* or 6 oz/A of *SelectMax* with glyphosate products (Table 10) to control glyphosate-resistant corn in glyphosate-resistant soybean. Include ammonium sulfate (17 lb/100 gal). • Refer to Table 2M and the label for rates and additives for tank mixes with various postemergence broadleaf herbicides. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Grass antagonism can occur with tank mixes of postemergence broadleaf herbicides. Sequential applications are more effective. Apply the postemergence grass herbicide 1 day prior to the broadleaf herbicide(s) — if the broadleaf herbicide is applied first, wait 7 days or until the grasses are actively growing before applying the grass herbicide • Refer to label and Table 12 for crop rotation restrictions.

Soybean – Postemergence for Broadleaf Weeds

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	pyroxasulfone + fluthiacet *(Anthem MAXX)* + crop oil concentrate	0.1	3 oz 4.3SE + 1%	• Refer to Table 2B for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply from planting through the V3 (3 trifoliates) stage. • Application rates vary by soil type. *Anthem MAXX* rates range from 2 to 5.5 oz/A (3 oz/A). • Refer to Table 2I for maximum weed sizes for *Anthem MAXX*. • 28% liquid nitrogen (1-2 qt/A) or ammonium sulfate (2-2.5 lb/A) may be added to crop oil concentrate (1% v/v) to enhance weed control (Table 2J). • The pyroxasulfone component of *Anthem MAXX* will provide residual control of grass and small seeded broadleaf weeds. • Tank mixtures with other herbicides will be needed to broaden the spectrum of weed control. • Refer to Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	bentazon *(Basagran, Broadloom)* + crop oil concentrate +/OR ammonium sulfate	1	2 pt 4L + 1 qt +/OR 2.5 lb	• Refer to Table 2B for weed control and crop tolerance ratings. • Most effective on small weeds. Rate can be reduced to 1.5 pt/A if weeds are smaller than maximum growth stage (Table 2I). • 3 pt/A can suppress cocklebur up to 24 inches and velvetleaf up to 12 inches. • Use a minimum of 20 gal. water/A for adequate coverage. • DO NOT apply if soybeans are under stress from herbicide injury, cold or dry weather, or hail damage. • For improved velvetleaf control, 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2.5 lb/A) can be used INSTEAD OF crop oil concentrate. However, if common ragweed and common lambsquarters are present, a crop oil concentrate must also be included (Table 2J). • Split applications (1.5 pt + 1.5 pt) plus crop oil concentrate (1 qt + 1 qt) can be used to control yellow nutsedge and Canada thistle. Applications should be made approximately 10 days apart. For improved Canada thistle control, increase rate to 1 qt for each application. • Allow 30 days between application and soybean harvest. • *C*an be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control (Table 2J). • *C*an be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.
	fluthiacet-methyl *(Cadet)* + crop oil concentrate	0.0065	0.9 oz 0.91EC + 1%	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2I for maximum weed sizes. • 28% liquid nitrogen (1-2 qt/A) or ammonium sulfate (2-2.5 lb/A) may be added to crop oil concentrate (1% v/v) to enhance weed control (Table 2J). • *Cadet* can be applied to soybean only between the first trifoliate and full flowering. • *Cadet* can be applied at 0.5 oz/A when tank mixed with other herbicides for additional broadleaf weed control. • DO NOT apply more than 1.25 oz/A of *Cadet* per cropping season. • Allow 60 days between *Cadet* application and soybean harvest. • *Cadet* can be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	chlorimuron-ethyl *(Classic)* + crop oil concentrate + ammonium sulfate	0.0106	0.67 oz 25WG + 1% + 2-4 lb	• Refer to Table 2B for weed control and crop tolerance ratings. • Labeled rates of 0.5-0.75 oz/A are most effective on small weeds (Table 2I). • For optimal rotational flexibility on soils with pH greater than 7.0, apply no more than 1 oz/A of *Classic* per season. On soils with a pH of 7.0 or less, a maximum of 1.5 oz/A of *Classic* can be applied during the growing season. When the rate of *Classic* is 0.33 oz/A or less, shorter rotation restrictions for alfalfa, cucumber, and watermelon are available. • *Classic* can be applied at 0.25 or 0.33 oz/A when tank mixed with Harmony or glyphosate. • Apply after the first trifoliate leaf of soybean has fully expanded. • Apply with crop oil concentrate (1% v/v) or non-ionic surfactant (0.125-0.25% v/v) plus 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2-4 lb/A). • Crop oil concentrate provides better control under hot conditions. However, increased injury may result (Table 2J). • DO NOT apply to soybeans or weeds under stress from herbicide injury or cold or dry weather — crop injury or poor weed control may result. Delay application until the stress passes. • 0.75 oz/A is required for Jerusalem artichoke control. • Allow 60 days between *Classic* application and soybean harvest. • *Classic* will not control ALS-resistant weed species. • *Classic* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control (Table 2K). • *Classic* can be tank mixed for postemergence grass control (Table 2M). • Soil pH and *Classic* use rates are critical for rotational crops (see label). • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	lactofen *(Cobra)* + crop oil concentrate	0.125	8 oz 2EC + 0.5%	• Refer to Table 2B for weed control and crop tolerance ratings. • *Cobra* can be applied at 8-12.5 oz/A when tank mixed with other herbicides or when applied alone. Refer to Table 2I for maximum weed sizes. • Higher rates of *Cobra* 10 to 12.5 fl oz/A is needed to control herbicide-resistant Palmer amaranth and common waterhemp. • DO NOT apply to soybeans in the cotyledon stage. • DO NOT apply to soybeans or weeds under stress from herbicide injury, cold or dry weather, or hail damage — crop injury or poor weed control may result. Delay application until the stress passes. • *Cobra* causes more soybean leaf burn than other post-emergence herbicides. • For best results, apply with crop oil concentrate (0.25-1.0% v/v), depending on environmental conditions (see label). Surfactant (0.25% v/v), may be substituted for crop oil concentrate when weeds are actively growing under high temperature, high humidity and high soil moisture conditions (Table 2J). • Apply at a minimum of 20 gal. water/A at 40 psi. • Allow 45 days between *Cobra* application and soybean harvest. • *Cobra* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2K). • *Cobra* can be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.
	cloransulam-methyl *(FirstRate)* + surfactant + ammonium sulfate	0.016	0.3 oz 84WG + 0.25% + 8.5-17 lb/100 gal	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2I for maximum weed sizes. • *FirstRate* use rates range from 0.3-0.6 oz/A. • Applications prior to first trifoliate stage may cause temporary yellowing. • Apply before soybean reach the R2 growth stage. • Apply with non-ionic surfactant (0.125-0.25% v/v) plus 28% nitrogen liquid (2.5% v/v) or ammonium sulfate (8.5-17 lb/100 gal). Apply with crop oil concentrate (1.2% v/v) when weeds are stressed by hot and dry conditions; soybean injury will be more severe (Table 2J). • 28% liquid nitrogen or ammonium sulfate must be added for velvetleaf control. • Allow 70 days between *FirstRate* application and soybean harvest or 25 days if soybean is used for forage or hay. • *FirstRate* will not control ALS-resistant weed species. • *FirstRate* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2K). • *FirstRate* can be tank mixed for postemergence grass control (Table 2M). However, grass antagonism may occur under certain conditions. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	fomesafen *(Flexstar)* + crop oil concentrate + ammonium sulfate	0.25	1 pt 1.88L + 0.5-1.0% + 8.5 lb/100 gal	• Refer to Table 2B for weed control and crop tolerance ratings. • *Flexstar* can be applied only in the lower peninsula of Michigan. • DO NOT apply *Flexstar* or other fomesafen products to the same field in CONSECUTIVE years. • *Flexstar* is *Reflex* formulated with additional surfactants. • *Flexstar* is most effective when weeds are small (Table 2H). • *Flexstar* can be reduced to 0.75 pt/A to control certain smaller weeds (Table 2I). • Apply with crop oil concentrate (0.5-1.0% v/v) or non-ionic surfactant (0.25-0.5% v/v). 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (8.5 lb/100 gal) can be added to either crop oil concentrate or surfactant for improved weed control (Table 2J). • Apply at 10-20 gal. water/A at 30-60 psi. • *Flexstar* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2K). • *Flexstar* can be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.
	thifensulfuron-methyl *(Harmony SG)* + surfactant + ammonium sulfate	0.004	0.125 50WG + 0.125-0.25% + 2-4 lb	• Refer to Table 2B for weed control and crop tolerance ratings. • *Harmony* is most effective on small weeds (Table 2I). • Apply after the first trifoliate leaf of soybeans has fully expanded. • Applications of *Harmony* may cause temporary wilting, leaf yellowing, and stunting. • DO NOT apply to soybeans or weeds under stress from weed control may result. Delay application until the stress passes. • Allow 60 days between *Harmony* application and soybean harvest. • Apply with non-ionic surfactant (0.125-0.25% v/v) or crop oil concentrate (1% v/v) plus 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2-4 lb/A). The addition of a nitrogen source is required for velvetleaf control. • Under dry conditions, *Harmony* can be applied with crop oil concentrate, but soybean injury is likely to be more severe. • Use a minimum of 10 gal. water/A. For heavy weed pressure, increase volume to 15 gal/A. • *Harmony* will not control ALS-resistant weed species. • *Harmony* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2K). • *Harmony* can be tank mixed for postemergence grass control (Table 2M). • **Special precaution:** A special sprayer clean-out procedure is required (see label). • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	fluthiacet + fomesafen *(Marvel)* + crop oil concentrate	0.17	7.25 fl oz 3L + 1%	• Refer to Table 2A for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • 28% liquid nitrogen (1-2 qt/A) or ammonium sulfate (2.5 lb/A) may be added to enhance weed control. • Apply *Marvel* from the first trifoliate through full flower (prior to R3 stage). • Allow 60 days between *Marvel* application and soybean harvest. • *Marvel* can be tank mixed for postemergence grass control (Table 2M). • DO NOT apply more than 0.24 lb ai/A of fomesafen (from any fomesafen containing product) (i.e., 1 pt/A of *Reflex*) to the same field in CONSECUTIVE years. • Refer to Table 12 for crop rotation restrictions.
	lactofen *(Phoenix)* + surfactant	0.195	12.5 oz 2EC + 0.125%	• Refer to Table 2B for weed control and crop tolerance ratings. • *Phoenix* can be applied at 8-12.5 oz/A when tank mixed with other herbicides or when applied alone. Refer to Table 2I for maximum weed sizes. • *Phoenix* is *Cobra* formulated with additional surfactants. • DO NOT apply to soybeans or weeds under stress from herbicide injury, cold or dry weather, or hail damage — crop injury or poor weed control may result. Delay application until the stress passes. • Apply with non-ionic surfactant (0.125-0.25% v/v). Crop oil concentrate (1 pt/A) is recommended when weeds are stressed by hot and dry conditions, though soybean injury will be more severe (Table 2J). • Apply early when the soybean canopy doesn't interfere with coverage. • Allow 45 days between *Phoenix* application and soybean harvest. • *Phoenix* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2K). • *Phoenix* can be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.
	s-metolachlor + fomesafen *(Prefix)* + surfactant	1.32	2 pt 5.29L + 0.25%	• Refer to Table 2B for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply from planting up until 90 day prior to harvest. • Postemergence applications may cause temporary leaf bronzing and crinkling. • Refer to Table 2H for maximum weed sizes for Prefix. • Include 0.25% v/v of a non-ionic surfactant unless applied with glyphosate with a built-in adjuvant. DO NOT use crop oil concentrate or soybean injury will be increased (Table 2I). • The s-metolachlor component of Prefix will provide residual control of grass and small seeded broadleaf weeds. • DO NOT apply more than 0.24 lb ai/A of fomesafen (from any fomesafen containing product) (i.e., 1 pt/A of *Reflex*) to the same field in CONSECUTIVE years. • Refer to Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	imazethapyr *(Pursuit)* + crop oil concentrate + ammonium sulfate	0.063	4 oz 2L + 1% + 12-15 lb/100 gal	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2I for maximum weed sizes. • Apply with crop oil concentrate (1% v/v) or non-ionic surfactant (0.25% v/v) plus 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (12-15 lb/100 gal) (Table 2I). • Will control yellow and green foxtails, barnyardgrass and crabgrass up to 3 inches tall, and giant foxtail up to 6 inches tall. • Apply after the first trifoliate leaf of soybeans has fully expanded. • Allow 85 days between *Pursuit* application and soybean harvest. • *Pursuit* will not control ALS-resistant weed species. • *Pursuit* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2K). • *Pursuit* can be tank mixed with postemergence grass herbicides for volunteer corn control only (Table 2M). • *Pursuit* is very persistent and can limit rotational crops. Refer to label and Table 12 for crop rotation restrictions.
	imazamox *(Raptor)* + crop oil concentrate + ammonium sulfate	0.04	5 oz 1L + 1% + 12-15 lb/100 gal	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2I for maximum weed sizes. • Apply with crop oil concentrate (1% v/v) or non-ionic surfactant (0.25% v/v) plus 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (12-15 lb/100 gal) (Table 2J). • Apply after the first trifoliate leaf of soybeans has fully expanded but before soybean bloom. • Will control barnyardgrass, foxtails and panicum but ONLY SUPPRESS crabgrass. • Application rate must be 5 oz/A for annual grass and common lambsquarters control OR apply *Prowl* preemergence for control of these weeds. • Common ragweed less than 3 inches will be suppressed. • Increase common ragweed control by tank mixing with *Cobra* (4-6 oz/A), *Ultra Blazer* (8-16 oz/A), or *Flexstar* (6-8 oz/A). Higher rates can cause grass antagonism (Table 2J). • *Raptor* will not control ALS-resistant weed species. • DO NOT tank mix with postemergence grass herbicides unless for volunteer corn — antagonism will occur and grass control will equal that of *Raptor* alone. • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	fomesafen *(Reflex)* + crop oil concentrate + ammonium sulfate	0.25	1 pt 2L + 1% + 10 lb/100 gal	• Refer to Table 2B for weed control and crop tolerance ratings • *Reflex* can be applied only in the lower peninsula of Michigan. • DO NOT apply *Reflex* or other fomesafen products to the same field in CONSECUTIVE years. • *Reflex* is most effective when weed are small (Table 2I). • *Reflex* can be reduced to 0.75 pt/A to control certain smaller weeds (Table 2I). • Apply with crop oil concentrate (0.5-1.0% v/v) or non-ionic surfactant (0.25-0.5% v/v). 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (10 lb/100 gal) can be added to either crop oil concentrate or surfactant for improved weed control (Table 2J). • Apply at 10-20 gal. water/A at 30-60 psi. • *Reflex* can be tank mixed with many postemergence soybean herbicides for additional broadleaf weed control. Follow label directions closely regarding spray additives (Table 2K). • *Reflex* can be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.
	flumiclorac *(Resource)* + crop oil concentrate	0.041	6 oz 0.86L + 1 qt	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2I for maximum weed sizes. • 28% liquid nitrogen (1-2 qt/A) or ammonium sulfate (2-2.5 lb/A) may be added to crop oil concentrate (1 qt/A) to enhance weed control. • *Resource* can be applied at 2-4 oz/A when tank mixed with other herbicides for additional broadleaf weed control (Table 2K). • Allow 60 days between *Resource* application and soybean harvest. • *Resource* can be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	chlorimuron-ethyl + thifensulfuron-methyl *(Synchrony XP)* + crop oil concentrate + ammonium sulfate	0.013	0.75 oz 28.4WG + 1% + 2 lb	• Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2I for maximum weed sizes. • ONLY apply 0.75 oz/A of *Synchrony XP* to STS SOYBEANS. • *Synchrony XP* at 0.375 oz/A can be applied to NON-STS soybeans. DO NOT use crop oil concentrate. Instead, use a non-ionic surfactant at 0.25% v/v. • See Table 2C for individual product rate equivalents for the premix. • Apply after the first trifoliate leaf of soybeans has fully expanded. • For eastern black nightshade control, add *Cobra* (4-6 oz/A) or *Reflex* or *Flexstar* (1 pt/A) or *Ultra Blazer* (1 pt/A) or *Pursuit* (2 oz/A). Reduce the rate of crop oil concentrate to 0.5% if tank mixed with *Cobra*. DO NOT use crop oil concentrate if *Pursuit* or *Ultra Blazer* is tank mixed for nightshade control (Table 2J). • Allow 60 days between *Synchrony XP* application and soybean harvest. • *Synchrony XP* will not control ALS-resistant weed species. • *Synchrony XP* will suppress pokeweed, perennial sowthistle, and dandelion. • *Synchrony XP* can be tank mixed for control of some grasses (Table 2M). • Soil pH and *Synchrony XP* use rates are critical for rotational crops (see label). • Rotation intervals are dependent on soil pH and rate. Refer to label and Table 12 for crop rotation restrictions.
	acifluorfen *(Ultra Blazer)* + surfactant OR ammonium sulfate	0.38	1.5 pt 2SC + 0.25% OR 2.5 lb	• Refer to Table 2B for weed control and crop tolerance ratings. • Most effective on small weeds (Table 2I). • Use a minimum of 20 gal. water/A for adequate coverage. • DO NOT apply if soybeans are under stress from herbicide injury, cold or dry weather, or hail damage. • 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2.5 lb/A) may be added INSTEAD OF surfactant for improved weed control. • Allow 50 days between *Ultra Blazer* application and soybean harvest. • *Ultra Blazer* can be tank mixed with most postemergence soybean herbicides for additional broadleaf weed control (Table 2K). • *Ultra Blazer* can be tank mixed for postemergence grass control (Table 2M). • Refer to label and Table 12 for crop rotation restrictions.

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Soybean – Postemergence for Broadleaf Weeds *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	acetochlor + fomesafen *(Warrant Ultra)* + surfactant	1.3	50 oz 3.45CS + 0.25%	• Refer to Table 2B for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Apply before soybean reach the R2 growth stage. • Postemergence applications may cause temporary leaf bronzing and crinkling. • Refer to Table 2I for maximum weed sizes for *Warrant Ultra*. • Include 0.25-0.5% v/v of a non-ionic surfactant unless applied with glyphosate with a built-in adjuvant. Crop oil concentrate or a methylated seed oil may be used, however soybean injury will be increased (Table 2J). • The acetochlor component of *Warrant* will provide residual control of grass and small seeded broadleaf weeds. • DO NOT apply more than 0.24 lb ai/A of fomesafen (from any fomesafen containing product) (i.e., 1 pt/A of *Reflex*) to the same field in CONSECUTIVE years. • Refer to Table 12 for crop rotation restrictions.

TABLE 2E – Weed Control in Glyphosate-Resistant Soybean

RECOMMENDATIONS: One application of glyphosate alone will not consistently provide season-long weed control. One of the following strategies is recommended:

1) Soil-applied residual herbicide applied preemergence followed by glyphosate postemergence.
   a) Preemergence herbicide options can be found in Table 2A.
   b) Glyphosate should be applied when weeds are 4 inches tall.
2) Postemergence tank-mixtures with glyphosate when weeds are 2-4 inches tall.
   a) Several soil-applied residual herbicides can be tank-mixed with glyphosate and applied postemergence. Tank-mixtures with some residual herbicides may cause temporary burn or discoloration.
   b) There are many postemergence products that can be tank-mixed with glyphosate for additional weed control. Refer to Table 2B for options.
   c) There are several premixtures containing glyphosate that can be applied postemergence to glyphosate-resistant soybean. Refer to Table 2B and the following section for options.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves** **Suppression of perennials**	glyphosate (See Table 10) + ammonium sulfate	1.13 a.e.	See Table 10 + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT SOYBEANS ONLY.** • **See above recommendations for appropriate use of glyphosate in glyphosate-resistant soybean.** • Refer to Table 2B for weed control and crop tolerance ratings. • Many glyphosate products are registered for application to glyphosate-resistant soybeans. Read the label and see Table 10 to determine application rates and additives needed for different products. • For best results apply glyphosate at 1.13 lb a.e./A. DO NOT apply below a minimum rate of 0.75 lb a.e./A. • Higher rates of glyphosate (1.5 lb a.e./A) can be applied for perennial weed control and to control larger weeds and weeds under stress. • Addition of ammonium sulfate (17 lb/100 gal) will minimize antagonism from hard water and improve weed control if weeds are under stress or large. • Glyphosate should be applied before annual weeds are 4 inches tall to reduce weed competition and maximize soybean yield. • Use extreme caution to avoid spray drift to sensitive crops. • Apply from soybean cracking through full flower (R2 soybean). • DO NOT apply more than 2.25 lb a.e./A in-crop per season. • For VOLUNTEER GLYPHOSATE-RESISTANT CORN control, tank mix glyphosate (Table 10) with *Assure II/Targa, Fusilade DX, Fusion, Select/Arrow* or *Select Max* (Table 2L). Consult product remarks and limitations in E0434 and labels for additive choices and rates. • Control of PERENNIAL BROADLEAVES will be improved with a second application of glyphosate prior to soybean full flower. • For QUACKGRASS control, treat when quackgrass is 6-8 inches tall. • For YELLOW NUTSEDGE suppression, apply glyphosate when nutsedge is 3-4 inches tall. Adding *Classic* at 0.75 oz/A OR making a second glyphosate application 2-3 weeks later will improve suppression. • The addition of micronutrient fertilizers (e.g., manganese) can antagonize glyphosate, resulting in a reduction in weed control. Avoid antagonisms by making separate herbicide and fertilizer applications or using a full-chelated form of the fertilizer and including ammonium sulfate to minimize the antagonism.

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Weed Control in Glyphosate-Resistant Soybean *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves** **Suppression of perennials**	glyphosate + imazethapyr *(Extreme)* + surfactant + ammonium sulfate	0.81	3 pt 2.17L + 0.25% + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT SOYBEANS ONLY.** • Refer to Table 2B for weed control and crop tolerance ratings. • *Extreme* is a premix of *Pursuit* + glyphosate. See Table 2C for individual product rate equivalents for the premix. • Apply to weeds up to 4 inches tall. • Apply after the first trifoliate leaf of soybean has fully expanded up to soybean bloom. • Addition of ammonium sulfate will minimize antagonism from hard water and improve weed control if weeds are under stress or large. • Use extreme caution to avoid spray drift to sensitive crops. • *Pursuit* is very persistent and can limit rotational crops. Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + fomesafen *(Flexstar GT 3.5)* + surfactant + ammonium sulfate	1.23	3.5 pt 2.82L + 0.25% + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT SOYBEANS ONLY.** • Refer to Table 2B for weed control and crop tolerance ratings. • *Flexstar GT* is a premix of *Flexstar* and glyphosate. See Table 2C for individual product rate equivalents for the premix. • DO NOT apply products containing fomesafen (*Flexstar, Flexstar GT 3.5, Prefix* or *Reflex*) to the same field in CONSECUTIVE years. • Some cosmetic bronzing and leaf crinkling can occur after application. • Best if applied when weeds are 4 inches tall or less. • Apply in 15 to 20 gal. water/A. • DO NOT apply within 45 days of soybean harvest. • Refer to label and Table 12 for additional crop rotation
	glyphosate + s-metolachlor *(Sequence)* + ammonium sulfate	1.64	2.5 pt 5.25L + 17 lb/100gal	• **APPLY TO GLYPHOSATE-RESISTANT SOYBEANS ONLY.** • Refer to Table 2B for weed control and crop tolerance ratings. • Sequence is a premix of *Dual Magnum* + glyphosate. See Table 2C for individual product rate equivalents for the premix. • Apply from soybean cracking up to 90 days prior to harvest (PHI). • Cosmetic leaf crinkling or necrotic spots may occur under certain conditions. • DO NOT apply more than 3.5 pt/A of *Sequence* per season. • Refer to label and Table 12 for crop rotation restrictions.
	acetochlor *(Warrant)* + glyphosate + ammonium sulfate	1.125 1.13 a.e.	3 pt 3CS + See Table 10 + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT SOYBEAN WHEN TANK-MIXED WITH GLYPHOSATE.** • Refer to Table 2B for weed control and crop tolerance ratings. • Apply from emergence up to R2 soybean. • *Warrant* applied alone will not control emerged weeds, but will provide residual control of annual grasses and some small seeded weed species, e.g., pigweed and nightshade. Therefore, it is recommended *Warrant* be applied with postemergence weed control products (e.g., glyphosate). • Tank-mixtures with glyphosate should be applied when weeds are 2 to 4 inches tall. • Cosmetic soybean leaf crinkling may occur under certain conditions. • DO NOT apply more than 4 qt/A of *Warrant* per season. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 2F – Weed Control in LibertyLink (Glufosinate-Resistant) Soybean

RECOMMENDATIONS: One application of *Liberty* (glufosinate) alone will not consistently provide season-long weed control. The following strategy is recommended:

1) Soil-applied residual herbicide applied preemergence followed by *Liberty* postemergence.
   a) Preemergence herbicide options can be found in Table 2A.
   b) *Liberty* should be applied when weeds are 2-3 inches tall.
   c) Early canopy closure from planting narrow row soybean will help improve season-long weed control.
   d) Several soil-applied residual herbicides can be tank-mixed with *Liberty* and applied postemergence. Tank-mixtures with some residual herbicides may cause some temporary burn or discoloration.
   e) An additional application of *Liberty* can be applied if needed.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	glufosinate *(Liberty)* + ammonium sulfate	0.58	32 oz 2.34L + 8.5 lb/100 gal	• **APPLY TO *LIBERTYLINK* (glufosinate-resistant) SOYBEANS ONLY.** • **See above recommendations for appropriate use of *Liberty* in *LibertyLink* soybean.** • There are other glufosinate products (i.e., *Cheetah*) registered for use in *LibertyLink* soybean, consult specific labels. • Refer to Table 2B for weed control and crop tolerance ratings. • Refer to Table 2I for application rates and maximum broadleaf weed sizes. • Always add ammonium sulfate (8.5-17 lb/100 gal). If conditions are hot and humid, the ammonium sulfate rate should be 8.5 lb/100 gal. • Apply from soybean emergence up to but not including the bloom stage (R1 soybean). • Reduced weed control can occur if *Liberty* is applied 2 hours before sunset or later. • *Liberty* can be applied at rates ranging 32 – 43 oz/A depending on weed species and size. • If required, a second application of 32 – 43 oz/A of *Liberty* can be applied up to a yearly maximum of 87 oz/A. • Allow 70 days between *Liberty* application and soybean harvest. • Use a minimum carrier volume of 15 gallons per acre. • The use of drift control agents that reduce spray coverage will result in reduced weed control from *Liberty*. • Refer to label and Table 12 for crop rotation restrictions.

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TABLE 2F – Weed Control in LibertyLink (Glufosinate-Resistant) Soybean *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Annual broadleaves**	glufosinate + fomesafen *(Cheetah Max)* + ammonium sulfate	0.75	1 qt 3L + 17 lb/100 gal	• **APPLY TO *LIBERTYLINK* (glufosinate-resistant) SOYBEANS ONLY.** • Refer to Table 2B for weed control and crop tolerance ratings. • See Table 2C for individual product rate equivalents for the premix. • Always add ammonium sulfate (8.5-17 lb/100 gal). If conditions are hot and humid, the ammonium sulfate rate should be 8.5 lb/100 gal. • No additional surfactant is needed with tank mixtures. Tank mixtures with EC formulations can increase crop injury. • Apply from soybean emergence up to but not including the bloom stage (R1 soybean). • Postemergence applications may cause temporary leaf bronzing and crinkling. • Refer to Table 2I for maximum weed sizes for *Cheetah Max*. • DO NOT apply make more than one application of *Cheetah Max* or apply more than 0.24 lb ai/A of fomesafen (from any fomesafen containing product) to the same field in CONSECUTIVE years. • *Liberty* or other glufosinate products can be applied as long as no more than 87 oz/A of *Liberty* is applied per year. • Allow 70 days between *Cheetah Max* application and soybean harvest. • Refer to Table 12 for crop rotation restrictions.

TABLE 2G – Weed Control in Roundup Ready 2 Xtend (Dicamba-Resistant) Soybean

Soybeans – Preharvest Application

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	dicamba *(Engenia)* OR (XtendiMax/FeXapan)	0.5 a.e.	12.8 oz 5L OR 22 oz 2.9L	• **APPLY TO ROUNDUP READY 2 XTEND (dicamba-resistant) SOYBEANS ONLY.** • Roundup Ready 2 Xtend soybean are resistant to glyphosate and dicamba. • ***Engenia***, ***FeXapan***, and ***XtendiMax*** are the only dicamba formulations that are registered for use in Roundup Ready Xtend soybeans and are **Restricted Use Pesticides**. • Can be applied **preplant**, **preemergence**, or **post-emergence** (up to R1 soybean). • Apply to broadleaf weeds that are less than 4-inches in size. • A short period of residual activity on certain small-seeded broadleaf weeds is possible. However, this is dependent on weather conditions. • Refer to Table 2B for postemergence weed control and crop tolerance ratings. • Refer to Table 2O for information on preplant and preemergence burndown uses in no-till Roundup Ready 2 Xtend soybean. • *Engenia*: DO NOT apply more than a total of 25.6 oz/A postemergence, and a total of 51.2 oz/A for all applications. • *XtendiMax/FeXapan*: DO NOT apply more than a total of 44 oz/A preemergence and a total of 44 oz/A postemergence for a total of 88 oz/A for all applications. • DO NOT mix any other herbicides or additives with any of these dicamba products unless they are approved on the following websites: **engeniatankmix.com** **xtendimaxapplicationrequirements.com** **fexapanapplicationrequirements.dupont.com** • Several broadleaf plants including non-Xtend soybean are extremely susceptible to dicamba. • CAUTION should be taken to avoid spray system contamination, vapor and/or spray particle drift. • Specific guidelines for use are **required** when applying dicamba to Roundup Ready 2 Xtend soybeans. Information on application guidelines and stewardship to reduce potential off-target movement of these products can be found in the following section, "**Guidelines and Precautions for Dicamba Use in Roundup Ready 2 Xtend Soybean**". • Refer to Table 12 for crop rotation restrictions.

Guidelines and Precautions for Dicamba Use in Roundup Ready 2 Xtend Soybean

The Roundup Ready Xtend system in soybean was developed as a tool to help manage herbicide-resistant weeds. This system enables growers to apply registered dicamba formulations to soybean designated as Roundup Ready 2 Xtend. In addition to dicamba resistance these soybeans are also resistant to glyphosate. As we see an increase in glyphosate- and multiple-resistant weeds in Michigan, growers may choose to use the new Roundup Ready 2 Xtend system as an option to manage these resistant weeds. However, as with other herbicides it is important to keep in mind that every application of dicamba increases the selection for dicamba-resistance. If a grower decides to use this technology it will be important to use an integrated approach to control problematic and resistant weeds. An overreliance on this technology will lead to the development of dicamba-resistant weeds.

Approval of the new lower volatility dicamba formulations, *Engenia, FeXapan, and XtendiMax,* allowed for the first official registered use of dicamba on Roundup Ready 2 Xtend soybean on a large number of acres in 2017. The labels of these products were very detailed on how to protect sensitive/susceptible species and crops from off-target dicamba movement. However, in areas with high use of this technology in 2017 there were thousands of complaints of off-target movement that injured susceptible species in the United States. Some of these instances occurred because applicators took some of the label restrictions too lightly and did not follow the label when making applications. Some of these violations included not using the correct nozzles, spraying in too high of winds or during temperature inversions, not following the buffer requirements or tank mixture restrictions, and spraying when the wind was blowing toward susceptible crops. Improper sprayer and tank cleanout also lead to damage of susceptible crops. Other instances included dicamba movement in runoff waters following heavy rains and in some instances off-target movement could not easily be explained, leading some to believe dicamba volatility was occurring.

On October 12, 2017 the EPA approved revised labels of *Engenia, FeXapan,* and *XtendiMax* to help address some of the issues. Below is synopsis of some of the label changes and guidelines that must be followed if a grower decides to use dicamba in Roundup Ready 2 Xtend soybean. Remember it is the responsibility of the applicator to protect sensitive areas and susceptible crops from dicamba injury.

Label Guidelines and Restrictions:

1. **Use only approved dicamba products.** Currently, *Engenia, FeXapan,* and *XtendiMax* are the only dicamba products registered for preplant, preemergence, or postemergence use in Roundup Ready 2 Xtend soybean. **Use of other dicamba formulations is a violation of state and federal law.**
2. **The dicamba products *Engenia, FeXapan,* and *XtendiMax* are Restricted Use Pesticides.** This designation requires that only certified applicators, or those under their guidance be allowed to purchase and apply these herbicides.
3. **Dicamba or auxin-specific training is required.** As part of the federal labels for *Engenia, FeXapan,* and *XtendiMax,* applicators are required to attend an annual dicamba or auxin-specific (Group 4) training prior to using these products.
4. **Record keeping of all dicamba applications and spray system cleanout is required.** Records must be generated within 14 days of application and kept for 2 years. The full record keeping requirements are listed on the label. Additionally, specific sprayer and tank cleanout procedures are listed on the label.
5. **Wind direction.** There is a strict requirement on the approved dicamba labels that states that dicamba should not be applied if the wind is blowing towards adjacent susceptible/sensitive crops. What this really means is that if you are in the **vicinity of a susceptible/sensitive crop and the wind is blowing toward that crop DO NOT spray dicamba**. Susceptible/sensitive crops include, but are not limited to non-dicamba resistant soybean, tomatoes, grapes, dry beans, sugar beets, fruiting trees and vegetables, cucurbits, potatoes, flowers and other broadleaf plants, including greenhouse plants. Currently, there is not an exact distance listed on the label between where the dicamba application is being made in relation to the adjacent susceptible/sensitive crop. However, realistically if you can see the susceptible/sensitive crop or if it is within 0.5 mile and the wind is blowing in that direction DO NOT apply dicamba until the wind is blowing away from that susceptible/sensitive crop. Additionally, there are sensitive crop registries, such as **DriftWatch.org**, that applicators must consult.
6. **Buffer requirements.** Downwind buffers are required when making applications near sensitive areas. The buffers are set based on the dicamba application rate. The downwind buffer for *Engenia* (12.8 oz/A) or applications of *FeXapan* and *XtendiMax* at 22 oz/A is 110 feet. The downwind buffer is increased to 220 feet when *FeXapan* and *XtendiMax* are applied at 44 oz/A (PRE only application rate). Sensitive areas can include, but are not limited to, residential areas, bodies of water, and habitats for threatened and endangered species, such as ditch banks and fence rows.
7. **Wind speed.** The label states dicamba applications can only be made when the wind speed is between **3** and **10 mph**. Temperature inversions often exist when the wind speed is less than 3 mph, which can lead to unpredictable off-target movement. Wind speeds above 10 mph

increase the chances for particle drift. Applicators also need to be aware of wind gusts. If wind gusts exceed 10 mph it is strongly recommended not to apply dicamba.

8. **Temperature inversions.** The labels clearly states **DO NOT apply** these products **during a temperature inversion**. Under a temperature inversion the atmosphere is very stable and vertical air mixing is restricted. Herbicide particles can be trapped in the stable air and then move unpredictably when wind movement finally occurs. Temperature inversions occur when the air temperature at the earth's surface begins to cool and warmer air is trapped above it. Temperature inversions often begin at sunset and continue into morning. Ground fog is often a good indicator of a temperature inversion, however fog is not always present during an inversion. That is one reason for the wind speed and new time of day restrictions. New apps, such as Pocket Spray Smart, can be used to determine if a temperature inversion exists.

9. **Time of day.** The new labels now only allow for applications **between sunrise and sunset**. Again this is to avoid applications during times when temperature inversions are likely to occur.

10. **Rain free interval.** Additional label restrictions include: DO NOT apply dicamba when rain is expected within **24 hours** of application. This also includes the use of irrigation within 24 hours after application. This restriction is to help prevent the movement of dicamba in runoff water after heavy rainfall events.

11. **Tank-mixtures and spray additives.** Only approved spray additives and herbicides can be tank mixed with approved dicamba products. The list of these approved products are found on the respective dicamba products websites and change frequently. Many tank mixtures require the addition of a drift reduction agent (DRA), these requirements can be found on the label websites. These websites are part of the label and should be read within 7 days of making the application. The tank mixing of any products not listed on the websites is a direct violation of the label. Finally, **DO NOT add ammonium sulfate** or any products containing ammonium sulfate. The addition of ammonium sulfate and unapproved products increases the volatility of dicamba.

    Approved dicamba label websites:
    engeniatankmix.com
    xtendimaxapplicationrequirements.com
    fexapanapplicationrequirements.dupont.com

12. **Sprayer application requirements.**
    - **Nozzles:** Nozzle section is based on reducing off-target movement by lowering the amount of fines from the spray droplet spectrum. **Only approved nozzles** can be used. Consult the approved dicamba product websites for approved nozzles and spray pressures.
    - **Spray volume.** Applications must be made at a minimum of **15 GPA** (gallons of spray solution per acre).
    - **Travel speed.** The maximum travel speed when applying approved dicamba products is **15 mph**.
    - **Boom height.** The requirement on the label is to keep the boom height **24 inches** or less above the target pest or crop canopy. It is important to keep the boom close to this height to minimize the potential for off-target movement. Research has shown by simply reducing the boom height from 48 to 24 inches the travel distance of drift particles can be reduced by 50%. The slower travel speed mentioned above will help with keeping the boom level at this lower height.

Additional Recommendations:

1. **Follow label recommendations.** While the above is a synopsis of the label restrictions and guidelines, applicators of these products **must read the label and check the respective label websites** prior to making dicamba applications. Violations of any of these restrictions increases the chances for off-target movement and damage to susceptible species. Not following the label is a direct violation of state and federal law. Remember it is the responsibility of the applicator to protect sensitive areas and crops from off-target movement.

2. **Consider applying dicamba only preplant, preemergence or very early postemergence.** Over 90% of the off-target dicamba movement complaints occurred from postemergence applications. Postemergence applications have the greatest potential for coming into contact with susceptible vegetation. Additionally, applications later in the season will likely occur under higher temperatures, which may impact off-target movement. While there is not a strict temperature cutoff on the label, our recommendations are to avoid applications when temperatures exceed 80° F. If there is a possibility of volatility with some of these new lower volatility formulations it would likely increase with temperature.

3. **Communicate with neighbors.** It is important to have conversations with your neighbors to know what crops and technologies are being planted near your Roundup Ready 2 Xtend soybean fields. In 2017, off-target movement of dicamba to non-Xtend soybeans most frequently happened when neighbors planted Roundup Ready 2 Xtend soybeans next to non-Xtend fields. Communication prior to planting may have helped resolve some of these issues. Additionally, one of Michigan's agricultural strengths is its diversity. In order to maintain this strength we need to insure that our specialty crops are protected. Many of Michigan's specialty crops are susceptible to dicamba and do not have maximum residue limits (MRLs) established. Meaning if off-target movement occurs, these crops cannot be marketed and will need to be destroyed. The applicator will be responsible for the total loss of these crops. ***This is especially serious in perennial crops, such as vineyards, fruit trees, and orchards, where damage from dicamba will result in severe economic losses.***

TABLE 2H – Soybean – Preharvest Applications

Soybeans – Preharvest Application

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves** **Perennial weeds**	glyphosate + ammonium sulfate	0.75–3.6 lb a.e.	See Table 10 + 17 lb/100 gal	• See Table 10 for a list of glyphosate products, formulations and rates. • Apply to mature soybeans once pods have lost their color. • DO NOT apply to soybeans grown for seed. • *Roundup Ready* soybean: The maximum preharvest use rate is 0.75 lb a.e./A of glyphosate with a 14 day preharvest interval. • *non-Roundup Ready soybean:* The rate range is from 0.75 to 3.6 lb a.e./A (equivalent to 22 fl oz/A up to 3.3 qt/A of *Roundup PowerMax*) of glyphosate with a 7 day preharvest interval. • Apply in 10-40 gal of water. • Apply 0.75 lb a.e./A for annual weeds. • Consult glyphosate product label for specific rate needed for perennial weeds in non-Roundup Ready crops.
Annual grasses **Annual broadleaves**	paraquat *(Gramoxone SL 2.0)* + surfactant	0.25	16 oz 2SL + 0.25%	• *Gramoxone SL 2.0* is a restricted-use pesticide. • Indeterminate varieties: Apply when at least 65% of pods are mature brown (seed moisture less than 30%). • Always add a non-ionic surfactant at 0.25% v/v. • Immature soybeans will be injured. • Do not apply within 15 days of harvest. • Apply *Gramoxone SL 2.0* in 20 gal. water (ground) or 5 gal. water (air).
	paraquat *(Parazone)* + surfactant	0.25	10 oz 3SL + 0.25%	• *Parazone* is a restricted-use pesticide. • *Parazone* contains the same active ingredient as *Gramoxone SL 2.0* (paraquat), but at a different concentration. • See the Remarks and Limitations section for *Gramoxone SL 2.0*.
Annual broadleaves	carfentrazone-ethyl *(Aim)* + methylated seed oil	0.02	1.5 oz 2EC + 1%	• Apply to mature soybeans once pods have lost their color. • Do not apply within 3 days of harvest. • *Aim* is not as effective as glyphosate or *Gramoxone* on most species. • *Aim* at 1 oz/A can be applied with glyphosate or *Gramoxone* to broaden the spectrum of weed control over *Aim* alone. • Use a minimum of 10 gal of water. Higher spray volumes would provide better coverage.
	dicamba *(Clarity)*	0.25	8 oz 4L	• Apply when soybean pods have reached a mature brown color and at least 75% leaf drop has occurred. • *Clarity* can be used to suppress annual weeds, higher rates up to 32 oz/A can be applied to suppress biennial, or perennial weeds (consult label). • Apply up to 7 days before harvest. • DO NOT apply to soybean grown for seed. • Caution should be taken to avoid vapor and particle spray drift. • *Clarity* is not recommended as a preharvest interval if you are planning on planting winter wheat. • Refer to label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.

(Continued on next page)

Soybeans – Preharvest Application *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	saflufenacil *(Sharpen)* + methylated seed oil + ammonium sulfate	0.023	1 oz 2.85L + 1% + 17 lb/100 gal	• Apply when crop is mature – greater than 65% brown pods and greater than 70% leaf drop or when seed moisture is 30% or less. • *Sharpen* can be applied at rates up to 2 oz/A. • Soybeans can be harvested 3 days after application. However, it generally takes 7-10 days to reach maximum desiccation activity. • *Sharpen* is an effective desiccant. • DO NOT apply to soybeans grown for seed. • DO NOT graze or feed desiccation-treated hay or straw to livestock. • Refer to label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.

TABLE 2I – Maximum Broadleaf Weed Heights for Postemergence Control in Soybean*

Herbicide	RATE/A	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PALMER AMARANTH[d]	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WATERHEMP[d]	WILD MUSTARD	HORSEWEED (MARESTAIL)
		WEED HEIGHT[a] (inches)												
Anthem MAXX	3 oz	–	2	2	2[c]	–	2[c]	–	–	2[c]	36	2	–	–
Basagran/Broadloom	1.5 pt	6	6	1.5[c]	–	–	–	–	–	6	2	–	4	–
	2 pt	10	10	2[c]	–	–	–	3	6	10	6	–	8	–
Cadet	0.6 oz	–	2	2	2	–	2	–	–	–	36	2	–	–
	0.9 oz	–	2	2	2	–	4	–	–	–	36	2	–	–
Classic	0.5 oz	6	4	–	–	–	2	–	–	2	–	–	4	3
	0.75 oz	12	6	–	–	–	4	4	6	4	6	–	6	6
Cobra[b]	8 oz	3	3	–	4	–	3	–	–	–	–	–	–	–
	10 oz	4	4	–	4	2	4	2	–	–	–	2	–	–
	12.5 oz	4	4	–	5	3	4	4	2	–	–	3	–	–
FirstRate	0.3 oz	10	4	–	–	–	–	8	10	6	6	–	4	6
Flexstar[b]	0.75 pt	2L	4L	–	2L	2L	2L	–	–	–	–	–	4L	–
	1 pt	4L	6L	–	4L	4L	4L	4L	4L	4L	–	2L	6L	–
Harmony SG	0.12 oz	–	–	4	–	–	12	–	–	6	6	–	4	–
Marvel	7.25 oz	–	4	4	4	3	4	3	–	4	36	4	4	–
Phoenix	10 oz	–	2	–	2	–	4	4	5	–	–	2	2	–
	12.5 oz	2	4	–	3	2	4	6	4	–	–	3	4	–
Prefix[b]	2 pt	–	4L	–	2L	4L	2L	4L	–	4L	–	2L	4L	–
Pursuit	4 oz	8	3	<1[c]	2	–	6	2[c]	3[c]	3	2	–	3	–
Raptor	5 oz	8	6	3	3	–	6	3	4	4	4	–	3	–
Reflex[b]	0.75 pt	–	2L	–	2L	–	2L	2L	–	2L	–	–	2L	–
	1 pt	–	4L	–	2L	4L	2L	4L	–	4L	–	2L	4L	–
Resource	6 oz	–	–	3L[c]	–	–	3L[c]	4L[c]	–	–	6L	–	–	–
Synchrony XP	0.5 oz	8	5	4	–	–	8	4	4	8	8	–	5	5
Ultra Blazer	1 pt	–	4	–	<2	4	<4	2	<2	4	–	4	<4	–
	1.5 pt	2	6	2[c]	2	4	4	3	3	6	–	4	4	–
Warrant Ultra[b]	3 pt	–	4L	–	2L	4L	2L	4L	–	4L	–	2L	4L	–
GLYPHOSATE–RESISTANT SOYBEAN														
Glyphosate	1.13 lb a.e.	6	6	6	6	–	6	6	6	6	6	–	6	6
Extreme	3 pt	18	6	8	12	–	18	9	9	6	5	–	18	12
Flexstar GT 3.5	3.5 pt	4	4	4	4	1	4	4	4	4	4	2	6	–
Sequence	2.5 pt	12	12	6	6	–	12	12	12	6	6	–	18	12
LIBERTYLINK SOYBEAN														
Liberty/Cheetah	32 oz	14	10	6	8	4	4	10	12	14	4	5	6	6-12
Cheetah Max	1 qt	14	10	6	8	4	4	10	12	14	4	5	6	6
ROUNDUP READY 2 XTEND (DICAMBA-RESISTANT) SOYBEAN														
Engenia	12.8 oz	4	4	4	4	4	4	4	4	4	4	4	4	4
XtendiMax/FeXapan	22 oz	4	4	4	4	4	4	4	4	4	4	4	4	4

TABLE 2I – Maximum Broadleaf Weed Heights for Postemergence Control in Soybean* *(continued)*

* The weed heights listed on this table are estimates of the maximum size where consistent control is expected. The maximum height for effective control in any specific situation is dependent on environmental conditions, including soil moisture, temperature, and relative humidity.

[a] (–) No control or weed height not listed on label.

[b] Weed stages are based on maximum leaf numbers.

[c] Suppression only.

[d] Almost all populations of Palmer amaranth and waterhemp found in Michigan are resistant to the ALS-inhibiting herbicides (Group 2) and glyphosate (Group 9).

TABLE 2J – Suggested Additives for Postemergence Herbicide Applications in Soybean[a]

Herbicide	Crop Oil Concentrate (COC)	OR	Nonionic Surfactant (NIS)	AND/OR	28% liquid nitrogen (28%N) or ammonium sulfate (AMS)
Anthem MAXX	1%		0.25%		28% N (1-2 qt/A) or AMS (2.5 lb/A) optional
Assure II/Targa	1% (2% if drought stress)		0.25%		NO
Basagran/Broadloom[b]	1 qt/A		NO		28% N (2-4 qt) or AMS (2.5 lb/A) optional
Cadet	1 qt/A		0.25%		28% N (2.5%) or AMS (2 to 2.5 lb/A) optional
Classic[b]	1%		0.25%		28% N (2-4 qt) or AMS (2-4 lb/A)
Cobra	0.5%		0.25% if high RH		28% N (2.5%) or AMS (2-4 lb/A)
FirstRate[b]	1.2% if dry only		0.25%		Always add 28% N (2.5%) or AMS (8.5-17 lb/100 gal)
Flexstar	1%		0.25%		28% N (2.5%) or AMS (8.5 lb/100 gal) optional
Fusilade DX	0.5-1%		0.25-0.5%		28%N (2.5%) or AMS (17 lb/100 gal) optional
Fusion	0.5 – 1%		0.25– 0.5%		28% N (2.5%) or AMS (17 lb/100 gal) optional
Harmony[b]	1% if hot, dry only		0.125–0.25%		28% N (2 qt/A) or AMS (2-4 lb/A) optional
Marvel	1%		0.25%		28% N (1-2 qt/A) or AMS (2.5 lb/A) optional
Phoenix	1 pt/A if hot, dry		0.125–0.25%		NO
Poast[d] or Poast Plus	1 qt/A		NO		28% N (0.5-1 gal/A) or AMS (2.5 lb/A) optional
Prefix	NO		0.25%		
Pursuit	1%		0.25%		Always add 28% N (2.5%) or AMS (12-15 lb/100 gal)
Raptor[e]	1%		0.25%		Always add 28% N (2.5%) or AMS (12-15 lb/100 gal)
Reflex	0.5–1%		0.25–0.5%		28% N (2.5%) or AMS (10 lb/100 gal) optional
Resource	1 qt/A		NO		28% N (1 gal/A) or AMS (2.5 lb/A) optional
Select/Arrow	1%		NO		28% N (1-2 qt/A) or AMS (17 lb/100 gal) optional
Select Max	1%		0.25%		28% N (1 to 2 qt/A) or AMS (2.5 to 4 lb/A) optional
Synchrony XP	1%		0.25% non-STS beans		Always add 28% N (2 qt) or AMS (2 lb/A)
Ultra Blazer	NO		0.25%		28% N (2-4 qt/A) or AMS (2.5 lb/A) optional
Warrant Ultra	1%[g]		0.25-0.5%		
GLYPHOSATE-RESISTANT SOYBEAN					
glyphosate[c]	NO		Consult Table 10		AMS (17 lb/100 gal)
Extreme	NO		0.125%		AMS (17 lb/100 gal)
Flexstar GT 3.5	NO		0.25%		AMS (17 lb/100 gal)
Sequence	NO		NO		AMS (17 lb/100 gal)
LIBERTYLINK SOYBEAN					
Liberty/Cheetah	NO		NO		AMS (8.5 to 17 lb/100 gal)[f]
Cheetah Max	NO		NO		AMS (8.5-17 lb/100 gal)[f]
ROUNDUP READY 2 XTEND (DICAMBA-RESISTANT) SOYBEAN					
Engenia	Consult label		Consult label		NO
XtendiMax/FeXapan	Consult label		Consult label		NO

[a] 0.125% = 1 pt in 100 gal of spray solution; 0.25% = 1 qt in 100 gal; 1% = 1 gal in 100 gal; 4% = 4 gal in 100 gal.

[b] 28% N or AMS should be added for velvetleaf control.

[c] Consult Table 10 for glyphosate formulations and NIS requirements.

[d] 28% N or AMS improves control of large crabgrass, quackgrass, and volunteer corn and cereals.

[e] Use methylated seed oil (MSO) for improved common ragweed control.

[f] Use 8.5 lb/100 gal under hot, humid conditions.

[g] Greater crop response.

TABLE 2K – Additives for Postemergence Broadleaf Weed Control in Soybean

Additives are listed for each herbicide tank mixture based on the label of the herbicide in the Primary Herbicide column. Sometimes, a tank mixture may occur on only one label. For example, *Basagran* + *Classic* is listed as a tank mixture on the *Basagran* label but is not listed as a tank mixture on the *Classic* label. To find the correct additives for a tank mixture, find the first herbicide in the Primary Herbicide column and then move across the column to the box that corresponds with the tank mix partner.

	TANK MIX PARTNER												
PRIMARY HERBICIDE	**BASAGRAN**	**CLASSIC**	**COBRA**	**FIRSTRATE**	**FLEXSTAR**	**HARMONY**	**PHOENIX**	**PURSUIT**	**RAPTOR**	**REFLEX**	**RESOURCE**	**SYNCHRONY XP**	**ULTRA BLAZER**
Basagran	—	A+	B+	A+	B+	A+	NL	B+	B+	B+	B+	B+	B+
Cadet	B+	B+	D–	A+	B+	C+	C–	B+	B+	B+	B+	C+	A
Classic	NL	—	D+	B+	B+	C+	NL	D+	NL	B+	NL	NL	A+
Cobra[1]	D–	D–	—	D+	NL	C–	NL	D+	D+	NL	B–	D–	NL
FirstRate[2]	A+	A+	A+	—	A+	A+	NL	A+	A+	A+	A+	A+	A+
Flexstar[2]	B+	B+	NL	A+	—	C+	NL	B+	B+	NL	B+	B+	NL
Harmony	A+	NL	NL	NL	NL	—	NL	NL	NL	NL	NL	NL	NL
Phoenix	C–	C–	NL	C–	NL	C–	—	A–	A–	NL	C–	C–	NL
Pursuit	B+	NL	D+	A+	B+	A+	NL	—	NL	B+	NL	NL	A+
Raptor	B+	A–	D+	A+	B+	NL	NL	NL	—	B+	NL	NL	B+
Reflex[2]	B+	B+	NL	A+	NL	C+	NL	B+	B+	—	B+	B+	NL
Resource	B+	B+	B–	B+	B+	C+	NL	B+	B+	NL	—	B+	B+
Synchrony XP[3]	NL	NL	D+	B+	B+	NL	NL	NL	NL	B+	NL	—	A+
Ultra Blazer	A–	A–	NL	A+	NL	C+	NL	A+	A+	NL	B–	D+	—

Adjuvant

A = 0.25% v/v non-ionic surfactant
B = 1.0% v/v crop oil concentrate
C = 0.125% v/v non-ionic surfactant
D = 0.5% v/v crop oil concentrate
NL = Not on label

Nitrogen Source

— = DO NOT add a N fertilizer source
\+ = Add a N fertilizer sources, AMS or 28% UAN

[1] *Cobra* applied at 4 to 12 oz/A.

[2] These tank mixtures are labeled, adjuvant selection should be based on the tank mix partner label.

[3] Adjuvant selection is when *Synchrony XP* is used on STS designated soybeans.

TABLE 2L – Application Rates of Postemergence Grass Herbicides for Control of Grass Species at Various Heights

	Assure II/ Targa	Fusilade DX	Fusion[a]	Poast	Poast Plus	Select/ Arrow	Select Max
	oz/A						
Barnyardgrass							
1–2”	–	10	–	12	18	4	6
2–3”	8	12	8	12	18	4	6
3–4”	8	–	8	12	18	4	6
4–6”	8	–	–	16	24	6	9
6–8”	–	–	–	16	24	6	9
Crabgrass							
<1”	–	10	–	–	–	–	–
1–2”	8	12	8	16	24	6	6
2–6”	8	–	–	16	24	6	9
Fall Panicum							
1–2”	–	10	–	12	18	4	6
2–4”	7	12	8	12	18	4	6
4–6”	7	12	8	16	24	6	9
6–8”	–	–	–	16	24	6	9
Giant Foxtail							
1–2”	–	10	–	12	18	4	6
2–4”	7	12	8	12	18	4	6
4–6”	7	12	8	16	24	6	9
6–8”	7	–	8	16	24	6	9
8–12”	–	–	–	–	–	6	9
Green Foxtail							
1–2”	–	10	–	12	18	–	6
2–4”	7	12	8	12	18	6	6
4–6”	–	–	–	16	24	6	9
6–8”	–	–	–	16	24	6	9
Quackgrass							
4–6”	–	10	–	–	–	8–16+8	12+12
6–8”	10+7	12+8	12+8	24+16	36+24	8–16+8	12+12
8–10”	10+7	12+8	12+8	–	–	–	12+12
V. Corn							
1–4”	–	–	–	12	18	–	–
4–6”	–	–	–	12	18	4	6
6–12”	5	–	–	12	18	4	6
12–18”	5	6	6	16	24	6	9
18–20”	8	6	6	16	24	6	9
20–24”	8	6	6	–	–	6	9
Witchgrass							
1–2”	–	10	–	16	24	–	–
2–4”	7	12	8	16	24	6	9
4–6”	7	–	8	16	24	6	9
6–8”	–	–	–	16	24	6	9
Yellow Foxtail							
1–2”	–	10	–	16	24	–	6
2–4”	7	12	8	16	24	6	6
4–6”	–	–	–	16	24	6	9
6–8”	–	–	–	16	24	6	9

[a] = If grasses are small and not drought stressed, the *Fusion* rate can be reduced to 6 oz/A on barnyardgrass and all foxtails and 4 oz on volunteer corn.

– = Not labeled.

TABLE 2M – Labeled Tank Mixes With Postemergence Grass Herbicides in Soybean*

BROADLEAF HERBICIDES[1]	GRASS HERBICIDES						
	Assure II/ Targa	Fusilade DX	Fusion	Poast	Poast Plus	Select/ Arrow	Select Max
Basagran	Y[3]	Y	Y	Y[4]	Y[4]	Y[5]	Y[5]
Cadet	Y	Y	Y	Y	Y	Y	Y
Classic	Y[3]	Y[3]	Y[3]	Y	Y	Y[5]	Y[5]
Cobra	Y	Y	–	Y	Y	Y	Y
FirstRate	Y[5]	–	Y[5]	Y[5]	Y[5]	Y[5]	Y[5]
Flexstar	Y	Y	Y	Y	Y	Y	Y
Harmony SG	Y[5]	Y[5]	Y[5]	–	–	–	Y
Marvel	Y	Y	Y	Y	Y	Y	Y
Phoenix	–	–	–	–	–	Y	Y
Pursuit	–	Y[6]	Y[6]	Y[6]	Y[6]	Y[6]	Y[6]
Raptor	–	–	–	Y[6]	Y[6]	Y[6]	Y[6]
Reflex	Y	Y	Y	Y	Y	Y	Y
Resource	Y	Y	Y	Y	Y	Y	Y
Synchrony XP	Y[3]	Y	Y	Y	Y	Y[5]	Y[5]
Ultra Blazer	Y	Y	Y	Y	Y	Y	Y
GLYPHOSATE-RESISTANT SOYBEAN							
Glyphosate[2]	Y	Y	Y	Y	Y	Y	Y
Extreme	–	–	–	–	–	–	–
Flexstar GT 3.5[2]	Y	Y	Y	Y	Y	Y	Y
Sequence[2]	Y	Y	Y	Y	Y	Y	Y
LIBERTYLINK SOYBEAN							
Liberty	Y	Y	Y	Y	Y	Y	Y

* Y = the products may be tank mixed; – = tank mix is not legally labeled or recommended.

1 Tank mixing saves time and application cost but is only labeled for some herbicides and for a limited number of grasses. Consult remarks and limitations for individual products in this guide and pesticide labels for further information.

2 Volunteer glyphosate-resistant corn. Consult the POST grass herbicide and glyphosate label for correct additives.

3 DO NOT tank mix when the target grass is barnyardgrass, crabgrass, quackgrass, or yellow foxtail.

4 DO NOT tank mix if quackgrass is the target species.

5 Under certain conditions, grass antagonism may occur.

6 Volunteer corn and shattercane only. Grass antagonism will occur. NOT RECOMMENDED.

TABLE 2N – Feed and Forage Restrictions for Soybean Herbicides[a]

Herbicide	Site of Action[b]	For Use in Feed/Forage?	Preharvest Interval
Herbicides Applied PPI or PRE			
Afforia	2/2/14	No	none listed
Anthem MAXX	14/15	No	none listed
Authority Assist	2/14	No	none listed
Authority First/Sonic	2/14	No	65 days
Authority MAXX	2/14	No	none listed
Authority MTZ	5/14	No	120 days
Authority XL	2/14	No	none listed
Boundary	5/15	**Yes**	none listed
BroadAxe XC	14/15	**Yes**	30 days
Canopy/Canopy Blend	2/15	No	none listed
Canopy EX	2/2	No	none listed
Command 3ME	13	No	none listed
Dual II Magnum/Parallel	15	**Yes**	90 days
Envive	2/2/14	No	none listed
Fierce	14/15	No	none listed
Fierce XLT	2/14/15	No	none listed
FirstRate	2	**Yes**	70 days
Lorox/Linex	7	No	none listed
Metribuzin	5	**Yes**	none listed
OpTill	2/14	No	85 days
OpTill PRO	2/14/15	No	85 days
Outlook	15	No	none listed
Prefix	14/15	No	90 days
Prowl H_20/Prowl	3	**Yes**	none listed
Pursuit	2	No	none listed
Python/Accolade	2	No	none listed
Sharpen	14	**Yes**	65 days
Sonalan	3	No	none listed
Spartan	14	No	none listed
Spartan Charge	14/14	No	none listed
Surveil	2/14	No	none listed
Trifluralin	3	**Yes**	none listed
Trivence	2/5/14	No	none listed
Valor/Valor EZ/Rowel	14	No	none listed
Valor XLT/Rowel FX	2/14	No	none listed
Verdict	14/15	No	none listed
Warrant	15	No	none listed
Warrant Ultra	14/15	No	none listed
Zidua	15	**Yes**	none listed
Zidua PRO	2/14/15	No	none listed

[a] Restrictions based on herbicide labels. Always read and follow herbicide labels.

(Continued on next page)

[b] Herbicide Site of Action: The site of action key is located on pages 15-16.

[c] Consult specific glyphosate labels for feed and forage restrictions.

TABLE 2N – Feed and Forage Restrictions for Soybean Herbicides[a] *(continued)*

Herbicide	Site of Action[b]	For Use in Feed/Forage?	Preharvest Interval
Herbicides Applied POST			
Anthem MAXX	14/15	No	none listed
Assure II/Targa	1	No	80 days
Basagran/Broadloom	6	**Yes**	30 days
Cadet	14	No	60 days
Cheetah Max	10/14	No	70 days
Classic	2	No	60 days
Cobra/Phoenix	14	No	45 days
Engenia	4	**Yes**	7/14 days[d]
Extreme	2/9	No	85 days
FirstRate	2	**Yes**	70 days
Flexstar GT	9/14	No	45 days
Fusilade DX	1	No	Prebloom
Fusion	1	No	Prebloom
Glyphosate[c]	9	**Yes**[c]	14 days
Harmony	2	No	60 days
Liberty/Cheetah	10	No	70 days
Marvel	14/14	No	60 days
Poast/Poast Plus	1	**Yes**	75 days
Pursuit	2	No	85 days
Raptor	2	No	85 days
Reflex/Flexstar	14	No	45 days
Resource	14	No	60 days
Select/Arrow/Select Max	1	No	60 days
Sequence	9/15	No	90 days
Synchrony XP	2/2	No	60 days
Ultra Blazer	14	No	50 days
Warrant	15	No	none listed
Warrant Ultra	14/15	No	none listed
XtendiMax/FeXapan	4	**Yes**	7/14 days[d]

[a] Restrictions based on herbicide labels. Always read and follow herbicide labels.

[b] Herbicide Site of Action: The site of action key is located on pages 15-16.

[c] Consult specific glyphosate labels for feed and forage restrictions.

[d] Feeding and/or harvesting soybean forage/hay.

TABLE 2O – Weed Management in No-Till Soybean

Effective weed control in no-till soybeans requires control of **all weeds and cover crops** prior to soybean emergence. This can be accomplished by:

1. Late fall applications prior to planting soybeans the following spring **(FALL)**.
2. Early spring applications — up to 30 days prior to soybean planting **(EPP)**.
3. Applications at or very close to the time of planting **(PRE)**.

Regardless of the time of herbicide application, burndown herbicide(s) must be applied to control **all** of the existing vegetation. If some plant species are not controlled prior to soybean emergence, they will be competitive with the soybean crop, ultimately leading to soybean yield loss.

Burndown herbicide options include herbicides without residual activity: glyphosate (Table 10), *Gramoxone* (paraquat), *Liberty, 2,4-D ester, Aim, Express, Vida, Sharpen,* and *Verdict*. These herbicides control only existing vegetation and **DO NOT** have residual activity to control weeds that have not yet emerged. The following table lists the effectiveness of these herbicides in burndown applications to control existing vegetation. Selection of these herbicides should be made on the basis of weed type, weed height and the speed of control. In general, *Gramoxone* and *Liberty* will provide faster control than glyphosate or 2,4-D ester, but glyphosate will provide better control of dense weeds or cover crops. Glyphosate is preferred for control of perennial weeds or grasses prior to the completion of tillering.

2,4-D ester provides effective control of several annual, biennial and perennial broadleaf weeds but does not control grasses. Each of these herbicides has one or more weed species that it does not control (e.g., 2,4-D ester does not control chickweed). Therefore, these herbicides are often tank-mixed for broad-spectrum burndown applications. Sometimes application rates of burndown herbicides need to be increased to control large weeds or dense weed infestations. Please consult the herbicide labels for information. None of these burndown herbicides have soil activity to stop new weeds from emerging. Herbicides that persist in the soil to stop new weeds from emerging may be included in the burndown application.

Certain residual herbicides have burndown activity on some weed species. **Table 2O** gives the maximum weed height for **burndown** control of summer annual broadleaves and grasses. These herbicides are not as broad-spectrum as glyphosate, *Gramoxone, Liberty* or 2,4-D ester for burndown of existing vegetation. Therefore, the residual herbicides are always tank mixed with glyphosate, 2,4-D ester, *Gramoxone, Liberty* or combinations of glyphosate + 2,4-D ester. These residual herbicides will control germinating summer annual grasses and broadleaf weeds. The **effectiveness** of these residual herbicides on summer annual grass and broadleaf weed control is not the same. **Table 2A** gives the effectiveness ratings of these residual herbicides on annual weeds. The **length of weed control** from these residual herbicides is not the same. Some herbicides persist longer in the soil and are, therefore, more effective than other herbicides when applied in the fall. There are fewer noticeable differences in the length of summer annual weed control when these herbicides are applied in the spring **(EPP**) or at planting **(PRE)**. **Table 2N** gives the **length of summer weed control** (0 = no residual weed control; 1 = short residual control; 2 = moderate residual control; 3 = long residual control). When applying residual herbicides in the fall for summer annual weed control, choose a herbicide with a "3" rating. When applying residual herbicides in the spring, **EPP**, choose a herbicide with a "3" or "2" rating. When applying residual herbicides at or very close to the time of planting **(PRE**), choose a herbicide with a "3", "2" or "1" rating.

A few important comments for each herbicide in **Table 2N** are listed below.

Burndown Herbicides without Residual Activity

Glyphosate: Glyphosate can be applied in the **Fall, EPP** or **PRE** to control existing vegetation. Application rates range from 0.75 to 1.13 lb a.e./A, depending on weed size. Lower rates may be used to control smaller weeds at lower spray volumes — consult label. Consult **Table 2O** for maximum weed heights and effectiveness ratings. There are many formulations of glyphosate. Consult **Table 10** for a list of glyphosate products, use rates and the need for additional surfactant. Ammonium sulfate (AMS) at 17 lb/100 gal should be added to glyphosate, regardless of formulation. The addition of 2,4-D ester greatly improves control of horseweed (marestail), giant ragweed, mustards and some other key no-till weeds (see the following comments about 2,4-D ester). Herbicides with residual activity can also be tank mixed with glyphosate or glyphosate + 2,4-D ester.

Gramoxone SL 2.0 (2 SL): *Gramoxone SL 2.0* can be applied **EPP** or **PRE** to control existing vegetation. Apply *Gramoxone SL 2.0* at 2 pt/A for weeds less than 3 inches tall and 3.0 pt/A for weeds less from 3 to 6 inches tall. Consult **Table 2O** for maximum weed heights and effectiveness ratings. Always add surfactant at 0.25% v/v or a crop oil concentrate at 1% v/v. Regrowth of rye or wheat may occur if plants are not fully tillered when treated. Burndown effectiveness is highly dependent on the environment, with better burndown in warm, sunny conditions. For improved burndown control, *Gramoxone* can be tank mixed with 2,4-D ester or with a herbicide with residual activity.

Parazone (3 SL): *Parazone* contains the same active ingredient as *Gramoxone SL 2.0* (paraquat). However, *Parazone* is at a different concentration — 2 pints of *Parazone* is equal to 3 pints of *Gramoxone SL 2.0*. Refer to the *Gramoxone SL 2.0* section for further remarks on *Parazone*.

Liberty (2.34 L): *Liberty* can be applied **preplant** or **PRE** to control existing vegetation. Apply *Liberty* at 29 to 36 oz/A with ammonium sulfate at 17 lb/100 gal. If *Liberty* is used as a burndown herbicide, one additional in-season application can be made in Liberty Link soybean, as long as the season total does not exceed

65 fl oz/A. Consult **Table 2N** for maximum weed heights and effectiveness ratings for burndown applications. Burndown effectiveness is highly dependent on the environment, with better burndown activity in warm, sunny conditions. Spray coverage is extremely important. *Liberty* requires a minimum of 15 gal/A of spray solution. Consult label and Table 12 for crop rotation restrictions. Tank-mixtures with *Sharpen* or *Metribuzin* can greatly improve burndown activity. *Liberty* can also be tank-mixed with 2,4-D ester or with a herbicide with residual activity to broaden the spectrum of weed control.

2,4-D ester: 2,4-D-ester can be applied in the **Fall** or **EPP** to control existing annual, biennial and perennial broadleaf weeds. One qt/A of 2,4-D ester can be applied in the fall and up to 30 days prior to soybean planting; 1 pt/A of 2,4-D ester can be applied up to 7 days prior to soybean planting. Consult **Table 2O** for maximum weed heights and effectiveness ratings. 2,4-D ester does not control common chickweed. 2,4-D can be tank mixed with a number of herbicides for improved weed control.

Elevore (0.572 L): *Elevore* (halauxifen) can be applied **up to 14 days prior to planting soybean** to control existing vegetation i.e., glyphosate-resistant horseweed. Apply *Elevore* at 1 oz/A with either 1% v/v of methylated seed oil or crop oil concentrate. Consult **Table 2O** for maximum weed heights and effectiveness ratings. *Elevore* should be tank mixed with additional products i.e., glyphosate to broaden the spectrum of weed control. At least 14 days must pass between *Elevore* application and soybean planting.

Express (50 SG): *Express* can be applied in the fall and in the **spring 7 days or more** prior to soybean planting. Apply *Express* at 0.25 to 0.5 oz/A — use the higher rate for denser weed populations or weeds that are only partially controlled. If *Express* is applied at 0.25 oz/A soybean can be planted 1 day after application, unless on light textured soils or soils with pH greater than 7.9. Consult **Table 2O** for maximum weed heights and effectiveness ratings. Always add crop oil concentrate at 1% v/v. *Express* is very effective on common chickweed. For best burndown results, the addition of 2,4-D ester is recommended. *Express* can also be tank mixed with herbicides that have residual activity.

Aim (2 EC): *Aim* (carfentrazone) is labeled for preplant **(EPP)** through **PRE** burndown applications. Apply *Aim* at 0.5 to 2 oz/A; use the higher rate to control larger weeds (4 inches tall). *Aim* is a contact herbicide without residual activity and is effective only on broadleaf weeds. Always add surfactant (0.25% v/v) or crop oil concentrate (1% v/v). Visual injury symptoms appear soon after *Aim* application. *Aim* can be tank mixed with glyphosate, 2,4-D ester and/or herbicides with residual activity. Consult **Table 2O** for maximum weed heights and effectiveness ratings.

Vida (0.2 L): *Vida* (pyraflufen) is labeled for preplant **(EPP)** burndown applications. Apply *Vida* at 0.5 to 2 oz/A; use the higher rate to control larger weeds (4 inches tall). *Vida* is a contact herbicide without residual activity and is effective only on broadleaf weeds. Always add surfactant (0.25% v/v) or crop oil concentrate (1% v/v). Visual injury symptoms appear soon after *Vida* application. *Vida* can be tank mixed with glyphosate, 2,4-D ester and/or herbicides with residual activity. The pH of the spray solution needs to be less than 7.5 or hydrolysis will occur. Consult **Table 2O** for maximum weed heights and effectiveness ratings.

Sharpen (2.85 L): *Sharpen* can be applied **preplant** or **PRE** to control existing broadleaf vegetation. Apply *Sharpen* at 1 oz/A prior to soybean emergence. For enhanced burndown activity, higher rates of *Sharpen* can be applied. However, longer intervals are required between *Sharpen* application and soybean planting; a minimum of 14 days for 1.5 oz/A and 30 days for 2 oz/A of *Sharpen*. Always add a methylated seed oil (1% v/v) and ammonium sulfate (AMS) at 17 lb/100 gal. DO NOT apply *Sharpen* after soybean emergence or severe crop injury will occur. DO NOT apply to coarse-textured soils with 2% less organic matter unless soybean is planted 1 month after application; *Sharpen* at 2 oz/A requires 44 days. Tank mixtures or sequential applications of *Sharpen* with other Group 14 containing herbicides, such as flumioxazin *(Valor)*, sulfentrazone *(Authority* or *Spartan)*, or fomesafen *(Reflex)*, require 14 days between application and soybean planting with *Sharpen* at 1 oz/A and 30 days with *Sharpen* at 1.5 to 2 oz/A in reduced and no-till soybean. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications. Consult label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen. Rotation restrictions are longer for application rates greater than 1 oz/A. *Sharpen* is a very effective herbicide on horseweed (marestail) and may provide 2 to 4 weeks of residual control against this weed. *Sharpen* should be tank mixed with glyphosate or glyphosate + 2,4-D ester to broaden the spectrum of burndown weed control.

Verdict (5.57 L): *Verdict* can be applied in the **Fall, preplant** or **PRE** to control existing broadleaf vegetation. *Verdict* contains *Sharpen* (saflufenacil) and *Outlook* (dimethenamid-P) (see **Table 2C**). The labeled rate of *Verdict* for use in soybean is 5 to 10 oz/A. The soybean rate of 5 oz/A of *Verdict* will not provide residual weed control. For additional residual control and enhanced burndown activity, higher rates of *Verdict* can be applied. However, longer intervals are required between *Verdict* application and soybean planting; a minimum of 14 days for 7.5 oz/A and 30 days for 10 oz/A of *Verdict*. Always add a methylated seed oil (1% v/v) and ammonium sulfate (AMS) at 17 lb/100 gal. DO NOT apply *Verdict* after soybean emergence or severe crop injury will occur. DO NOT apply to coarse textured soils with less than 2% organic matter, unless soybean is planted 30 days after application. DO NOT tank-mix or apply *Verdict* within 30 days of soil-applied applications of flumioxazin *(Valor)*, sulfentrazone (*Authority* or *Spartan*), or fomesafen *(Reflex, Flexstar)* containing products. However, fomesafen *(Flexstar, Reflex)* and other POST PPO-inhibiting herbicides can be used 14 days after soybean emergence. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications. Consult label and Table 12 for crop rotation restrictions. Rotation restrictions are longer for *Verdict* applications rates greater than 5 oz/A. *Verdict* is a very effective herbicide on horseweed (marestail) and may provide 2 to 4 weeks of residual control against this weed. *Verdict* should be tank-mixed with glyphosate to broaden the spectrum of burndown weed control.

Burndown Herbicides with Residual Activity

Afforia (50.8 WG): *Afforia* can be applied in the **Fall**, **preplant**, or **PRE** (PRE applications are rate dependent) to control existing vegetation and to provide residual weed control. *Afforia* contains *Harmony* (thifensulfuron), *Express* (tribenuron), and *Valor* (flumioxazin) (see **Table 2C**). *Afforia* at 2.5 oz/A can be applied preemergence up to 3 days after planting, but prior to soybean emergence; at rates greater than 2.5 to 3.75 oz/A 7 days is needed prior to planting.

Always add a crop oil concentrate at 1% v/v or unless tank-mix products do not allow the use of a crop oil concentrate than use a non-ionic surfactant at 0.25% v/v. The addition of ammonium sulfate (AMS) at 17 lb/100 gal may aid in control when tank-mixed with glyphosate. DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products within 14 days of planting, unless soybeans are planted under no-till or minimum tillage conditions on wheat stubble or no-till field corn stubble or crop injury will occur. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. Tank-mixtures with 2,4-D ester, is recommended for best burndown results. Tank-mixtures with glyphosate, 2,4-D ester + glyphosate, *Gramoxone*, or *Liberty* may also be used to broaden the spectrum of burndown weed control.

Authority Assist (4 L): *Authority Assist* can be applied in the **Fall, EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual control. *Authority Assist* contains *Spartan* (sulfentrazone) and *Pursuit* (see **Table 2C**). *Authority Assist* use rates are based on soil texture, organic matter, and pH. *Authority Assist* rates range from 6 to 12 oz/A (10 oz/A). Reduced rates ranging from 4 to 6 oz/A (5 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. DO NOT apply to soils with pH of 7.5 or higher. Always add a crop oil concentrate or a methylated seed oil (1% v/v). Soybean varieties vary in their sensitivity to sulfentrazone, a component in *Authority Assist*; consult your local seed dealer for information. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. *Authority Assist* should be tank-mixed with 2,4-D ester, glyphosate, glyphosate + 2,4-D ester or *Gramoxone* to broaden the spectrum of burndown weed control.

Authority First/Sonic (70 DF): *Authority First/Sonic* can be applied **EPP** (up to 14 days) or **PRE** to control existing vegetation and to provide residual weed control. *Authority First/Sonic* contains *Spartan* (sulfentrazone) and *FirstRate* (see **Table 2C**). Apply *Authority First/Sonic* at 6.4 oz/A. Reduced rates ranging from 3.2 to 6 oz/A (4 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. Always add surfactant at 0.25% v/v + 28% N or ammonium sulfate (AMS) or crop oil concentrate + 28% N or AMS. Soybean varieties vary in their sensitivity to sulfentrazone, a component in *Authority First/Sonic*. Consult your local seed dealer for information. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. *Authority First/Sonic* should be tank mixed with 2,4-D ester, glyphosate, glyphosate + 2,4-D ester, or *Gramoxone* to broaden the spectrum of burndown weed control.

Authority MAXX (66 WG): *Authority MAXX* can be applied in the **Fall, preplant** or **PRE** to control existing broadleaf vegetation. *Authority MAXX* contains *Spartan* (sulfentrazone) and *Classic* (chlorimuron-ethyl) (see **Table 2C**). Apply *Authority MAXX* at 5 oz/A as part of a planned 2-pass program. DO NOT apply *Authority MAXX* to soils with pH greater than 7.6. Always add a crop oil concentrate or a methylated seed oil at 1% v/v or a non-ionic surfactant at 0.25% v/v. The addition of ammonium sulfate (AMS) at 17 lb/100 gal may aid in control when tank-mixed with glyphosate. Soybean varieties vary in their sensitivity to sulfentrazone a component in *Authority MAXX*; consult your local seed dealer for information. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. *Authority MAXX* should be tank-mixed with 2,4-D ester, glyphosate, *Gramoxone, Sharpen, Express,* or *Express* + 2,4-D ester to broaden the spectrum of burndown weed control.

Authority MTZ (45 DF): *Authority MTZ* can be applied in the **Fall, EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. *Authority MTZ* contains *Spartan* (sulfentrazone) and *Metribuzin* (see **Table 2C**). *Authority MTZ* use rates are based on soil texture, organic matter, and pH. *Authority MTZ* rates range from 12 to 20 oz/A (16 oz/A). Reduced rates ranging from 8 to 14 oz/A (12 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. DO NOT apply *Authority MTZ* at rates greater than 12 oz/A if the soil pH is greater than 7.5. Always add crop oil concentrate (1% v/v). Soybean varieties vary in their sensitivity to sulfentrazone and metribuzin components in *Authority MTZ*; consult your local seed dealer for information. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. *Authority MTZ* should be tank mixed with 2,4-D ester, glyphosate, glyphosate + 2,4-D ester, or *Gramoxone* to broaden the spectrum of burndown weed control.

Authority XL (70 WG): *Authority XL* can be applied in the **Fall, preplant** or **PRE** to control existing broadleaf vegetation. *Authority XL* contains *Spartan* (sulfentrazone) and *Classic* (chlorimuron-ethyl) (see **Table 2C**). Apply *Authority XL* at 3 to 5 oz/A as part of a planned 2-pass program. DO NOT apply *Authority XL* to soils with pH greater than 7.6. Always add a crop oil concentrate or a methylated seed oil at 1% v/v or a non-ionic surfactant at 0.25% v/v. The addition of ammonium sulfate (AMS) at 17 lb/100 gal may aid in control when tank-mixed with glyphosate. Soybean varieties vary in their sensitivity to sulfentrazone a component in *Authority XL*; consult your local seed dealer for information. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12

for crop rotation restrictions. *Authority XL* should be tank-mixed with 2,4-D ester, glyphosate, *Gramoxone, Express*, or *Express* + 2,4-D ester to broaden the spectrum of burndown weed control.

Autumn Super 51 WDG (51 WG): *Autumn Super 51 WDG* at 0.5 oz/A may be applied in the **Fall only** to control existing vegetation of certain weeds and provide some residual weed control. *Autumn Super 51 WDG* contains iodosulfuron and thiencarbazone-methyl (see **Table 2C**). Always add a crop oil concentrate or a methylated seed oil (1% v/v) and ammonium sulfate (2.5 lb/A). *Autumn Super 51 WDG* will not control ALS-resistant weeds. Consult **Table 2O** for maximum weed heights and effectiveness ratings. For improved burndown control, tank mixes with 2,4-D ester or glyphosate are recommended. Consult label and Table 12 for crop rotation restrictions.

Canopy (75 WG): *Canopy* can be applied in the **Fall, EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control in no-till and conservational till soybean. *Canopy* contains *Classic* (chlorimuron) and metribuzin (see **Table 2C**). *Canopy* use rates are based on soil texture, organic matter, and pH. *Canopy* rates range from 4 to 7 oz/A (4.5 oz/A). Reduced rates ranging from 2.25 to 4 oz/A (3 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. DO NOT apply *Canopy* at rates greater than 2.25 oz/A to soils with a composite pH greater than 7.0; use of higher rates may result in unacceptable injury to this year's crop and the following crop. DO NOT apply *Canopy* to soils with a composite pH exceeding 7.6. Always add a crop oil concentrate at 1% v/v or surfactant at 0.25% v/v. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Fall applications of *Canopy* provide early-season residual control of certain weeds including common lambsquarters. However, effectiveness from the residual components of *Canopy* is greater the closer it is applied to planting. Consult label and **Table 12** for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. The addition of 2,4-D ester in the fall or in EPP applications is recommended and is required for control of certain weeds. *Canopy* can be tank mixed with Express (fall) or glyphosate to improve common chickweed control.

Canopy Blend (58.3 WG): *Canopy Blend* can be applied in the **Fall, EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. *Canopy Blend* contains *Classic* (chlorimuron) and *Metribuzin* (see **Table 2C**). *Canopy Blend* use rates are based on soil texture, organic matter, and pH. *Canopy Blend* rates range from 5 to 9 oz/A (5.75 oz/A). Reduced rates ranging from 2.9 to 5 oz/A (4 oz/A) can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. DO NOT apply *Canopy Blend* at rates greater than 2.9 oz/A to soils with a composite pH greater than 7.0; use of higher rates may result in unacceptable injury to this year's crop and the following crop. DO NOT apply *Canopy Blend* to soils with a composite pH exceeding 7.6. Always add a crop oil concentrate at 1% v/v or surfactant at 0.25% v/v. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Fall applications of *Canopy Blend* provide early-season residual control of certain weeds including common lambsquarters. However, effectiveness from the residual components of *Canopy Blend* is greater the closer it is applied to planting. Consult label and **Table 12** for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. The addition of 2,4-D ester in fall or EPP applications is recommended and is required for control of certain weeds. *Canopy Blend* can be tank mixed with *Express* (fall) or glyphosate to improve common chickweed control.

Canopy EX (29.5 WG): *Canopy EX* can be applied in the **Fall** and to the time of soybean planting **(preplant)** at rates ranging from 1.1 to 1.5 oz/A. For application rates greater than 1.5 and up to 2.2 oz/A of *Canopy EX* applications need to occur at least 7 day prior to soybean planting. *Canopy EX* contains *Classic* (chlorimuron) and *Express* (see **Table 2C**). *Canopy EX* use rates range from 1.1 to 2.2 oz/A, depending on soil pH. DO NOT apply *Canopy EX* at rates greater than 1.1 oz/A to soils with a composite pH greater than 7.0. DO NOT apply *Canopy EX* to soils with a composite pH exceeding 7.6. Always add a crop oil concentrate at 1% v/v or surfactant at 0.25% v/v. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. Fall applications of *Canopy EX* provide early-season residual control of certain weeds including common lambsquarters. However, effectiveness from the residual component of *Canopy EX* is greater the closer it is to planting. *Canopy EX* will not control ALS-resistant weeds. For best burndown results, the addition of 2,4-D ester is recommended.

Envive (41.3 WG): *Envive* can be applied in the **Fall, EPP** or **PRE** to control existing vegetation and to provide residual weed control. *Envive* contains *Classic* (chlorimuron), *Harmony*, and *Valor* (see **Table 2C**). *Envive* use rates range between 2.5 and 5.3 oz/A, for portions of Michigan south of highway I-96. The maximum use rate of *Envive* for portions of the Michigan north of I-96 is 2.5 oz/A. Soil pH also influences the maximum use rate of *Envive*. If the composite soil pH is between 7.1 and 7.6, do not apply more than 2.5 oz/A. DO NOT apply to soils with a composite pH exceeding 7.6. Always add a crop oil concentrate at 1% v/v. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. DO NOT tank mix with Group 15 herbicides such as metolachlor *(Dual)*, dimethenamid *(Outlook)*, or acetochlor *(Warrant)* products within 14 days of planting, unless soybeans are planted under no-till or minimum till conditions on wheat stubble or no-till field corn stubble. Fall applications of *Envive* provide early-season residual control of certain weeds including common lambsquarters. However, effectiveness from the residual components of *Envive* is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. For best burndown results, the addition of 2,4-D ester is recommended.

Extreme (2.17 L): *Extreme* can be applied in the **Fall, EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. *Extreme* contains glyphosate and *Pursuit* (see **Table 2C**). Apply *Extreme* at 3 pt/A. Always add surfactant at 0.25% v/v + 17 lb/100 gal of ammonium sulfate (AMS). Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control *(Pursuit)*. Effectiveness from the residual component of *Extreme* is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. For fall applications, adjust the rotational crop intervals by basing the interval on the date of soybean planting, not herbicide application. Apply with 2,4-D ester for improved horseweed (marestail) and perennial weed control.

Fierce (76 WG): *Fierce* can be applied in the **Fall, preplant** or **PRE** to control existing vegetation and to provide residual weed control. *Fierce* contains *Valor* (flumioxazin) and *Zidua* (pyroxasulfone) (see **Table 2C**). Apply *Fierce* at 3 or 3.75 oz/A depending on soil type and application timing. Always add a crop oil concentrate or a methylated seed oil at 1% v/v or a non-ionic surfactant at 0.25% v/v. The addition of ammonium sulfate (AMS) at 17 lb/100 gal may aid in control when tank-mixed with glyphosate. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. The effectiveness of *Fierce* is greater the closer it is to planting. Consult label and Table 12 for crop rotation restrictions. *Fierce* should be tank-mixed with 2,4-D ester, glyphosate, 2,4-D ester + glyphosate, *Gramoxone*, or *Liberty* to broaden the spectrum of burndown weed control.

Fierce XLT (62.41 WG): *Fierce XLT* can be applied in the Fall, preplant or PRE to control existing vegetation and to provide residual weed control. *Fierce XLT* contains *Valor* (flumioxazin), *Classic* (chlorimuron) and *Zidua* (pyroxasulfone) (see **Table 2C**). Apply Fierce XLT at 4 oz/A as part of a 2-pass program. Always add a crop oil concentrate or a methylated seed oil at 1% v/v or a non-ionic surfactant at 0.25% v/v. The addition of ammonium sulfate (AMS) at 17 lb/100 gal may aid in control when tank-mixed with glyphosate. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. DO NOT apply *Fierce XLT* to soils with a composite pH greater than 6.8. Crop injury may occur when *Fierce XLT* is applied to poorly drained soils and/or under cool, wet conditions. Consult label and Table 12 for crop rotation restrictions. *Fierce* should be tank-mixed with 2,4-D ester, glyphosate, 2,4-D ester + glyphosate, *Gramoxone*, or *Liberty* to broaden the spectrum of burndown weed control.

FirstRate (84 WG): *FirstRate* can be applied **EPP** (up to 14 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply *FirstRate* at 0.3 to 0.6 oz/A, use the 0.6 oz/A rate for improved residual control. Always add crop oil concentrate at 1% v/v and 28% N at 2.5% v/v. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. *FirstRate* will not control ALS-resistant weeds. To broaden the spectrum of weed control, tank mix with glyphosate, *Gramoxone* or 2,4-D ester. More effective burndown occurs when conditions are warm and sunny.

Flexstar 3.5 GT (2.82 L): *Flexstar GT 3.5* can be applied **preplant** or **PRE** to control existing vegetation and to provide some residual weed control. *Flexstar GT 3.5* contains glyphosate and *Flexstar* (see **Table 2C**). Apply *Flexstar GT 3.5* at 3 pt/A. Crop oil concentrate at 1% v/v and ammonium sulfate (AMS) at 17 lb/100 gal. should be added to *Flexstar GT 3.5*. DO NOT apply products containing fomesafen (*Flexstar, Flexstar GT 3.5, Prefix* or *Reflex*) to the same field in CONSECUTIVE years. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications. Consult label and Table 12 for crop rotation restrictions. The addition of 2,4-D ester may enhance horseweed (marestail) and perennial weed control.

Linex/Lorox (4 L): *Linex/Lorox* can be applied **EPP** (up to 30 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply *Linex/Lorox* at 1 pt/A. Always add crop oil concentrate at 1% v/v (preferred) or 0.25% v/v surfactant. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Effectiveness from *Linex/Lorox* is greater the closer it is applied to planting. To broaden the spectrum of weed control, tankmix with glyphosate or 2,4-D ester.

Metribuzin (75 DF): *Metribuzin* can be applied **EPP** (up to 30 days) or **PRE** for control of existing vegetation and to provide residual weed control. *Metribuzin* use rates are dependent on soil texture, organic matter, and pH. Apply *Metribuzin* at 8 oz/A. A lower rate of 5.33 oz/A can be applied in tank mixtures or as part of a 2-pass program in glufosinate or glyphosate-resistant soybean. Always add crop oil concentrate at 1% v/v. *Metribuzin* can also be applied in the fall for burndown activity of winter annual weeds, but it is not likely to provide extended residual control in the spring. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Effectiveness from *Metribuzin* is greater the closer it is applied to planting. *Metribuzin* will not control triazine-resistant weeds. To broaden the spectrum of weed control, tank mix with glyphosate, *Gramoxone*, 2,4-D ester, Liberty or Sharpen.

OpTill (68 WG): *OpTill* can be applied **preplant** or **PRE** to control existing vegetation and to provide residual control. *OpTill* contains *Sharpen* (saflufenacil) and *Pursuit* (see **Table 2C**). Apply *OpTill* at 2 oz/A. Always add a methylated seed oil (1% v/v) and ammonium sulfate (AMS) at 17 lb/100 gal. DO NOT apply *OpTill* after soybean emergence or severe crop injury will occur. DO NOT apply to coarse-textured soils with less than 2% organic matter unless soybean is planted 1 month after application. DO NOT tank mix or apply *OpTill* within 30 days of products containing flumioxazin *(Valor)*, sulfentrazone *(Authority or Spartan)*, or fomesafen *(Reflex)*. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. *Optill* should be tank mixed with glyphosate or glyphosate + 2,4-D ester to broaden the spectrum of burndown weed control.

OpTill PRO (co-pack): *OpTill PRO* can be applied in the **Fall, preplant** or **PRE** to control existing vegetation and to provide residual control. *OpTill PRO* is a co-pack of *OpTill* (*Sharpen* + *Pursuit*) and *Outlook* (see **Table 2C**). Apply *OpTill PRO* at 2 oz/A (dry) and 10 oz/A (liquid). Always add a methylated seed oil (1% v/v) and ammonium sulfate (AMS) at 17 lb/100 gal. DO NOT apply *OpTill PRO* after soybean emergence or severe crop injury will occur. DO NOT apply to coarse textured soils with less than 2% organic matter, unless soybean is planted 1 month after application. DO NOT tank-mix or apply *OpTill PRO* within 30 days of preemergence applications of flumioxazin *(Valor)*, sulfentrazone *(Authority* or *Spartan)* or fomesafen *(Reflex)* containing products. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. *Optill PRO* should be tank-mixed with glyphosate, or glyphosate + 2,4-D ester to broaden the spectrum of burndown weed control.

Python WDG/Accolade (80 WG): *Python/Accolade* can be applied **EPP** (up to 30 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply at 1.14 oz/A. Always add crop oil concentrate at 1% v/v. Can also be applied in the **Fall** for burndown activity of winter annual weeds, but it is not likely to provide extended residual control in the spring. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Effectiveness is greater the closer it is applied to planting. *Python/Accolade* will not control ALS-resistant weeds. To broaden the spectrum of weed control, tank-mix with glyphosate, *Gramoxone* or 2,4-D ester. More effective burndown occurs when conditions are warm and sunny.

Sequence (5.25 L): *Sequence* can be applied **EPP** (up to 30 days) or **PRE** to control existing vegetation and to provide residual weed control. *Sequence* contains glyphosate and *Dual Magnum* (see **Table 2C**). Apply *Sequence* at 2.5 pt/A. Ammonium sulfate (AMS) at 17 lb/100 gal should be added. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control *(Dual Magnum)*. The addition of 2,4-D ester may enhance horseweed (marestail) and perennial weed control.

Spartan Charge (3.5 SC): *Spartan Charge* can be applied in the **Fall, EPP** or **PRE** to control existing vegetation and to provide residual control. *Spartan Charge* contains *Spartan* (sulfentrazone) and *Aim* (see **Table 2C**). *Spartan Charge* use rates are based on soil texture, organic matter, and pH. *Spartan Charge* rates range from 5.75 to 8.5 oz/A (8 oz/A). A reduced rate of 6 oz/A can be applied as part of a 2-pass program in glufosinate or glyphosate-resistant soybean, unless resistant weeds are present. Use the lower end of the rate range when the pH is greater than 7.0. DO NOT apply *Spartan Charge* to soils with pH of 7.5 or higher or on sands with less than 1% organic matter. Always add a 0.5% v/v of a non-ionic surfactant and 17 lb/100 gal of ammonium sulfate. Soybean varieties vary in their sensitivity to sulfentrazone, a component in *Spartan Charge*; consult your local seed dealer for information. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. For improved burndown control, tank mixes with 2,4-D ester or glyphosate are recommended.

Surveil (48 WG): *Surveil* can be applied in the **Fall**, **EPP** or **PRE** to control existing vegetation and to provide residual weed control. *Surveil* contains *FirstRate* (cloransulam) and *Valor* (flumioxazin) (see **Table 2C**). Use rates range from 2.1-4.2 oz/A, 3.5 oz/A is a typical rate, unless *Surveil* is part of a 2-pass program in glufosinate or glyphosate-resistant soybean, a lower rate of 2.8 oz/A can be applied. Always add crop oil concentrate at 1% v/v; ammonium sulfate is also recommended. Consult **Table 20** for maximum weed heights and effectiveness ratings and **Table 2A** for residual weed control. DO NOT tank mix with Group 15 herbicides such as metolachlor *(Dual)*, dimethenamid *(Outlook)*, acetochlor *(Warrant)*, or pyroxasulfone *(Zidua)* products within 14 days of planting, unless soybeans are planted under no-till or minimum till conditions on wheat stubble or no-till field corn stubble. Refer to label and **Table 12** for crop rotation restrictions. For best burndown results, the addition of 2,4-D ester, glyphosate, or glyphosate + 2,4-D ester is recommended. *Gramoxone* or *Liberty* may also be used to broaden the spectrum of burndown weed control.

Synchrony XP (28.4 WG): *Synchrony XP* can be applied **EPP** (up to 45 days) or **PRE** to control existing vegetation and to provide residual weed control. *Synchrony XP* contains *Classic* (chlorimuron) and *Harmony* (see **Table 2C**). *Synchrony XP* use rates range between 1 and 3 oz/A, depending on soil pH. If the composite soil pH is between 7.1 and 7.6, do not apply more than 1 oz/A. DO NOT apply to soils with a composite pH exceeding 7.6. Use a minimum of 1 oz/A of *Synchrony XP* for burndown activity and a minimum of 1.25 oz/A for residual control of labeled weeds. Always add a crop oil concentrate at 1% v/v. Consult **Table 20** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Fall applications of *Synchrony XP* provide early-season residual control of certain weeds including common lambsquarters. However, effectiveness from the residual components of *Synchrony XP* is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. *Synchrony XP* will not control ALS-resistant weeds. For best burndown results, the addition of 2,4-D ester is recommended.

Trivence (61.3 WG): *Trivence* can be applied in the **Fall**, **EPP**, or **PRE** to control existing vegetation and to provide residual weed control. *Trivence* contains *Classic* (chlorimuron), *Metribuzin*, and *Valor* (flumioxazin) (see **Table 2C**). *Trivence* use rates range from 6 and 8 oz/A for portions of Michigan south of State Road 46. The maximum use rate of *Trivence* for portions north of State Road 46 is 6 oz/A. If soil pH is greater than 7, do not exceed 6 oz/A of *Trivence*. DO NOT use *Trivence* if soil pH exceeds 7.6. Always add a crop oil concentrate at 1% v/v. DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products within 14 days of planting, unless soybeans are planted under no-till

or minimum tillage conditions on wheat stubble or no-till field corn stubble or crop injury will occur. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. For best burndown results, the addition of 2,4-D ester is recommended. Tank-mixtures with glyphosate, 2,4-D ester + glyphosate, *Gramoxone*, or *Liberty* may also be used to broaden the spectrum of burndown weed control.

Valor/Rowel (51 WG) or ***Valor EZ (4L):*** *Valor/Valor EZ/Rowel* can be applied **EPP** (up to 14 days) or **PRE** for control of existing vegetation and to provide residual weed control. Apply at 2 to 3 oz/A, 2.5 oz/A is the typical use rate. Always add crop oil concentrate at 1% v/v; for burndown activity. Can also be applied in the **Fall** for burndown activity of winter annual weeds, but it is not likely to provide extended residual control in the spring. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products – crop injury will occur. These tank mixtures can be made if there is 14 days between application and planting or if there is 14 days between application of *Valor/Valor EZ/Rowel* and applications of these other products. Effectiveness is greater the closer it is applied to planting. More effective burndown occurs when conditions are warm and sunny. *Valor/Valor EZ/Rowel* has poor postemergence activity on horseweed (marestail), but it had good preemergence activity. Tank-mix with 2,4-D ester, glyphosate, glyphosate + 2,4-D ester, or *Gramoxone* to broaden the spectrum of burndown weed control.

Valor XLT/Rowel FX (40.3 WG): *Valor XLT/Rowel FX* can be applied in the **Fall, EPP** or **PRE** to control existing vegetation and to provide residual weed control. *Valor XLT/Rowel FX* contains *Classic* (chlorimuron) and *Valor/Rowel* (flumioxazin) (see **Table 2C**). Use rates range between 3 and 5 oz/A (4 oz/A), depending on soil pH. If the composite soil pH is greater than 6.8, do not apply more than 2.5 oz/A. Weeds will only be suppressed at this rate. DO NOT apply to soils with a composite pH exceeding 7.6. Always add a crop oil concentrate at 1% v/v; ammonium sulfate is also recommended. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. DO NOT tank mix or apply with metolachlor *(Dual)*, dimethenamid *(Outlook)* or acetochlor *(Warrant)* products – crop injury will occur. These tank mixtures can be made if there is 14 days between application and planting or if there is 14 days between application of *Valor XLT/Rowel FX* and applications of these other products. Fall applications provide early-season residual control of certain weeds including common lambsquarters. However, effectiveness from the residual components of *Valor XLT/Rowel FX* is greater the closer it is applied to planting. Consult label and Table 12 for crop rotation restrictions. For best burndown results, the addition of 2,4-D ester, glyphosate, or glyphosate + 2,4-D ester is recommended.

Zidua PRO: *Zidua PRO* can be applied in the **Fall**, **preplant** or **PRE** to control existing vegetation and to provide residual control. *Zidua PRO* is a premixture of *OpTill* (*Sharpen* + *Pursuit*) and *Zidua* (see Table 2C). Apply *Zidua PRO* at 6 oz/A. Always add a methylated seed oil (1% v/v) and ammonium sulfate (AMS) at 17 lb/100 gal. DO NOT apply *Zidua PRO* after soybean emergence or severe crop injury will occur. DO NOT apply to coarse textured soils with less than or equal to 2% organic matter, unless soybean is planted 1 month after application. DO NOT tank-mix or apply *Zidua PRO* within 30 days of preemergence applications of flumioxazin (*Valor*), sulfentrazone (*Authority* or *Spartan*), fomesafen (*Reflex*), or clomazone (*Command*) containing products. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications and **Table 2A** for residual weed control. Consult label and Table 12 for crop rotation restrictions. *Zidua PRO* should be tank-mixed with glyphosate, or glyphosate + 2,4-D ester to broaden the spectrum of burndown weed control.

Burndown Herbicides in Roundup Ready 2 Xtend Soybean

Engenia (5 L): *Engenia* (dicamba) can be applied in the **Fall, EPP** or **PRE** to Roundup Ready 2 Xtend soybean to control existing vegetation. A short period of residual activity on certain small seeded broadleaf weeds is possible, but is dependent on weather conditions. Apply *Engenia* at 12.8 oz/A to actively growing broadleaf weeds. *Engenia* is effective at controlling several broadleaf weed species, including glyphosate-resistant horseweed. *Engenia* is a Restricted Use Pesticide and has several restrictions for use. Consult the label and **Table 2G** for application requirements and precautions. Only labeled nozzles and tank-mixtures can be applied with *Engenia*. Applicators must consult the label website: **engeniatankmix.com** prior to tank mixing and application. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications.

XtendiMax/FeXapan (2.9 L): *XtendiMax/FeXapan* (dicamba) can be applied in the **Fall, EPP** or **PRE** to Roundup Ready 2 Xtend soybean to control existing vegetation. A short period of residual activity on certain small seeded broadleaf weeds is possible, but is dependent on weather conditions. Apply *XtendiMax/FeXapan* at 22 oz/A to actively growing broadleaf weeds. A use rate of 44 oz/A can be used prior to crop emergence, however the downwind buffer is greater at this rate. *XtendiMax/FeXapan* are effective at controlling several broadleaf weed species, including glyphosate-resistant horseweed. *XtendiMax/FeXapan* are Restricted Use Pesticides and have several restrictions for use. Consult the labels and **Table 2G** for application requirements and precautions. Only labeled nozzles and tank-mixtures can be applied with *XtendiMax/FeXapan*. Applicators must consult the label websites: **xtendimaxapplicationrequirements.com** for *XtendiMax* and **fexapanapplicationrequirements.dupont.com** for *FeXapan* prior to tank mixing and application. Consult **Table 2O** for maximum weed heights and effectiveness ratings for burndown applications.

Effectiveness of Herbicides for No-Till Soybean

Fall or Spring Burndown	LENGTH OF CONTROL[d]	ANNUAL BROADLEAVES / GRASSES												WINTER ANNUALS / PERENNIALS									COVER CROPS			
		Cocklebur	Jimsonweed	Lambsquarters	Nightshade (E. Black)	Pigweed	Ragweed (Common)	Ragweed (Giant)	Smartweed	Velvetleaf	Wild mustard	Barnyardgrass	Foxtails	Chickweed (Common)	Deadnettle	Henbit	Horseweed (Marestail)	Pennycress	Shepherd's-purse	Yellow rocket	Dandelion	Quackgrass	Rye	Wheat	Clover	Hairy Vetch
		Maximum Weed Height (inches)												Herbicide Effectiveness												
Glyphosate (0.75 lb ae/A)[a]	0	6	6	6	6	6	6	6	6	6	6	6	6	**E**	F	**G**	**E**	**E**	**E**	**E**	**G**[e]	**G**	**E**	**E**	F	F
Glyphosate (1.13 lb ae/A)[a]	0	12	12	12	12	12	12	12	12	12	12	12	12	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**G**[e]	**G**	**E**	**E**	F	F
Gramoxone SL 2.0 (2 pt/A)	0	3	3	3	3	3	3	3	–	3	3	3	3	**E**	P	**G**	P	**G**	**G**	**G**	P	P	F	F	P	P
Gramoxone SL 2.0 (3 pt/A)	0	6	6	6	6	6	6	6	–	6	6	6	6	**E**	F	**G**	P	**E**	**E**	**E**	P	P	**G**	**G**	F	F
Liberty (32 oz/A)	0	14	10	6	8	4	10	12	14	4	6	5	12	**E**	F	F	**G**	**G**	**G**	**G**	F	N	P	F	P	**G**
2,4-D ester[b] (1 pt/A)	0	3	–	3	3	3	3	3	–	2	3	–	–	P	P	P	**E**	**G**	**G**	**G**	P	N	N	N	F	F
2,4-D ester[c] (1 qt/A)	1	6	3	6	6	6	6	6	3	5	6	–	–	P	F	F	**E**	**E**	**E**	**E**	F	N	N	N	**G**	**G**
Elevore (1 oz/A)	0	-	-	4	-	4	4	-	-	-	-	-	-	-	**G**	**G**	**G**	-	-	-	-	-	-	-	-	-
Express (0.25 oz/A)	0	–	–	3	–	–	–	–	–	–	3	–	–	**E**	**G**	**G**	P	**G**	F	P	F	N	N	N	N	N
Aim + glyphosate (1 oz + 0.75 lb ae/A)	0	4	4	4	4	4	4	4	4	4	4	4	4	**G**	F	**G**	**G**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Sharpen (1 oz/A)	0	6	–	6	6	6	6	6	6	6	6	–	–	F	P	P	**E**	**G**	**G**	**G**	P	N	N	N	F	N
Sharpen + glyphosate (1 oz + 0.75 lb ae/A)	0	6	6	6	6	6	6	6	6	6	6	6	6	**G**	F	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Verdict + glyphosate (5 oz + 0.75 lb ae/A)	0	6	6	6	6	6	6	6	6	6	6	6	6	**G**	F	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Vida + glyphosate (1 oz + 0.75 lb ae/A)	0	4	–	4	4	4	4	4	4	4	–	–	–	**E**	F	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Afforia (2.5 oz/A)	2	–	–	3	–	3	–	–	3	–	–	–	–	**E**	**G**	**G**	P	**G**	**E**	**G**	F	N	N	N	P	P
Authority Assist (10 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	N	N	N	N	N
Authority First/Sonic (6.4 oz/A)	2	10	4	–	–	–	8	10	6	6	2	–	–	P	P	P	**E**	**G**	F	F	P	N	N	N	P	P
Authority MAXX (5 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	F	F	**G**	**G**	**G**	**G**	**G**	F[e]	N	P	P	P	P

(Continued on next page)

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not labeled or recommended.

[a] See Table 10 for glyphosate products, formulations and rates. Lower glyphosate rates may be used for smaller weeds at lower spray volumes. Consult label.

[b] Wait a minimum of 7 days before planting soybean.

[c] Wait a minimum of 30 days before planting soybean.

[d] Length of summer weed control: 0 = no residual control; 1 = short residual control; 2 = moderate residual control; 3 = long residual control.

[e] Dandelion control from fall applications.

Effectiveness of Herbicides for No-Till Soybean *(continued)*

Fall or Spring Burndown	LENGTH OF CONTROL[d]	ANNUAL BROADLEAVES / GRASSES												WINTER ANNUALS / PERENNIALS									COVER CROPS			
		Cocklebur	Jimsonweed	Lambsquarters	Nightshade (E. Black)	Pigweed	Ragweed (Common)	Ragweed (Giant)	Smartweed	Velvetleaf	Wild mustard	Barnyardgrass	Foxtails	Chickweed (Common)	Deadnettle	Henbit	Horseweed (Marestail)	Pennycress	Shepherd's-purse	Yellow rocket	Dandelion	Quackgrass	Rye	Wheat	Clover	Hairy Vetch
		Maximum Weed Height (inches)												Herbicide Effectiveness												
Authority MTZ (16 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	**G**	**G**	**G**	F	**G**	**G**	**G**	P	N	N	N	P	P
Authority XL (4 oz/A)	3	–	–	3	3	3	3	3	3	–	3	1	1	F	F	**G**	**G**	**G**	**G**	**G**	**G**[e]	N	P	P	P	P
Autumn Super (0.5 oz/A)	2	–	–	–	–	3	–	–	–	–	3	–	–	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	–	–	**G**	**G**
Canopy (4.5 oz/A)	3	-	-	3	-	3	3	3	3	-	3	2	2	**G**	**G**	**G**	F	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
Canopy Blend (5.75 oz/A)	3	–	–	3	–	3	3	3	3	–	3	2	2	**G**	**G**	**G**	F	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
Canopy EX (1.65 oz/A)	3	–	–	–	–	3	3	3	3	3	3	–	–	**E**	**G**	**G**	**G**	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
Envive (3.5 oz/A)	3	–	–	–	–	3	3	3	3	3	3	–	–	P	**G**	**G**	F	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
Extreme (3 pt/A)	2	18	6	8	12	18	9	9	6	5	18	6	18	**E**	F	**G**	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	P	P
Fierce (3 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	P	F	F	P	**G**	**E**	**G**	F	N	N	N	P	P
Fierce XLT (4 oz/A)	3	–	–	–	–	–	–	–	–	–	–	–	–	P	**G**	**G**	F	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
FirstRate (0.6 oz/A)	2	10	4	–	–	–	8	10	6	6	2	–	–	P	P	P	**E**	**G**	F	F	P	N	N	N	P	P
Flexstar GT 3.5 (3.5 pt/A)	1	4	4	4	4	4	4	4	4	4	6	6	18	**E**	**G**	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F
Linex/Lorox (1 pt/A)	2	6	–	6	–	–	6	–	6	6	6	2	2	**G**	P	P	P	P	P	P	P	P	P	P	P	P
Metribuzin (8 oz/A)	1	1	–	1	–	1	1	–	–	–	–	–	–	**G**	**G**	**G**	F	**G**	**G**	**G**	P	N	N	N	P	P
OpTill (2 oz/A)	2	8	3	6	6	6	6	6	6	6	6	3	3-6	F	P	P	**E**	**G**	**G**	**G**	P	N	N	P	F	N
OpTill PRO (2 + 10 oz/A)	2	8	3	6	6	6	6	6	6	6	6	3	3-6	F	P	P	**E**	**G**	**G**	**G**	P	N	N	P	F	N
Python WDG/Accolade (1.14 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	**G**	P	P	**G**	**G**	F	**G**	P	N	N	N	P	P
Sequence (2.5 pt/A)	2	12	12	6	6	12	12	12	6	6	18	6	18	**E**	F	**G**	**E**	**E**	**E**	**E**	F	**G**	**E**	**E**	F	F

(Continued on next page)

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not labeled or recommended.

[a] See Table 10 for glyphosate products, formulations and rates. Lower glyphosate rates may be used for smaller weeds at lower spray volumes. Consult label.

[b] Wait a minimum of 7 days before planting soybean.

[c] Wait a minimum of 30 days before planting soybean.

[d] Length of summer weed control: 0 = no residual control; 1 = short residual control; 2 = moderate residual control; 3 = long residual control.

[e] Dandelion control from fall applications.

Effectiveness of Herbicides for No-Till Soybean *(continued)*

Fall or Spring Burndown	LENGTH OF CONTROL[d]	Cocklebur	Jimsonweed	Lambsquarters	Nightshade (E. Black)	Pigweed	Ragweed (Common)	Ragweed (Giant)	Smartweed	Velvetleaf	Wild mustard	Barnyardgrass	Foxtails	Chickweed (Common)	Deadnettle	Henbit	Horseweed (Marestail)	Pennycress	Shepherd's-purse	Yellow rocket	Dandelion	Quackgrass	Rye	Wheat	Clover	Hairy Vetch
		ANNUAL BROADLEAVES / GRASSES												WINTER ANNUALS / PERENNIALS									COVER CROPS			
		Maximum Weed Height (inches)												Herbicide Effectiveness												
Spartan Charge (8 oz/A)	2	–	3	3	3	3	–	–	3	3	3	–	–	–	–	–	–	**G**	**G**	**G**	P	N	–	–	–	–
Surveil (3.5 oz/A)	2	10	4	–	–	–	8	10	6	6	2	–	–	P	F	F	**E**	**G**	**E**	**G**	F	N	N	N	P	P
Synchrony XP (1.5 oz/A)	3	–	–	3	–	3	3	3	3	3	3	–	–	P	**G**	**G**	F	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
Trivence (8 oz/A)	3	–	–	–	–	3	3	3	3	3	3	–	–	**G**	**G**	**G**	F	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
Valor/Valor EZ/Rowel (2.5 oz/A)	2	–	–	–	–	–	–	–	–	–	–	–	–	P	F	F	P	**G**	**E**	**G**	F	N	N	N	P	P
Valor XLT/Rowel FX (4 oz/A)	3	–	–	–	–	–	–	–	–	–	–	–	–	P	**G**	**G**	F	**E**	**E**	**E**	**G**[e]	N	P	P	P	P
Zidua PRO (6 oz/A)	2	8	3	6	6	6	6	6	6	6	6	-	-	F	P	P	**E**	**G**	**G**	**G**	P	N	N	P	F	N
ROUNDUP READY 2 XTEND (DICAMBA-RESISTANT) SOYBEAN																										
Engenia (12.8 oz)	1	4	4	4	4	4	4	4	4	4	4	-	-	F/**G**	F	F	**E**	**E**	**G**	**E**	**G**	N	N	N	**E**	**G**
XtendiMax/FeXapan 22 oz/A	1	4	4	4	4	4	4	4	4	4	4	-	-	F/**G**	F	F	**E**	**E**	**G**	**E**	**G**	N	N	N	**E**	**G**

P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not labeled or recommended.

[a] See Table 10 for glyphosate products, formulations and rates. Lower glyphosate rates may be used for smaller weeds at lower spray volumes. Consult label.
[b] Wait a minimum of 7 days before planting soybean.
[c] Wait a minimum of 30 days before planting soybean.
[d] Length of summer weed control: 0 = no residual control; 1 = short residual control; 2 = moderate residual control; 3 = long residual control.
[e] Dandelion control from fall applications.

TABLE 3A — Weed Response to Herbicides in Small Grains*

			WINTER ANNUAL GRASSES					WINTER ANNUAL BROADLEAVES									SUMMER ANNUALS					PERENNIALS				
	SITE OF ACTION	CROP TOLERANCE**	BLUEGRASS (ANNUAL)	CHEAT	DOWNY BROME	RYEGRASS (ANNUAL)	WINDGRASS (COMMON)	CHICKWEED (COMMON)	DEADNETTLE (PURPLE)	HENBIT	HOARY ALYSSUM	HORSEWEED (MARESTAIL)[a]	MAYWEED (DOGFENNEL)	MUSTARD SPECIES	PENNYCRESS (FIELD)	SHEPHERDSPURSE	LAMBSQUARTERS (COMMON)	PIGWEED	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	BINDWEED (FIELD)	CANADA THISTLE	SOWTHISTLE	WILD GARLIC	WILD ONION
2,4-D AMINE	4	3	N	N	N	N	N	P	F	P	**G**	**G**	P	**E**	**E**	**E**	**G**	**G**	**G**	**G**	P	P	P	P	P	P
2,4-D ESTER	4	3	N	N	N	N	N	P	F	P	**G**	**G**	P	**E**	**E**	**E**	**G**	**G**	**G**	**G**	P	F	F	P	F	F
AFFINITY BROADSPEC	2/2	1	N	N	N	N	N	**E**	**G**	**E**	P	F	**E**	**E**	**E**	**E**	**E**	**E**	F	P	**E**	P	F	F	**G**	F
AXIAL XL	1	1	N	N	N	**E**	**G**	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
BANVEL/CLARITY	4	3	N	N	N	N	N	F	P	P	F	**G**	F	F	P	**G**	**G**	**G**	**G**	**G**	**G**	F	F	F	F	F
BUCTRIL/MOXY	6	1	N	N	N	N	N	P	-	**G**	F	P	F	**E**	**G**	**G**	**E**	P	**G**	**G**	**G**	P	P	N	N	N
CURTAIL	4/4	3	N	N	N	N	N	P	-	-	**G**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	F	P	F	P	P	P
EXPRESS	2	1	N	N	N	N	N	**E**	**E**	**E**	P	F	**E**	**E**	**E**	**G**	**E**	F	P	P	F	P	F	F	F	P
HARMONY	2	1	N	N	N	N	N	**G**	-	-	P	N	**E**	**G**	**G**	**G**	**G**	**E**	F	P	**E**	P	P	P	**E**	F
HARMONY EXTRA	2/2	1	N	N	N	N	N	**E**	**G**	**E**	P	F	**E**	**E**	**E**	**E**	**E**	**E**	F	P	**E**	P	F	F	**E**	F
HUSKIE	6/27	1	N	N	N	N	N	**G**	**E**	**E**	F	**E**	F	**E**	**E**	**E**	**E**	**E**	**E**	**G**	F	P	F	F	N	N
MCPA	4	2	N	N	N	N	N	P	-	-	**G**	**G**	P	**G**	**G**	**G**	**G**	**G**	**G**	F	P	P	P	P	P	P
NIMBLE	2/2	1	N	N	N	N	N	**E**	**G**	**E**	P	F	**E**	**E**	**E**	**E**	**E**	**E**	F	P	**E**	P	F	F	**E**	F
OSPREY	2	2	**G**[b]	F	-	**G**	**E**	P	N	N	N	N	N	**G**	**G**	-	N	P	N	N	N	N	N	N	N	N
PEAK	2	2	N	N	N	N	N	**G**	F	F	-	-	P	**E**	**E**	**G**	F	**E**	**E**	F	F	F	F	N	**G**	N
POWERFLEX HL	2	2	**G**[b]	**E**	**G**	**E**	**E**	**G**	F	F	N	P	-	**E**	**E**	**G**	**G**	**G**	N	N	F	N	N	N	F	N
PROWL H_2O	3	2	-	-	-	-	P	N	N	N	N	N	N	-	-	-	F	F	N	N	N	N	N	N	N	N
PUMA	1	2	N	N	-	-	F	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
QUELEX	2/4	2	N	N	N	N	N	**G**	**G**	**G**	-	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	-	P	P	P	N	N
STARANE ULTRA	4	2	N	N	N	N	N	F	-	-	N	-	P	F	-	-	P	P	**E**	**E**	F	F	P	P	N	N
STINGER	4	2	N	N	N	N	N	P	-	-	P	**E**	**G**	-	-	-	P	P	**G**	**G**	F	P	**G**	F	N	N
TALINOR	6/27	1	N	N	N	N	N	**G**	F	F	-	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	P	F	**E**	-	-
WIDEMATCH	4/4	2	N	N	N	N	N	P	-	-	P	**E**	**G**	**G**	-	-	P	P	**E**	**G**	F	F	**G**	F	N	N

[a] Group 2 (ALS-inhibiting) herbicides will not control Group 2 resistant horseweed.

[b] Will not control annual bluegrass that has already started to flower.

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high. Recommended only in rescue situations.

TABLE 3B – Herbicide Premixes in Small Grains

TRADE NAME	COMPANY	FORMULATION	TYPICAL USE RATE	=	EQUIVALENT RATES
Affinity BroadSpec	DuPont	50WG	0.75 oz/A	=	0.375 oz Harmony SG + 0.375 oz Express
Curtail	BASF	2.38L	2 pt/A	=	0.25 pt Stinger + 1 pt 2,4-D amine
Harmony Extra	DuPont	50WG	0.75 oz/A	=	0.5 oz Harmony SG + 0.25 oz Express
Huskie	Bayer CropSciences	2.06L	13.5 oz/A	=	0.74 pt Buctril + 0.033 lb ai pyrasulfotole
Nimble	Cheminova	75WG	0.5 oz/A	=	0.5 oz Harmony SG + 0.25 oz Express
Quelex	Dow AgroSciences	20WG	0.75 oz/A	=	0.0046 lb ae halauxifen + 0.0046 lb ai florasulam
Talinor	Syngenta	1.77L	13.7 oz/A	=	0.62 pt Buctril + 0.033 lb ai bicyclopyrone
Widematch	Dow AgroSciences	1.5L	1.33 pt/A	=	5.3 oz Stinger + 0.67 pt Starane

TABLE 3C – Small Grain Herbicides – Remarks and Limitations

Direct-Drilled Small Grains (No-Till)

(fall or spring seedings following soybeans, corn or dry edible beans)

In general, complete control of all plants present at the time of planting is required for successful weed control. With direct drilling (no-till), vegetation control is accomplished before planting with burndown herbicides such as paraquat *(Gramoxone)* or glyphosate (Table 10). Other herbicides such as *Sharpen* may be tank-mixed with these products to help improve control of certain weed species (e.g., glyphosate-resistant horseweed). The required application rate varies, depending on weed species and size. Refer to the product labels for details. *Gramoxone* provides faster kill. Glyphosate is preferred if perennial weeds are present, but fields with serious perennial weed problems should not be direct drilled with a small grain until the perennial weeds have been controlled.

The need for a burndown herbicide depends on the species of weeds present. If no weeds are present, a burndown herbicide is not needed. For fall-seeded small grains, fields with small seedlings of species that DO NOT overwinter (summer annuals only) and are present at low densities DO NOT need a burndown herbicide. If the weeds are large, however, or capable of overwintering (winter annuals, biennials or perennials) or if identification of the weeds cannot be confirmed, a burndown herbicide should be used. For spring-seeded small grains, a burndown herbicide should be used if any weeds are present at planting time, regardless of species or size.

Herbicides applied after small grain emergence are not affected by the tillage system used. All of the herbicides listed below can be used in all tillage systems including direct drilling. No weed problems are unique to no-till small grain production. Therefore, no-till small grain production does not present any special weed control concerns.

Wheat Only — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	mesosulfuron *(Osprey)* + surfactant + ammonium sulfate	0.013	4.75 oz 4.5WG + 0.5% + 3 lb	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply in the fall after wheat emergence, or in the spring before jointing. • *Osprey* will provide control of windgrass, annual bluegrass, annual ryegrass, and cheat. • Methylated seed oil at 1.5 pt/A can be used in place of surfactant + ammonium sulfate. • Red clover can be frost-seeded after fall applications of *Osprey* – some initial injury may occur. DO NOT apply *Osprey* in the spring if red clover is frost-seeded. • DO NOT apply to barley. • *Osprey* should be applied using water as the spray carrier, but up to 15% of the spray solution can be nitrogen fertilizer solution. • DO NOT use spray additives that alter the spray solution below 6.0 pH. • DO NOT apply more than a total of 4.75 oz/A per crop year. • May be tank mixed with other herbicides to control a broader spectrum of broadleaf weeds. See label for tank mix partners. • Refer to Table 3E for harvest restrictions. • **Crop rotation restrictions**: Rotation interval for corn is 12 months. Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Wheat Only — All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	pyroxsulam *(PowerFlex HL)* + surfactant + ammonium sulfate	0.016	2 oz 13WG + 0.5% + 3 lb	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply to winter wheat in the fall or spring from the 3 leaf stage to jointing, between Feeke's stages 1.3 and 6 (Figure 1). • *PowerFlex HL* may only be applied to wheat. • *PowerFlex HL* is labeled for control of windgrass and cheat. • Most effective when grass weeds are at the 2 leaf stage and broadleaf weeds are less than 2 inches tall. • Red clover can be frost-seeded after fall applications of *PowerFlex HL* – some initial injury may occur. DO NOT apply *PowerFlex HL* in the spring if red clover is frost-seeded. • *PowerFlex HL* may be applied with no more than 50% of the spray carrier as liquid nitrogen (<30 lb actual nitrogen), reduce the rate of surfactant to 0.25% - foliar leaf burn, yellowing, and reduced growth may occur. • *PowerFlex HL* will not control ALS-resistant weed species. • DO NOT apply to barley. • DO NOT tank-mix with dicamba, 2,4-D amine, or MCPA – grass control will be reduced. • Refer to Table 3E for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	pendimethalin *(Prowl H_2O)*	0.95	2 pt 3.8CS	• Refer to Table 3A for weed control and crop tolerance ratings. • *Prowl H_2O* may only be applied to wheat. • Apply between 1 leaf and flag leaf emergence, between Feeke's stages 1 and 7.9 (Figure 1). • *Prowl H_2O* has limited effectiveness against windgrass. • *Prowl H_2O* will not control emerged weeds. *Prowl H_2O* should be applied before target weed emergence. • Wheat seed must be planted 1/2 to 1 inch deep to avoid crop injury. • Refer to Table 3E for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

Barley and Wheat — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	pinoxaden *(Axial XL)*	0.054	16.4 oz 0.42L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply from the 2-leaf stage to pre-boot stage (Figure 1). • *Axial XL* is labeled for control of windgrass. • May be tank mixed with most other herbicides. Consult label for tank mix partners. • Weeds should be actively growing, 1- to 5-leaf grasses. • *Axial XL* contains a built-in adjuvant. • Refer to Table 3E for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Barley and Wheat — All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	fenoxaprop-p-ethyl *(Puma)*	0.082	0.66 pt 1EC	• Refer to Table 3A for weed control and crop tolerance ratings. • *Puma* can be applied on wheat and barley from crop emergence up to the 5-leaf stage but not after jointing begins, between Feeke's stages 1 and 6 (Figure 1). • *Puma* will provide control of windgrass. • *Puma* will only control emerged grass weeds. Rate of application varies based on weed species present to be controlled. • *Puma* will control susceptible grass weeds in the 1-leaf to 2-tiller stage of growth. • May be tank mixed with other herbicides to improve broadleaf weed control. See label for tank mix partners and details on rates. • May be tank mixed with either *Baythroid XL, Furadan, Sevin*, or *Warrior* insecticides. DO NOT tank mix with malathion. • May be tank mixed with mancozeb, *Tilt* and *Stratego* (without additional adjuvant), or *Topsin M* fungicides. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
Annual broadleaves	2,4-D amine or *2,4-D ester*	0.5 0.5	1 pt 4L 1 pt 4L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply in the spring to actively growing grain following tillering (usually about 6-8 inches tall) but prior to jointing, between Feeke's stages 3 and 6 (Figure 1). • DO NOT treat in the BOOT to DOUGH stage. • DO NOT apply in the fall. • Most effective when weeds are small (less than 4 inches). • DO NOT frost-seed red clover if *2,4-D* is applied. • *2,4-D ester* will provide suppression of wild garlic and wild onion. • Not effective on smartweed and wild buckwheat. • Liquid nitrogen fertilizer solutions can be used as the carrier in place of water. • *2,4-D ester* mixes easier with 28% liquid nitrogen. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.

(Continued on next page)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	thifensulfuron-methyl + tribenuron-methyl *(Affinity BroadSpec)* + surfactant	0.023	0.75 oz 50WG + 0.25%	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply to winter wheat and barley after the crop is in the 2-leaf stage but before the flag leaf is visible, between Feeke's stages 1.2 and 7.9 (Figure 1). • Most effective if weeds are small, 4 inches or less. • Red clover can be frost-seeded after fall applications of *Affinity BroadSpec*. DO NOT apply *Affinity BroadSpec* in the spring if red clover is frost-seeded. • *Affinity BroadSpec* may be tank mixed with 2,4-D, MCPA or *Buctril* and improved control of ragweed. • Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk, apply 2,4-D at no more than 0.5 pt/A (0.25 lb ai/A) of 2.4-D and reduce surfactant concentration to 0.125%. • For severe infestation, increase *Affinity BroadSpec* rate to 1.0 oz/A. • **Caution:** If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. Crop injury is greatly reduced if the spray carrier is a 50:50 mixture of liquid nitrogen to water compared with 100% liquid nitrogen as the carrier. With favorable growing conditions the symptoms are temporary, but this practice is not recommended. • **Caution:** DO NOT USE *Affinity BroadSpec* plus malathion, as crop injury will occur. • Refer to Table 3E for harvest restrictions. • See Table 12 for crop rotation restrictions.
	dicamba *(Banvel, Clarity)*	0.125	0.25 pt 4L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply in spring to actively growing plants with a well established secondary root system or following tillering but prior to jointing, between Feeke's stages 3 and 6 (Figure 1). • Some wheat varieties are sensitive to dicamba. • DO NOT apply dicamba to wheat varieties Wakefield or Madison — severe injury and yield loss will occur. • DO NOT apply to spring-seeded barley. • DO NOT frost-seed red clover if dicamba is applied. • Most effective when weeds are small, less than 4 inches. • Dicamba provides some control of bindweed, thistles, wild garlic and wild onion. • More effective than 2,4-D on smartweed, wild buckwheat, and perennials. • CAUTION should be taken to avoid vapor and particle spray drift. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.

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Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	bromoxynil (*Buctril, Moxy,* others)	0.35	1.5 pt 2L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply from emergence to boot stage, between Feeke's stages 1 and 9 (Figure 1). • *Buctril* may be applied to small grains seeded with ALFALFA only. Alfalfa needs to have at least 4 trifoliate leaves prior to application and air temperatures should not exceed 70°F at and 3 days following application. • Good coverage is essential. • Bromoxynil must be applied to small weeds for effective control. • Redroot pigweed and mustard must be controlled when very small (refer to label for details). • Very good crop safety. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	clopyralid+ 2,4-D amine *(Curtail)*	0.6	2 pt 2.38L	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • For control of annual broadleaves and suppression of 3 Canada thistle. • Apply to wheat and barley following tillering but prior to jointing, between Feeke's stages 3 and 6 (Figure 1). • DO NOT treat in the BOOT to DOUGH stage. • DO NOT treat a field with *Curtail* that has been treated previously with 2,4-D or dicamba. • Refer to Table 3E for harvest restrictions. • Rotation interval for soybeans and dry beans is extended to 18 months if soils contain less than 2% organic matter and natural precipitation is less than 15 inches during the 10.5 months following treatment. • See Table 12 for crop rotation restrictions.
	tribenuron-methyl *(Express SG)* + surfactant	0.016	0.5 oz 50WG + 0.25%	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply after the crop has reached the 2-leaf stage but 3 before the flag leaf is visible, between Feeke's stages 1.2 and 7.9 (Figure 1). • Provides some suppression of Canada thistle and sowthistle. Apply when thistles are actively growing and 4-8 inches tall with 2-6 inches of new growth. • *Express* may be tank mixed with 2,4-D, MCPA or *Buctril* for improved control of ragweed. • Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk, apply no more than 0.5 pt/A (0.25 lb a.i./A) of 2,4-D and reduce surfactant concentration to 0.125%. • Spectrum of annual weeds controlled is narrower than with *Harmony Extra* or *Affinity Broadspec*. • Very good crop safety. • **Caution:** If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. With favorable growing conditions the symptoms are temporary, but this practice is not recommended. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.

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Barley and Wheat — All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	thifensulfuron-methyl *(Harmony SG)* + surfactant	0.023	0.75 oz 50WG + 0.25%	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply to winter wheat and barley after the crop is in the 2-leaf stage but before the flag leaf is visible, between Feeke's stages 1.2 and 7.9 (Figure 1). • Most effective if weeds are small, 4 inches or less. • *Harmony* may be tank mixed with 2,4-D, MCPA or *Buctril* for improved control of ragweed. • Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk, apply no more than 0.5 pt/A (0.25 lb ai/A) of 2,4-D and reduce surfactant concentration to 0.125%. • For severe infestation, increase *Harmony SG* rate to 0.9 oz/A. • For mayweed (dogfennel) control, reduce the *Harmony SG* rate to 0.45 oz/A. • Control of common ragweed is inconsistent. • **Caution:** If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. With favorable growing conditions the symptoms are temporary, but this practice is not recommended. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	thifensulfuron-methyl + tribenuron-methyl *(Harmony Extra SG)* + surfactant	0.023	0.75 50WG + 0.25%	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply to winter wheat and barley after the crop is in the 2-leaf stage but before the flag leaf is visible, between Feeke's stages 1.2 and 7.9 (Figure 1). • *Harmony Extra* is the best herbicide option for controlling wild garlic — increase the rate to 0.9 oz/A and apply when wild garlic is less than 12 inches tall with 2-4 inches of new growth. • *Harmony Extra* will provide some control of wild onion. • Most effective if weeds are small, 4 inches or less.3 • *Harmony Extra* may be tank mixed with 2,4-D, *MCPA* or *Buctril* for improved control of ragweed. Tank mixes with 2,4-D may improve thistle control but also carry a greater risk of crop injury. To reduce this risk, no more than 0.5 pt/A (0.25 lb ai/A) of 2,4-D and reduce surfactant concentration to 0.125%. • For severe infestations and control of Canada thistle, increase the *Harmony Extra SG* rate to 0.9 oz/A. • For mayweed (dogfennel) control, *Harmony Extra SG* rate may be reduced to 0.45 oz/A. • Control of common ragweed is inconsistent. • **Caution:** If liquid nitrogen fertilizer is used as the herbicide carrier, leaf burn, yellowing, and stunting are likely. With favorable growing conditions the symptoms are temporary, but this practice is not recommended. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.

(Continued on next page)

Barley and Wheat — All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	pyrasulfotole + bromoxynil *(Huskie)* + surfactant + ammonium sulfate	0.217	13.5 oz 2.06L + 0.25% + 1 lb/A	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply between 1 leaf and up to flag leaf emergence, between Feeke's stages 1 and 7.9 (Figure 1). • Apply to actively growing weeds with 1 to 4 leaves. • A nitrogen source — ammonium sulfate (0.5 to 1 lb/A) or 28% nitrogen (1 to 2 qt/A) — is required. • Under cool conditions early in the spring, increase the *Huskie* rate to 15 oz/A. • Red clover can be frost-seeded after fall applications of *Huskie* – some initial leaf margin bleaching may occur. DO NOT apply *Huskie* in the spring if red clover is frost-seeded. • Liquid nitrogen fertilizer solutions can be used as the carrier in place of water (WHEAT ONLY). For fall applications, DO NOT apply more than a 50:50 mixture of liquid nitrogen to water as the spray carrier. In the spring, crop injury is greatly reduced if the spray carrier is a 50:50 mixture of liquid nitrogen to water compared with 100% liquid nitrogen as the carrier. • Refer to Table 3E for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	MCPA	0.19	0.38 pt 4L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply in the spring to actively growing grain following tillering (usually about 6-8 inches high) but prior to jointing (Figure 1). DO NOT treat grain in boot to dough stage. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • *MCPA* may be applied to small grains underseeded with legumes (e.g., red clover). • A canopy of grain and weeds over the seeding will reduce the possibility of injury to the legume. • Apply in 5-6 gal of water/A to minimize crop injury. • Sweet clover is very sensitive to *MCPA*. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	thifensulfuron-methyl + tribenuron-methyl *(Nimble)* + surfactant	0.023	0.5 oz 75WG + 0.25% •	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • *Nimble* contains the same ratio of active ingredients as *Harmony Extra*, but at a different concentration. • See the Remarks and Limitations section for *Harmony Extra*. • Refer to label and Table 12 for crop rotation restrictions.

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Barley and Wheat — All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	prosulfuron *(Peak)* + crop oil concentrate	0.013	0.38 oz 57DF + 1%	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply from emergence to before the second node is detectable in stem elongation, between Feeke's stages 1 and 7 (Figure 1). • *Peak* provides good control of wild garlic. • May be tank mixed with 2,4-D, dicamba, *Buctril* or *MCPA* to improve control of other broadleaf species. • Weeds should be actively growing, less than 4 inches tall. • Surfactant (0.25% v/v) should replace crop oil concentrate when applied with liquid fertilizer as the carrier. • For severe infestations, increase the *Peak* rate to 0.5 oz/A. • DO NOT apply when the crop is under stress due to drought, cold weather or other factors, or if cold, wet conditions are expected within one week after application. • Refer to Table 3E for harvest restrictions. • Rotation restrictions are 22 months for several crops, including soybeans. • Refer to label and Table 12 for crop rotation restrictions.
	halauxifen + florasulam *(Quelex)* + crop oil concentrate	0.009	0.75 oz 20WG + 1%	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply between 2 leaf and up to flag leaf emergence, between Feeke's stages 1.2 and 7.9 (Figure 1). • Apply to actively growing weeds less than 4 inches tall. • *Quelex* can be applied with a methylated seed oil at 1% v/v. • DO NOT frost-seed red clover if *Quelex* is applied. • Liquid nitrogen fertilizers can be used as a carrier in place of water. Only a non-ionic surfactant at a maximum rate of 0.25% v/v can be used as the adjuvant if nitrogen fertilizers are the carrier. Temporary crop injury can occur when liquid nitrogen is used as a carrier. • Extreme growing conditions (drought or freezing) prior to, at, or following the time of application may reduce weed control and the risk of crop injury. • Refer to Table 3E for harvest restrictions. • DO NOT compost any plant material from treated areas. • Refer to label and Table 12 for crop rotation restrictions.
	fluroxypyr *(Starane Ultra)*	0.14	0.4 pt 2.8L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply from 2-leaf stage up to and including flag leaf emergence, between Feeke's stages 1.2 and 9 (Figure 1). • *Starane Ultra* provides excellent control of hemp dogbane. • Apply to actively growing weeds up to 8 inches tall. • Increase the rate to 0.7 pt/A to control volunteer potato. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.

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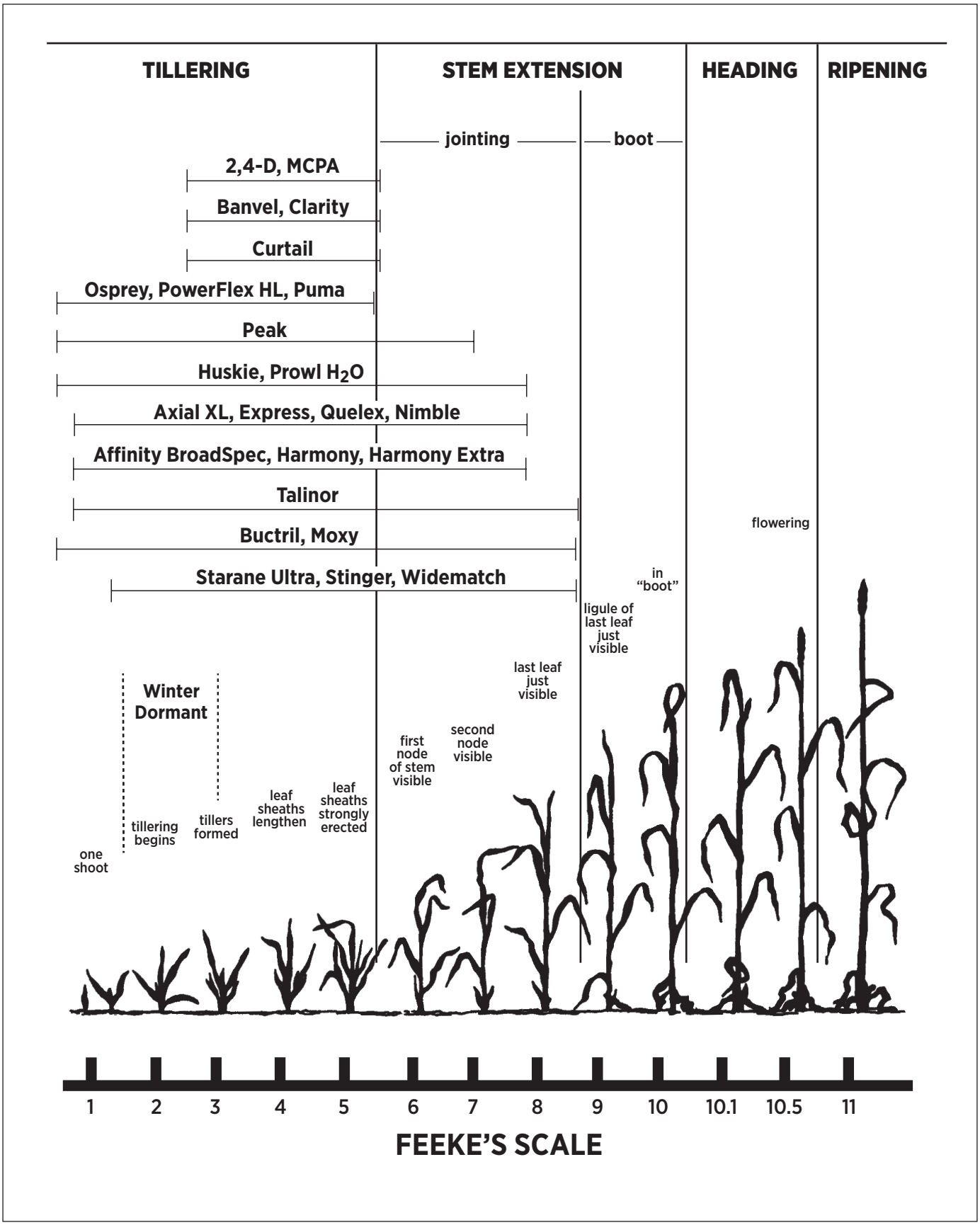
Barley and Wheat — All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	clopyralid *(Stinger)*	0.094	0.25 pt 3L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply to wheat or barley from the 3-leaf stage to boot stage, between Feeke's stages 1.3 and 9 (Figure 1). • May be tank mixed with 2,4-D, dicamba, *Buctril, Harmony Extra* or *Express* for control of additional weeds. See label for details on rates. • *Stinger* provides good control of Canada thistle and sow-thistle. For best results increase the rate to 0.33 pt/A and treat thistle plants between the rosette stage and bud stage. • Refer to Table 3E for harvest restrictions. • See Table 12 for crop rotation restrictions.
	bromoxynil + bicyclopyrone *(Talinor)* + *CoAct+* + crop oil concentrate	0.19	13.7 oz 1.77L + 2.75 oz + 1%	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply between 2 leaf and up to the pre-boot stage, Feekes stage 1.2 and 8 (Figure 1). • Apply to actively growing weeds with 1 to 4 leaves. • *CoAct+* must be applied with *Talinor* and either a crop oil concentrate or surfactant, depending on tank mix partner. • DO NOT add ammonium sulfate or nitrogen products or severe crop injury can occur. • DO NOT apply *Talinor* in the spring if red clover is under-seeded. • DO NOT apply to a crop that is stressed by frost, drought, flooding, or other conditions. • *Talinor* maybe tank mixed with certain fungicides, consult label. • DO NOT tank mix with any organophosphate or cambamate insecticide. • Refer to Table 3E for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	clopyralid + fluroxypyr *(WideMatch)*	0.25	1.33 pt 1.5L	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply to wheat, barley and oats from the 3-leaf stage to the boot stage, between Feeke's stages 1.3 and 9 (Figure 1). • DO NOT frost-seed red clover if *WideMatch* is applied. • May be tank mixed with 2,4-D, dicamba, *Buctril, Harmony Extra, Affinity BroadSpec* or *Express* for control of additional weeds. See label for details on rates. • *WideMatch* provides some control of thistles and hemp dogbane. • Refer to Table 3E for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

FIGURE 1 — Wheat growth stages according to the Feeke's scale. Management inputs are indicated.



Oats — All Tillage Systems

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	2,4-D amine	0.38	0.75 pt 4L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply in the spring to actively growing grain following tillering (usually about 6-8 inches high) but prior to jointing. DO NOT treat grain in boot to dough stage. The boot stage is when the upper sheath is beginning to swell with the enlarging head. • Most effective when weeds are small (less than 4 inches). • Some yield reduction may occur but generally less than that caused by weeds. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	bromoxynil *(Buctril, Moxy)*	0.38	1.5 pt 2L	• Refer to Table 3A for weed control and crop tolerance ratings. • May be applied from emergence up to boot stage. • Good coverage essential. • *Bromoxynil* must be applied to small weeds for effective control (see label). • Redroot pigweed and mustard must be controlled when very small (refer to label for details). • Very good crop safety. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	thifensulfuron-methyl *(Harmony SG)* + surfactant	0.018	0.6 oz 50SG + 0.25%	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply to oats in the 3- to 5-leaf stage but before jointing. • DO NOT apply to Ogle, Porter, or Premier varieties. • Most effective if weeds are small (4 inches or less). • Addition of surfactant is essential for adequate results. • Control of common ragweed is inconsistent. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	thifensulfuron-methyl + tribenuron-methyl *(Harmony Extra SG)* + surfactant	0.018	0.6 oz 50SG + 0.25%	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply to oats in the 3- to 5-leaf stage but before jointing. • DO NOT apply to Ogle, Porter, or Premier varieties. • Most effective if weeds are small (4 inches or less). • Addition of surfactant is essential for adequate results. • Control of common ragweed is inconsistent. • DO NOT graze or feed forage or hay from treated areas to livestock. (Dry-harvested straw may be used for bedding and/or feed.) • Injury symptoms will appear on weeds in 1-3 weeks after application. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	MCPA	0.38	0.75 pt 4L	• Refer to Table 3A for weed control and crop tolerance ratings. • Less injurious and less effective than 2,4-D. • Most effective when weeds are small (less than 4 inches). • Apply at or after full tillering but before the boot stage (the first node is detectable and the grain is usually 6-8 inches tall at full tillering; the boot stage is when the upper sheath is beginning to swell with the enlarging head). • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.

(Continued on next page)

Oats — All Tillage Systems *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	thifensulfuron-methyl + tribenuron-methyl *(Nimble)* + surfactant	0.018	0.38 oz 75WG + 0.25%	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • *Nimble* contains the same ratio of active ingredients as *Harmony Extra*, but at a different concentration. • See the Remarks and Limitations section for *Harmony Extra*. • Refer to label and Table 12 for crop rotation restrictions.
	fluroxypyr *(Starane Ultra)*	0.14	0.4 pt 2.8L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply from 2-leaf stage up to and including flag leaf emergence (between 1.2 and 9 on Feeke's scale). • Apply to actively growing weeds up to 8 inches tall. • Narrow spectrum of weeds controlled. • DO NOT apply to small grains underseeded with a legume. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.
	clopyralid *(Stinger)*	0.094	0.25 pt 3L	• Refer to Table 3A for weed control and crop tolerance ratings. • Apply to oats from the 3-leaf stage to boot stage. See label for details. • May be tank mixed with *Buctril* for control of additional weeds. • Refer to Table 3E for harvest restrictions. • See Table 12 for crop rotation restrictions.
	clopyralid+ fluroxypyr *(WideMatch)*	0.25	1.33 pt 1.5L	• Refer to Table 3A for weed control and crop tolerance ratings. • See Table 3B for individual product rate equivalents for the premix. • Apply to wheat, barley and oats from the 3-leaf stage to boot stage (between 1.3 and 9 on Feeke's scale). See label for details. • May be tank mixed with 2,4-D, dicamba, *Buctril, Harmony Extra, Affinity BroadSpec* or *Express* for control of additional weeds. See label for details on rates. • Refer to Table 3E for harvest restrictions. • Refer to Table 12 for crop rotation restrictions.

TABLE 3D — Wheat – Preharvest Applications

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	glyphosate + ammonium sulfate	0.75 lb a.e.	See Table 10 + 17 lb/100 gal	• See Table 10 for a list of glyphosate products, formulations and rates. • Apply to wheat after the hard-dough stage when grain contains 30% moisture or less. • Apply up to 7 days before harvest. • DO NOT apply to wheat grown for seed. • Wheat stubble can be grazed immediately after harvest.
Annual broadleaves	2,4-D ester or 2,4-D amine	0.5 0.5	1 pt 4L 1 pt 4L	• Apply to wheat after the hard-dough stage when grain contains 30% moisture or less. • Apply up to 14 days before harvest. • Caution should be taken to avoid vapor and particle spray drift. • DO NOT double crop soybean unless 7 days have occurred between 2,4-D ester application and planting or 15 days between 2,4-D amine application and planting. • Refer to Table 3E for harvest restrictions.
	carfentazone *(Aim)* + methylated seed oil	0.02	1.5 oz 2EC + 1% v/v	• Apply when wheat is in the hard-dough stage and the green color is gone from the nodes of the stem. • *Aim* can be used to defoliate velvetleaf. • Apply up to 3 days before harvest. • *Aim* is not as effective as glyphosate on most species. • *Aim* can be tank-mixed with other preharvest herbicides. • Use a minimum of 10 gallons of water. Higher spray volumes will provide better coverage. • DO NOT harvest for forage within 7 days of application.
	dicamba *(Clarity)*	0.25	8 oz 4L	• Apply when wheat is in the hard-dough stage and the green color is gone from the nodes of the stem. • *Clarity* can be used to suppress annual broadleaf weeds. • Apply up to 7 days before harvest. • DO NOT apply to wheat grown for seed. • Caution should be taken to avoid vapor and particle spray drift. • DO NOT double crop soybean unless 1-inch of rainfall and 14 days have occurred between *Clarity* application and planting. • Refer to Table 3E for harvest restrictions.
	suflufenacil *(Sharpen)* + methylated seed oil + ●ammonium sulfate	0.046	2 oz 2.85L + 1% + 17 lb/100 gal	• Apply when wheat is in the hard-dough stage when grain contains 30% moisture or less. • *Sharpen* desiccation rates range between 1 to 2 oz/A. • Apply up to 3 days before harvest. However, it generally takes 7 days to reach maximum activity. • *Sharpen* is an effective desiccant on common ragweed and horseweed. Glyphosate should be added for common lambsquarters desiccation. • If double cropping to soybean use *Sharpen* at 1 oz/A. • DO NOT apply to wheat or barley grown for seed or malting. • Desiccation treated straw can be grazed or fed to livestock. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 3E — Harvest Restrictions for Small Grain Herbicides

Herbicide	Restrictions
2,4-D	DO NOT permit dairy animals or meat animals being finished for slaughter to forage treated grain fields within 2 weeks after treatment. DO NOT feed treated straw to livestock if a preharvest or emergency treatment is used. See label.
Affinity BroadSpec	Allow 7 days between application and grazing of treated forage or feeding of forage from treated areas to livestock. Allow 30 days between application and feeding of hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed. DO NOT apply closer than 45 days before harvesting grain.
Axial XL	DO NOT graze livestock or harvest forage for hay for a minimum of 50 days following application. DO NOT harvest grain for 60 days following application.
Banvel/Clarity	A waiting interval of 7 days is required before harvest. DO NOT use preharvest-treated wheat for seed unless a germination test is performed on the seed with an acceptable result of 95% germination or better. If small grains are used for pasture or hay, consult the label for harvesting restrictions.
Buctril	DO NOT graze treated fields for 45 days following application.
Curtail/Stinger	DO NOT cut treated grass for hay within 30 days after application. Remove meat animals from freshly treated areas 7 days before slaughter. Withdrawal is not needed if 2 weeks have elapsed since application. DO NOT graze dairy animals in treated areas for 14 days after application. DO NOT use hay or straw from treated areas or manure from animals grazed in treated areas for composting or mulching on susceptible broadleaf crops. DO NOT transfer livestock from treated grazing areas onto sensitive broadleaf crop areas without first allowing 7 days of grazing on an untreated pasture. Otherwise, urine may contain enough clopyralid to cause injury to sensitive broadleaf plants. DO NOT permit dairy animals or meat animals being finished for slaughter to forage or graze treated grain fields within 1 week after treatment. DO NOT harvest hay from treated fields.
Express	Allow 7 days between application and grazing of treated forage or feeding of forage from treated areas to livestock. Allow 30 days between application and feeding of hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed. DO NOT apply closer than 45 days before harvesting grain.
Harmony	Allow 7 days between application and grazing of treated forage or feeding of forage from treated areas to livestock. Allow 30 days between application and feeding of hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed. DO NOT apply closer than 45 days before harvesting grain.
Harmony Extra	Allow 7 days between application and grazing of treated forage or feeding of forage from treated areas to livestock. Allow 30 days between application and feeding of hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed. DO NOT apply closer than 45 days before harvesting grain.
Huskie	DO NOT graze or harvest forage within 25 days or harvest grain and straw within 60 days after application.
MCPA	DO NOT allow livestock to forage or graze treated areas within 7 days of slaughter.
Nimble	Allow 7 days between application and grazing of treated forage or feeding of forage from treated areas to livestock. Allow 30 days between application and feeding of hay from treated areas to livestock. Harvested straw may be used for bedding and/or feed. DO NOT apply closer than 45 days before harvesting grain.
Osprey	DO NOT apply *Osprey* herbicide within 30 days of harvesting wheat forage, and 60 days for hay, grain and straw.
Peak	DO NOT graze or feed treated crops to livestock until 30 days after application.
PowerFlex HL	DO NOT graze within 7 days or harvest the treated crop for hay within 28 days of application. DO NOT apply within 60 days of grain harvest.
Prowl H_2O	DO NOT harvest wheat forage within 11 days, wheat hay within 28 days, or wheat grain and straw within 60 days after application.
Puma	DO NOT apply within 57 and 70 days of harvesting barley and wheat, respectively.
Quelex	DO NOT apply within 60 days of harvest, 21 days before cutting hay, or graze within 7 days of treating the crop.
Starane Ultra	DO NOT allow livestock to graze treated areas or harvest treated forage within 7 days of application. DO NOT apply closer than 40 days before harvesting of grain or straw.
Talinor	DO NOT apply within 60 days of harvest, graze livestock or harvest forage for hay within 30 days, or feed treated straw to livestock within 60 days of treating the crop.
WideMatch	DO NOT apply closer than 14 days before cutting of hay or 40 days before harvesting of grain and straw. DO NOT allow livestock to graze treated areas or harvest treated forage within 7 days of application.

TABLE 4A —Weed Response to Herbicides in Forage Legumes*

			ANNUAL BROADLEAVES													ANNUAL GRASSES							PERENNIALS					
	SITE OF ACTION	CROP TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. Black)	PIGWEED (Redroot)	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	HOARY ALYSSUM	YELLOW ROCKET	CHICKWEED (Common)	HENBIT/DEADNETTLE	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	BINDWEED (FIELD)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	DANDELION	CURLY DOCK
Seedling Legumes																												
2,4-DB	4	2	P	P	**G**	F	**G**	F	P	F	F	F	F	P	F	N	N	N	N	N	N	N	P	P	N	N	N	F
BUCTRIL/MOXY	6	3	**G**	**G**	**E**	**G**	F	**G**	**G**	**G**	F	F	F	P	**G**	N	N	N	N	N	N	N	P	P	N	N	P	P
EPTAM	8	2	P	P	**G**	P	F	F	F	F	F	F	F	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	F	P	N	P
KERB	3	1	P	P	P	P	P	P	P	P	P	P	P	**G**	**G**	F	F	P	F	F	P	P	N	N	**G**	N	N	P
POAST/POAST PLUS	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	F	N	N	N
PROWL H_2O	3	2	N	N	**G**	P	F	P	P	F	P	N	P	P	P	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	N	N	N
PURSUIT	2	2	**E**	F	P	**E**	**E**	F	**G**	**G**	**G**	–	**G**	**G**	F	F	F	**G**	**G**	**G**	F	F	P	P	N	F	P	P
RAPTOR	2	2	**G**	**G**	**G**	**E**	**E**	F	**G**	**G**	**E**	–	**G**	**G**	P	F	F	**E**	**G**	**G**	F	F	P	F	P	P	–	–
SELECT MAX/ SELECT/ARROW	1	1	N	N	N	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	**G**	N	N	N
Established Alfalfa																												
METRIBUZIN	5	3	**E**	**G**	**E**	N	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	**E**	**E**	**G**	**G**	N	N	P	P	**G**	P
SINBAR	5	3	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	P	F	F	P	F	P
VELPAR	5	3	**G**	**G**	**E**	F	**E**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	F	F	F	F	**E**	P
Glyphosate-Resistant Alfalfa																												
EXTREME	2/9	2	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	**G**	**E**	**E**	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	F	F	F
GLYPHOSATE	9	1	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**E**	F	**G**	F

TABLE 4B —Weed Response to Herbicides in Established Forage Grasses*

			ANNUAL BROADLEAVES													ANNUAL GRASSES							PERENNIALS					
	SITE OF ACTION	CROP TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. Black)	PIGWEED (Redroot)	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	HOARY ALYSSUM	YELLOW ROCKET	CHICKWEED (Common)	HENBIT/DEADNETTLE	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	BINDWEED (FIELD)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	DANDELION	CURLY DOCK
2,4-D ESTER	4	2	**G**	F	**G**	**G**	**G**	**G**	F	**G**	**G**	**G**	**G**	P	F	N	N	N	N	N	N	N	F	F	N	N	**G**	P
BANVEL/CLARITY	4	2	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	F	P	N	N	N	N	N	N	N	**G**	F	N	N	**G**	F
2,4-D + BANVEL	4/4	2	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	F	P	N	N	N	N	N	N	N	**G**	F	N	N	**G**	F
CIMARRON PLUS	2/2	3	**E**	–	**E**	**E**	**E**	**E**	**E**	–	**E**	**E**	–	**E**	**E**	N	N	N	N	N	N	N	–	**G**	N	N	**E**	**E**
CROSSBOW	4/4	3	**E**	–	**E**	**E**	**E**	**E**	**G**	–	**E**	–	–	**E**	**E**	N	N	N	N	N	N	N	–	**G**	N	N	**E**	**E**
GRAZONNEXT HL	4/4	3	**G**	F	**G**	**G**	**G**	**E**	**E**	**G**	**G**	–	**G**	F	F	N	N	N	N	N	N	N	F	**E**	N	N	F	**E**
MILESTONE	4	3	**G**	–	**G**	–	**G**	**E**	**E**	–	P	–	P	F	F	N	N	N	N	N	N	N	–	**E**	N	N	P	**E**
STINGER	4	2	**E**	**G**	P	P	P	**G**	F	P	P	P	P	P	P	N	N	N	N	N	N	N	P	**G**	N	N	F	P

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (cold, wet); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high.

TABLE 4C — Forage Herbicides — Remarks and Limitations

Direct-Drilled Forage Legumes (No-Till)

(fall or spring seedings following soybeans, corn or dry edible beans)

In general, the major benefits of weed control in new alfalfa seedings are improved forage quality in the first harvest and insurance against stand loss from intense weed competition. In conventional tillage, weeds present at planting are killed by tillage during final seedbed preparation. With direct seeding (no-till), vegetation control is accomplished before planting with burndown herbicides such as paraquat *(Gramoxone)* or glyphosate. The required application rate varies, depending on weed species and size. Refer to the product labels for details. *Gramoxone* provides faster kill. *Glyphosate* is preferred if perennial weeds are present, but fields with serious perennial weed problems should not be direct drilled with a forage legume. Perennial weeds should be controlled in the previous crop or in the fall prior to a spring seeding. Herbicide options in the fall include glyphosate, 2,4-D ester, or a combination of glyphosate plus 2,4-D amine. Do not apply 2,4-D in the spring prior to spring planting.

The need for a burndown herbicide depends on the presence of weeds at planting time. If no weeds are present, a burndown herbicide is not needed. However, a burndown herbicide will improve first-harvest forage quality if weeds are present at planting time, regardless of species or size.

Herbicides applied after crop emergence are not affected by the tillage system used. All of the herbicides listed for postemergence application can be used in all tillage systems including direct drilling.

Forage Legumes – Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	EPTC *(Eptam)*	3	3.5 pt 7EC	• **Apply preplant incorporated only.** • Refer to Table 4A for weed control and crop tolerance ratings. • Apply prior to planting **alfalfa, birdsfoot trefoil,** or **clover** not seeded with a grass or small grain companion crop. • Work into soil immediately after application. • Seed may be planted immediately after application. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

Forage Legumes – Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	pendimethalin *(Prowl H_2O)*	0.95	2 pt 3.8SC	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply to **seedling** or **established alfalfa** not seeded with a grass or small grain companion crop. • Apply to seedling alfalfa at 2 pt/A once alfalfa has reached the second trifoliate. • Apply to established alfalfa at 3 pt/A after cutting or mowing in the fall or spring. • All applications need to be made prior to weed emergence – *Prowl H_2O* will not control emerged weeds. • Applications may cause some stunting and chlorosis. • DO NOT apply more than 4.2 qt/A per season. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

Forage Legumes – Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Perennial grasses** **Volunteer cereals**	sethoxydim *(Poast)* OR *(Poast Plus)* + crop oil concentrate	0.19	 1 pt 1.5SC OR 1.5 pt 1SC 1 qt	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply to seedling or **established alfalfa, birdsfoot trefoil,** or **clover** not seeded with a grass or small grain companion crop. • Apply to grasses up to 8 inches tall (crabgrass up to 6 inches). • *Poast* at 0.75 pt/A or *Poast Plus* at 1.125 pt/A will control 1 to 4 inch tall barnyardgrass, green and giant foxtails, and fall panicum. • Volunteer cereals need to be treated before tillering (up to 4 inches tall). • Apply *Poast* at 1.5 pt/A or *Poast Plus* at 2.25 pt/A for perennial grass weed control. • The addition of ammonium sulfate (2.5 lb/A) has been shown to improve control of difficult weeds – e.g., crabgrass and quackgrass. • DO NOT apply more than 6.5 pt/A per season of *Poast* or 9.75 pt/A per season of *Poast Plus*. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	clethodim *(Select Max)* OR *(Select/Arrow)* + crop oil concentrate	 0.068 0.094	 9 oz 0.97EC OR 6 oz 2EC + 1%	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply to seedling or **established alfalfa, birdsfoot trefoil,** or **clover** not seeded with a grass or small grain companion crop. • Apply to grasses up to 8 inches tall (crabgrass up to 6 inches). • *Select Max* at 6 oz/A or *Select/Arrow* at 4 oz/A will control 1 to 4 inch tall barnyardgrass, green and giant foxtails, and fall panicum. • Volunteer cereals need to be treated between 2 to 6 inches tall. • Apply *Select Max* from 12 to 32 oz/A or *Select/Arrow* from 9 to 16 oz/A for perennial grass weed control. • The addition of ammonium sulfate (2.5 to 4 lb/A) has been shown to improve control of difficult weeds – e.g., quackgrass, Johnsongrass, and volunteer cereals. • There is more adjuvant flexibility with *Select Max* tank-mixtures. Consult label. • DO NOT apply more than 64 oz/A per season of *Select Max* or 64 oz/A per season of *Select/Arrow*. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves	2,4-DB (*Butyrac 200*, others)	1	2 qt 2L	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply to seedling and **established alfalfa**, or **seedling birdsfoot trefoil**. • DO NOT apply to clover. • Apply postemergence when legume seedlings are at or beyond the 1 to 2 trifoliate stage. • To control hoary alyssum 2,4-DB should be applied to seedlings in the 2 to 4 leaf stage. • DO NOT apply when crop is under stress. • DO NOT spray when temperatures are expected to exceed 90° F within 3 days of application or if temperatures are expected to be below 40° F. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Forage Legumes – Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	bromoxynil (*Buctril/Moxy*, others)	0.25	1 pt 2L	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply postemergence to **seedling** or **established alfalfa** when the majority of the field has 4 trifoliates. • DO NOT apply to birdsfoot trefoil or clover. • Can be applied to alfalfa companion seeded with small grains. • Temporary crop leaf burn occurs after application – burn is enhanced under warm, humid conditions. • DO NOT spray when temperatures are expected to exceed 70° F within 3 days of application – can result in unacceptable crop injury. • DO NOT apply more than 2 pt/A per season. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	imazethapyr *(Pursuit)* + surfactant + ammonium sulfate	0.063	4 oz 2L + 0.25% + 2.5 lb	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply postemergence to **seedling** or **established alfalfa**, **birdsfoot trefoil**, or **clover** not seeded with a grass or small grain companion crop. • Apply postemergence when legume seedlings are at or beyond the 2 trifoliate stage and weeds are 1 to 3 inches. • Apply to established alfalfa or clover after cutting or mowing in the fall or spring. • Applications can cause a temporary reduction in growth. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	imazamox *(Raptor)* + crop oil concentrate + ammonium sulfate	0.031	4 oz 1L + 1% + 2.5 lb	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply postemergence to **seedling** or **established alfalfa** not seeded with a grass or small grain companion crop. • DO NOT apply to birdsfoot trefoil. • Apply postemergence when legume seedlings are at or beyond the 2 trifoliate stage and weeds are 1 to 3 inches. • Apply to established alfalfa or clover after cutting or mowing in the fall or spring. • Increase the rate to 6 oz/A for more effective control of giant foxtail, Pennsylvania smartweed, henbit, and common purslane. • Applications can cause a temporary reduction in growth. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

Forage Legumes – Dormant Applications

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves**	pronamide *(Kerb)*	0.75	1.5 lb 50WG	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply in the fall or winter to **seedling** or **established alfalfa, birdsfoot trefoil**, or **clover** not seeded with a grass or small grain companion crop. • Apply after soil temperatures drop below 55° F, but before soil freeze-up. • Apply 3 lb/A for quackgrass control. • DO NOT apply more than 4 lb/A per season. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	metribuzin *(Metribuzin)*	0.5	0.67 lb 75DF	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply to **established alfalfa** only (one year or more). • Can be used on mixed alfalfa-grass stands. • Apply to **dormant alfalfa** in late fall or early spring. • Increase the rate to 1.3 lb/A for control of dandelion. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	terbacil *(Sinbar)*	1	1.25 lb 80WG	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply to **established alfalfa** only (one year or more). • Apply to **dormant alfalfa** in late fall or early spring. • DO NOT use on mixed alfalfa-grass stands. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	hexazinone *(Velpar)*	0.5	0.67 lb 75DF	• Refer to Table 4A for weed control and crop tolerance ratings. • Apply to **established alfalfa** only (one year or more). • Apply to **dormant alfalfa** in late fall or early spring for greatest crop safety. • Can be applied in the spring before new growth exceeds 2 inches in height or to alfalfa stubble after cutting and before regrowth exceeds 2 inches – severe injury can occur if alfalfa regrowth is more than 2 inches. • DO NOT use on mixed alfalfa-grass stands. • Increase the rate to 1.3 lb/A for control of dandelion. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

Table 4D - Weed Control in Roundup Ready (Glyphosate-Resistant) Alfalfa

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves** **Perennials**	glyphosate + ammonium sulfate	0.75 a.e.	See Table 10 + 17 lb/100 gal	• **APPLY TO ROUNDUP READY ALFALFA ONLY.** • Refer to Table 4A for weed control and crop tolerance ratings. • Many glyphosate products are registered for application to Roundup Ready alfalfa. Read the label and see Table 10 to determine application rates and additives needed for different products. • *Establishment:* Apply 0.75 lb a.e. to alfalfa before the 4 trifoliate stage of growth to eliminate seedlings not containing the glyphosate-resistant gene. • Most effective before first cutting to eliminate weeds and allow establishment of a pure alfalfa stand. Second applications in the establishment year are generally not needed. • *Established alfalfa:* Glyphosate applications are generally not needed in established alfalfa. However, if needed glyphosate can be applied after cutting to newly emerged weeds but before alfalfa regrowth interferes with spray coverage. • Apply 1.5 lb a.e./A of glyphosate for henbit control. • DO NOT exceed 1.5 lb a.e./A in a single application or 4.5 lb a.e./A per season. • Refer to Table 4F for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + imazethapyr *(Extreme)* + surfactant + ammonium sulfate	0.81	3 pt 2.17L + 0.25% v/v + 17 lb/100 gal	• **APPLY TO ROUNDUP READY ALFALFA ONLY.** • Refer to Table 4A for weed control and crop tolerance ratings. • *Extreme* at 3 pt/A contains 1.5 pt of glyphosate 3L and 4 oz/A of *Pursuit*. • Apply to alfalfa at the second trifoliate stage or larger and when weed are 1-3 inches tall. • *Extreme* can be applied at rates ranging from 2.2-4.4 pts/A. • *Establishment:* Apply 3 pt/A to alfalfa before the 4 trifoliate growth stage to eliminate seedlings not containing the glyphosate-resistant gene. • *Established alfalfa: Extreme* can be applied in the fall, in the spring to dormant or semi-dormant alfalfa, or between cuttings before alfalfa regrowth interferes with spray coverage. • DO NOT apply more than 3 pts/A of *Extreme* during the last year of the stand. • DO NOT feed, graze, or harvest Roundup Ready alfalfa for 30 days following application. Refer to Table 4F. • DO NOT replant alfalfa for 4 months following an *Extreme* application. • *Extreme* is very persistent and can limit rotational crops. Refer to label and Table 12 for crop rotation restrictions.

Table 4E - Weed Control in Grass Pastures

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves **Perennial broadleaves**	2,4-D ester	1	1 qt 4L	• Refer to Table 4B for weed control and crop tolerance ratings. • Use only on established stands of perennial grasses. • Can be applied up to 2 qt/A for moderately susceptible biennial and perennial broadleaf weeds. • Caution should be taken to avoid off-target movement. • DO NOT make more than 2 applications per year. • Refer to Table 4G for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	dicamba *(Banvel/Clarity)*	1	1 qt 4L	• Refer to Table 4B for weed control and crop tolerance ratings. • Use on established stands of perennial grasses. • Can be applied up to 1 qt/A for moderately susceptible biennial and perennial broadleaf weeds. • Treat biennials weeds in the rosette stage. • Caution should be taken to avoid off-target movement. • DO NOT exceed 2 qt/A per year. • Refer to Table 4G for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	2,4-D ester + dicamba *(Banvel, Clarity)*	0.75 + 0.25	1.5 pt 4L + 0.5 pt 4L	• Refer to Table 4B for weed control and crop tolerance ratings. • Use on established stands of perennial grasses. • Caution should be taken to avoid off-target movement. • Refer to Table 4G for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	metsulfuron-methyl + chlorsulfuron *(Cimarron Plus)* + surfactant	0.01	0.25 oz 63WG + 0.125%	• Refer to Table 4B for weed control and crop tolerance ratings. • Use on established stands of perennial grasses. • DO NOT use on timothy pastures. • *Cimarron Plus* may temporarily stunt fescue and cause it to turn yellow. • Make applications in the spring after new growth is 5 to 6 inches tall, or in the fall. • DO NOT exceed 0.5 oz/A per year. • Refer to Table 4G for harvest restrictions. • *Cimarron Plus* has extensive residual activity consult label for pasture renovation and recropping restrictions.
	2,4-D ester + triclopyr *(Crossbow)*	1.5	2 qt 3L	• Refer to Table 4B for weed control and crop tolerance ratings. • Use on established stands of perennial grasses. • Make applications when brush and broadleaf weeds are actively growing. • Caution should be taken to avoid off-target movement. • DO NOT make more than one application per year. • Refer to Table 4G for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Table 4E - Weed Control in Grass Pastures *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves **Perennial broadleaves**	aminopyralid + 2,4-D *(GrazonNext HL)* + surfactant	0.156	1.5 pt 3.74L + 0.25%	• Refer to Table 4B for weed control and crop tolerance ratings. • Can be applied after perennial grasses are well established. • Make applications when broadleaf weeds are actively growing. • Caution should be taken to avoid off-target movement. • DO NOT use aminopyralid-treated plant residues or manure from animals that have grazed aminopyralid-treated areas for compost or mulch for sensitive broadleaf plants – conduct a bioassay. • DO NOT apply more than 2.1 pt/A per year. • Refer to Table 4G for harvest restrictions. Refer to label and Table 12 for crop rotation restrictions.
	aminopyralid *(Milestone)* + surfactant	0.156	5 oz 2L + 0.25%	• Refer to Table 4B for weed control and crop tolerance ratings. • Can be applied after perennial grasses are well established. • Make applications when broadleaf weeds are actively growing. • Caution should be taken to avoid off-target movement. • DO NOT use aminopyralid-treated plant residues or manure from animals that have grazed aminopyralid-treated areas for compost or mulch for sensitive broadleaf plants – conduct a bioassay. • DO NOT apply more than 7 oz/A per year. • Refer to Table 4G for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.
	clopyralid *(Stinger)*	0.19	0.5 pt 3SL	• Refer to Table 4B for weed control and crop tolerance ratings. • Can be applied after perennial grasses are well established. • Make applications when broadleaf weeds are actively growing. • Caution should be taken to avoid off-target movement. • DO NOT use aminopyralid-treated plant residues or manure from animals that have grazed aminopyralid-treated areas for compost or mulch for sensitive broadleaf plants – conduct a bioassay. • Refer to Table 4G for harvest restrictions. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 4F — Harvest Restrictions for Forage Legume Herbicides

Herbicide	Restrictions
2,4-DB	Do not graze established alfalfa or feed straw or hay from treated crops to livestock within 30 days after application. Do not graze or feed seedling alfalfa, clover or birdsfoot trefoil within 60 days after application.
Buctril, Moxy	Do not cut for feed or graze spring-treated alfalfa within 30 days following treatment. Do not cut for feed or graze fall or winter treated alfalfa until spring, at least 60 days after treatment.
Eptam	None for preplant application.
Kerb	Do not graze or harvest for forage or dehydration within 120 days of application.
Metribuzin	Do not graze or harvest within 28 days after application.
Poast, Poast Plus	Do not apply within 7 days of feeding, grazing or harvesting for (undried) forage, or within 14 days of feeding or harvesting for (dry) hay.
Prowl H_2O	Do not apply within 28 days of harvesting alfalfa forage.
Pursuit	Do not feed, graze or harvest alfalfa for 30 days following application.
Raptor	There should be an interval of at least 20 days between application and cutting or feeding alfalfa forage or hay.
Select, Select Max, Arrow	Do not apply within 15 days of grazing, feeding or harvesting (cutting) alfalfa for hay or forage.
Sinbar	None.
Velpar	Do not graze or feed forage or hay to livestock within 30 days after application.
Glyphosate-Resistant Alfalfa	
Extreme	Do not feed, graze, or harvest Roundup Ready alfalfa for 30 days following application.
Glyphosate	Do not harvest or graze alfalfa for a minimum of 5 days following application.

TABLE 4G — Harvest Restrictions for Forage Grass Herbicides

Herbicide	Restrictions
2,4-D	Do not graze animals on treated areas within 7 days after treatment. Do not permit dairy animals or meat animals being finished for slaughter to forage treated fields within 3 days of slaughter. Do not cut grass for hay within 30 days after application.
Banvel/Clarity	Animals cannot be removed from treated area for slaughter prior to 30 days after last application. There is no waiting period between treatment and grazing for non-lactating animals. Timing restriction for lactating dairy animals following treatment: up to 1 pt/A—7 days before grazing, 37 days before hay harvest; up to 1 qt/A—*21 days before grazing, 51 days before hay harvest. See label for details.*
Cimarron Plus	None.
Crossbow	Do not apply within 14 days of harvesting hay.
GrazonNext HL	Do not graze or harvest hay within 7 days of application. See remarks and limitations section on residue and manure management.
Milestone	None. See remarks and limitations section on residue and manure management.
Stinger	None. See remarks and limitations section on residue and manure management.

TABLE 5A –Weed Response to Herbicides in Dry Edible Beans*

			ANNUAL BROADLEAVES									ANNUAL GRASSES								PERENNIALS				
	SITE OF ACTION	CROP TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																								
DUAL MAGNUM/PARALLEL	15	2	N	N	P	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	**G**
EPTAM	8	2	P	P	**G**	F	F	F	F	F	F	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	F	F
OUTLOOK	15	3[a]	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
PROWL H_2O/PROWL	3	1	N	N	**G**	P	F	P	P	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
PURSUIT	2	3	F	F	P	**E**	**E**	P	F	F	**G**	P	P	F	F	F	P	P	P	N	N	N	N	F
SONALAN	3	1	N	N	**G**	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
TRIFLURALIN	3	1	N	N	**G**	N	**G**	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	N	N
Preemergence																								
DUAL MAGNUM/PARALLEL	15	2	N	N	P	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	F
OUTLOOK	15	3[a]	N	N	P	**G**	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
PERMIT/SANDEA	2	3	F	F	F	P	**E**	**G**	P	**G**	**E**	N	N	N	N	N	N	N	N	N	N	N	N	F
PURSUIT	2	3	P	P	P	**E**	**E**	P	F	P	**G**	P	P	F	F	F	P	P	P	N	N	P	N	F
REFLEX	14	2	P	P	**G**	**E**	**E**	**G**	**G**	P	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N
SEQUENCE[b]	9/15	2	N	N	P	F	**G**	P	P	N	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	F
Postemergence																								
ASSURE II/TARGA	1	1	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**G**	**E**	**E**	**E**	N	N	N	**E**	N
BASAGRAN/BROADLOOM[c]	6	2	**E**	**G**	F	P	P	F	**E**	**G**	**E**	N	N	N	N	N	N	N	N	N	N	**G**	N	**G**
FUSILADE DX	1	1	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N
PERMIT	2	3	**E**	**G**	N	P	**E**	**G**	F	**G**	**E**	N	N	N	N	N	N	N	N	P	P	P	N	**E**
POAST	1	1	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	F	N
PURSUIT[d]	2	3	F	P	P	**E**	**E**	P	F	F	**E**	P	P	F	P	P	P	P	P	N	N	P	N	F
PURSUIT[d] + BASAGRAN	2/6	2	**E**	**G**	F	**E**	**E**	F	**G**	**G**	**E**	P	P	F	P	P	P	P	P	N	N	**G**	N	**G**
RAPTOR[d]	2	3	F	F	F	**E**	**E**	P	F	**G**	**E**	F	P	F	P	P	P	P	P	N	N	P	N	P
RAPTOR[d] + BASAGRAN (8 oz)	2/6	2	**G**	F	F/**G**	**E**	**E**	F	**G**	**G**	**E**	F	P	F	P	P	P	P	P	N	N	F	N	F
RAPTOR[de] + BASAGRAN (16 oz)	2/6	2	**E**	**G**	**G**	**E**	**E**	F	**E**	**G**	**E**	P	P	F	P	P	P	P	P	N	N	**G**	N	F
REFLEX	14	2	P	F	P	**G**	**G**	**E**	P	P	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N
REFLEX + BASAGRAN	6/14	2	**E**	**G**	F/**G**	**G**	**G**	**E**	**E**	**G**	**E**	N	N	N	N	N	N	N	N	N	N	F	N	**G**
REFLEX + RAPTOR[e]	2/14	3	F	F	F	**E**	**E**	**E**	F	**G**	**E**	F	P	F	P	P	P	N	N	N	N	P	N	P
SELECT/SELECT MAX/ARROW	1	1	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N
VARISTO	2/6	2	**E**	**G**	**G**	**E**	**E**	F	**E**	**G**	**E**	P	P	F	P	P	P	P	P	N	N	**G**	N	F

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None

*The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.

** Crop Tolerance: 1 = Minimal risk of crop injury; 2 = Crop injury can occur under certain conditions (soil applied — cold, wet; foliar applied — hot, humid); 3 = Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4 = Risk of severe crop injury is high.

[a] Crop tolerance for navy and black beans = 3. For other bean classes, crop tolerance = 2. Preplant incorporation will increase tolerance of navy and black beans to *Outlook*.

[b] Sequence is a premixture of *Dual Magnum* and glyphosate and should be used to control existing vegetation prior to planting dry beans. See Remarks and Limitations section.

[c] Control of **hairy nightshade** is good.

[d] Control of **hairy nightshade** with *Pursuit* and *Raptor* is excellent.

[e] **Common lambsquarters** will be controlled with this tank mixture ***if*** the weeds are less than 2 inches tall and ***not*** under drought stress.

TABLE 5B –Dry Edible Bean Herbicides – Remarks and Limitations

Dry Edible Beans — Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	EPTC *(Eptam)*	2.25	1.25 qt 7EC	• **Apply preplant incorporated only**. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Eptam* suppresses common ragweed and wild mustard. • ***Prowl* (pendimethalin)**, ***trifluralin***, or ***Sonalan*** should be **tank mixed** with ***Eptam*** for additional broadleaf control, including lambsquarters. • *Pursuit* (2 oz) can be added to tank mixes with *Prowl*, *trifluralin*, or *Sonalan* for nightshade control. • *Pursuit* (2 oz) may also be applied preemergence after preplant incorporated applications of *Eptam* tank mixed with *Prowl, trifluralin*, or *Sonalan*. See remarks for *Pursuit*. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses **Annual broadleaves**	pendimethalin *(Prowl)* OR *(Prowl H_2O)*	0.75	1.8 pt 3.3EC OR 1.6 pt 3.8CS	• **Apply preplant incorporated only**. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Prowl* provides better velvetleaf control than *trifluralin* or *Sonalan*. • ***Prowl*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	ethalfluralin (Sonalan)	0.75	2 pt 3EC	• **Apply preplant incorporated only.** • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • ***Sonalan*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	trifluralin *(many)*	0.5	1 pt 4EC	• **Apply preplant incorporated only.** • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • *Trifluralin* provides better pigweed control than *Prowl* or *Sonalan*. • ***Trifluralin*** should be **tank mixed** with ***Eptam***. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.

Dry Edible Beans — Soil Applied

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	s-metolachlor *(Dual Magnum, EverpreX))* OR *(Dual II Magnum, Cinch)*	1.27	1.33 pt 7.62EC OR 1.33 pt 7.64EC	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5A for weed control and crop tolerance ratings. • PREPLANT INCORPORATED *Dual Magnum* minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce *Dual Magnum* rate to 1 pt/A on coarse-textured soils with low organic matter. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Dual Magnum* provides better yellow nutsedge control than *Outlook*. • *Prowl, trifluralin* or *Sonalan* can be tank mixed preplant incorporated for lambsquarters control. • *Pursuit* (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of *Basagran, Pursuit* or *Raptor* may be necessary for additional broadleaf control. • DO NOT apply *Dual Magnum* within 60 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	dimethenamid-P *(Outlook)*	0.66	14 oz 6L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5A for weed control and crop tolerance ratings. • PREPLANT INCORPORATED Outlook minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce *Outlook* rate to 12 oz/A on coarse-textured soils with low organic matter. • Navy and black beans are more sensitive to *Outook* applications than to *Dual Magnum*. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Outlook* provides better pigweed and nightshade control than *Dual Magnum*. • *Prowl, trifluralin,* or *Sonalan* can be tank mixed preplant incorporated for lambsquarters control. • *Pursuit* (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of *Basagran, Pursuit,* or *Raptor* may be necessary for additional broadleaf control. • DO NOT apply *Outlook* within 70 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

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Dry Edible Beans — Soil Applied *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	metolachlor *(Parallel PCS)*	1.3	1.33 pt 8EC	• **May be applied preplant incorporated or preemergence.** • *Parallel PCS* is a mix of the R and S-isomers of metolachlor. Limited research has shown that 1.33 pt/A of these products provide similar activity to s-metolachlor products at 1.33 pt/A. However, *Parallel PCS* may not provide the consistency, length of control or performance on more difficult to control weeds. Rates would need to be increased to 2.0 pt/A to provide the same amount of s-metolachlor (the more active isomer) in the 1.33 pt/A rate of *Dual Magnum/ Dual II Magnum/Cinch* (s-metolachlor). • Refer to Table 5A for weed control and crop tolerance ratings. • See remarks and limitations for *Dual Magnum*. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + s-metolachlor *(Sequence)* + ammonium sulfate	1.64	3 pt 2.25L + 17 lb/100 gal	• **May be applied preplant or preemergence.** • Sequence contains 0.9 lb a.e./A of glyphosate and 1.2 pt/A of *Dual Magnum*. • *Sequence* is best used to control existing vegetation prior to planting no-till dry beans with the residual control of *Dual Magnum*. • Refer to Table 5A for residual weed control and crop tolerance ratings. • DO NOT apply to emerged dry bean – severe injury will occur. • DO NOT apply more than 3.5 pt/A on coarse textured soils or 4 pt/A on medium and fine textured soils. • Apply only one application per crop year. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves	halosulfuron *(Permit/Sandea)*	0.023	0.67 oz 75DG	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5A for weed control and crop tolerance ratings. • Reduce the rate of *Permit/Sandea* to 0.5 oz/A on lighter textured soils with low organic matter. • *Permit/Sandea* can cause injury under cool and wet growing conditions. • Delayed maturity may result from applications of *Permit/ Sandea*. • Dry bean varieties and classes vary in their tolerance to *Permit/Sandea*. From MSU research, CAUTION should be taken when applying *Permit/Sandea* to kidney and black beans. • *Permit/Sandea* can be tank mixed with *Eptam* for grass and additional lambsquarters control. • *Permit/Sandea* can be tank mixed with metolachlor products or *Outlook* for annual grass control. • *Permit/Sandea* will not control ALS-resistant weed species. • DO NOT plant SUGAR BEETS within 21 months of a *Permit/ Sandea* application. • Refer to label and Table 12 for crop rotation restrictions.

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Dry Edible Beans — Soil Applied *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	imazethapyr *(Pursuit)*	0.031	2 oz 2L	• **May be applied preplant incorporated or preemergence.** • Refer to Table 5A for weed control and crop tolerance ratings. • DO NOT use on sands or loamy sand soils. • DO NOT apply *Pursuit* if cold and/or wet conditions are present or predicted to occur within 1 week of application. • Delayed maturity may result from applications of *Pursuit*. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • On heavy soils with greater than 2% organic matter and heavy weed pressure, 3 oz of *Pursuit* may be applied. • *Pursuit* can be tank mixed and applied preplant incorporated with *Eptam* plus *trifluralin*; *Prowl* or *Sonalan*; or *Dual Magnum* or *Outlook*; or preemergence with *Dual Magnum* or *Outlook*. *Pursuit* in these mixes will control eastern black nightshade. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • *Pursuit* will NOT control common ragweed. • Dry bean varieties vary in their sensitivity to *Pursuit*. Use ONLY on navy, black turtle, pinto, kidney, and cranberry beans. DO NOT use on DOMINO black or OLATHE pinto beans. • DO NOT apply within 60 days of harvest. • DO NOT use if SUGAR BEETS, CUCUMBERS, CANOLA or TOMATOES are in the rotation; requires 40 months and a soil bioassay. • Refer to label and Table 12 for crop rotation restrictions.
	fomesafen *(Reflex)*	0.25	1 pt 2L	• **May be applied preplant surface or preemergence.** • Refer to Table 5C for weed control and crop tolerance ratings. • *Reflex* will provide 4-5 weeks of control and/or suppression of broadleaf weeds. • Rainfall that splashes treated soil onto newly emerged seedlings can cause temporary crop injury. • Tank mixtures or sequential herbicide applications are needed to broaden the spectrum of weed control. • *Reflex* can be applied only in the Lower Peninsula of Michigan. • DO NOT apply *Reflex* or other fomesafen products to the same field in CONSECUTIVE years. • The maximum use rate of *Reflex* per field is 1 pint per acre. • Refer to Table 12 for crop rotation restrictions.

Dry Edible Beans — Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Grasses	quizalofop-P-ethyl *(Assure II/Targa)* + crop oil concentrate OR surfactant	0.044	7 oz 0.88L + 1% OR 0.25%	• Refer to Table 5A for weed control and crop tolerance ratings. • Treat actively growing grasses (annual grasses up to 4 inches). • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 5 days prior to and 7 days following application. • Allow 30 days between *Assure II/Targa* application and dry bean harvest. • *Assure II/Targa* can be tank mixed with *Basagran* for foxtails and barnyardgrass. Increase the *Assure II/Targa* rate by 2 oz. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • *Assure II/Targa* (10 oz/A) plus crop oil concentrate (1% v/v) or nonionic surfactant (0.25% v/v) will control quackgrass 6-10 inches tall. A sequential application of 7 oz/A may be needed 14-21 days later. • Refer to label and Table 12 for crop rotation restrictions.
	fluazifop-P-butyl *(Fusilade DX)* + crop oil concentrate	0.188	12 oz 2L + 1%	• Refer to Table 5A for weed control and crop tolerance ratings. • Apply 6 oz/A of *Fusilade DX* to control volunteer corn. • Allow 60 days between *Fusilade DX* application and dry bean harvest. • Two applications 7-14 days apart are usually needed for control of perennial grasses. • Tank mixes with *Pursuit* and *Raptor* are not recommended – grass antagonism will occur. • DO NOT apply more than 48 oz/A of *Fusilade DX* per season. • Refer to label and Table 12 for crop rotation restrictions.
	sethoxydim *(Poast)* + crop oil concentrate + ammonium sulfate	0.19	1 pt 1.5SC + 1 qt + 2.5 lb	• Refer to Table 5A for weed control and crop tolerance ratings. • Reduced rates of *Poast* (12 oz/A) may be used when barnyardgrass, green and giant foxtail, and fall panicum are less than 4 inches tall and the target species. • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 5 days prior to and 7 days following application. • Allow 30 days between *Poast* application and dry bean harvest. • *Poast* is generally less effective than other postemergence grass herbicides for perennial grass control. • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans — Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Grasses	clethodim *(Select/Arrow)* + crop oil concentrate OR *(Select Max)* + surfactant + ammonium sulfate	0.094 0.068 	6 oz 2EC + 1% OR 9 oz 0.97EC + 0.25% + 2.5 lb	• Refer to Table 5A for weed control and crop tolerance ratings. • Reduced rates of *Select/Arrow* (4-5 oz/A) or *Select Max* (6-8 oz/A) may be used when some grass species are small. • The addition of ammonium sulfate at 2.5 to 4 lb/A has been shown to improve control of difficult to control weeds, e.g., quackgrass, rhizome Johnsongrass, volunteer cereals, and volunteer corn. • DO NOT apply to grasses under stress — poor weed control will result. • DO NOT cultivate within 7 days prior to and 7 days following application. • Allow 30 days between application and dry bean harvest. • *Select/Arrow* or *Select Max* can be tank mixed with *Basagran*. Increase the *Select/Arrow* rate to 8-10 oz/A and the *Select Max* rate to 12 oz/A and apply with crop oil concentrate (1% v/v). • Tank mixes with *Pursuit* and *Raptor* are not recommended — grass antagonism will occur. • *Select/Arrow* (8-16 oz/A) plus crop oil concentrate (1% v/v) plus ammonium sulfate (2.5 lb/A) will control quackgrass 4-12 inches tall. A sequential application of 8 oz/A may be needed 14-21 days later. Sequential applications of *Select Max* (12 + 12 oz/A) are needed to control 4 to 12 inch quackgrass. • Refer to label and Table 12 for crop rotation restrictions.
Annual Broadleaves	bentazon *(Basagran/Broadloom)* + crop oil concentrate	0.75	1.25 pt 4L + 1 qt	• Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds. Check dry bean label for specific rate and proper weed growth stage. • Beans MUST HAVE one fully expanded trifoliate before application. • Use a minimum of 20 gal. water/A for adequate coverage. • DO NOT apply if dry beans are under stress from herbicide injury, cold or dry weather, or hail damage. • For improved velvetleaf control 28% liquid nitrogen (2-4 qt/A) or ammonium sulfate (2.5 lb/A) can be used INSTEAD OF crop oil concentrate. However, if common ragweed and common lambsquarters are present, a crop oil concentrate must also be included. • Split applications of (1 pt + 1 pt) plus crop oil concentrate (1 pt + 1 pt) can be used for more consistent common ragweed and lambsquarters control. Make the first application when weeds are less than 1 inch tall, and make second application 10-14 days later. • For CANADA THISTLE and YELLOW NUTSEDGE control, apply sequential applications of (1.5 pt + 1.5 pt) plus crop oil concentrate (1 qt + 1 qt) when Canada thistle is 6-8 inches tall and yellow nutsedge is 4-6 inches. Make second application 7-10 days later. • Allow 30 days between application and dry bean harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans — Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual Broadleaves	halosulfuron *(Permit)* + surfactant	0.023	0.67 oz 75WG + 0.25%	• Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Apply when beans have 1-3 trifoliate leaves. • DO NOT apply if dry beans have begun to flower. • *Permit* can be tank-mixed with other herbicides for additional broadleaf and grass control. • Dry bean varieties and classes vary in their tolerance to *Permit*. From MSU research, CAUTION should be taken when applying to kidney and black beans. Under adverse conditions maturity of the treated crop can be delayed which can affect harvest date, yield, and quality. • DO NOT use on adzuki beans. • DO NOT plant SUGARBEETS within 21 months of *Permit* application. • Refer to Table 12 for crop rotation restrictions.
	imazethapyr *(Pursuit)* + surfactant	0.031	2 oz 2L + 0.25%	• Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliate before application. • DO NOT apply if dry beans have begun to flower. • Apply *Pursuit* with non-ionic surfactant (0.25% v/v). • DO NOT add 28% liquid nitrogen (2.5% v/v) or ammonium sulfate (2.5 lb/A) unless at least 8 oz of *Basagran* is added to "safen" this application. • Increase the rate of *Basagran* (16 oz) when tank mixed with *Pursuit* to control common cocklebur and jimsonweed. • Delayed maturity may result from applications of *Pursuit*. DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • DO NOT tank mix with postemergence grass herbicides — grass antagonism will occur. • Dry bean varieties vary in their sensitivity to *Pursuit*. Use ONLY on navy, black turtle, pinto, kidney, and cranberry beans. DO NOT use on DOMINO black or OLATHE pinto beans. • DO NOT apply within 60 days of harvest. • DO NOT use if sugar beets, cucumbers, canola or tomatoes are in the rotation; requires 40 months and a soil bioassay. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans — Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual Broadleaves	imazamox *(Raptor)* + bentazon *(Basagran)* + crop oil concentrate + ammonium sulfate	0.032 0.25	4 oz 1L + 8 oz 4L + 1% + 2.5 lb	• Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches). • Beans MUST HAVE one fully expanded trifoliate before application. • DO NOT apply if dry beans have begun to flower. • DO NOT apply if planting is delayed and frost is likely to occur prior to maturity. • Apply *Raptor* with crop oil concentrate (1% v/v) or a non-ionic surfactant (0.25% v/v). • At least 8 fl oz of *Basagran* **must** be tank mixed with *Raptor*, if ammonium sulfate (12-15 lb/100 gal) or 28% liquid nitrogen (2.5% v/v) are added. *Basagran* "safens" this application. • Increase the rate of *Basagran* (16 oz) when tank mixed with *Raptor* to control common cocklebur and jimsonweed, and to provide good control of common lambsquarters (less than 2 inch tall). • DO NOT tank mix with postemergence grass herbicides — grass antagonism will occur. • DO NOT apply within 60 days of harvest. • DO NOT use the combination of *Raptor* + *Basagran* on adzuki beans. *Basagran* causes significant injury to adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	fomesafen *(Reflex)* + surfactant	0.25	1 pt 2L + 0.25%	• Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds; common ragweed 4-inches or less and eastern black nightshade 2-inches or less. • Common ragweed less than 4-inches will be controlled with 0.5 pt/A of *Reflex*. • Beans MUST HAVE one fully expanded trifoliate before application. • A non-ionic surfactant at 0.25-0.5% v/v or a crop oil concentrate at 0.5-1.0% v/v must be included for effective control. • *Reflex* can be tank-mixed with *Basagran*, *Raptor*, or *Pursuit*. Include a COC when tank-mixing *Reflex* + *Basagran*. ONLY include a non-ionic surfactant when tank-mixing with *Raptor* or *Pursuit*. DO NOT add AMS or 28%N. • *Reflex* can be applied only in the Lower Peninsula of Michigan. • DO NOT apply *Reflex* or other fomesafen containing products to the same field in CONSECUTIVE years. • DO NOT apply within 45 days of harvest. • Refer to Table 12 for crop rotation restrictions.
	basagran + imazamox (*Varisto*) + crop oil concentrate + ammonium sulfate	0.68	21 oz 4.18L + 1% + 2.5 lb	• Refer to Table 5A for weed control and crop tolerance ratings. • *Varisto* at 21 fl oz/A is equivalent to 21 fl oz/A of *Basagran* 4L and 4 fl oz/A of *Raptor*. • Most effective on small weeds (less than 2 inches). • Beans must have one fully expanded trifoliate before application. • DO NOT apply if dry beans have begun to flower. • DO NOT tank-mix with postemergence grass herbicides – grass antagonism will occur. • DO NOT apply within 30 days of harvest. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.

Table 5C – Preharvest Treatments in Dry Edible Beans

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Preharvest	glyphosate *(many)* + ammonium sulfate	0.75 lb a.e.	See Table 10 + 17 lb/100gal	• Glyphosate should ONLY be used to control weeds that hinder harvest. • Not all glyphosate products are labeled for **Preharvest** application in dry edible beans. Consult product labels for legal applications. Roundup branded products, *Duramax, Durango DMA, Touchdown Total* and *Traxion* are some glyphosate products that are currently labeled. • ***DO NOT*** use glyphosate for **vine desiccation** — residues of glyphosate have been found in harvested beans if applications are made too early. • Glyphosate should be applied when beans are in the ***hard dough stage*** **(30% moisture or less)**. • Glyphosate applications should be made at least 7 days before harvest. • ONLY one application should be made per year. • DO NOT apply glyphosate to beans grown for seed. • DO NOT feed treated vines and hay from these crops to livestock.
	paraquat *(Gramoxone SL 2.0)* + surfactant	0.3-0.5	1.2–2 pt 2SL + 0.25%	• *Gramoxone SL 2.0* is a restricted-use pesticide. • Apply when crop is mature, at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • Always add a non-ionic surfactant at 0.25% v/v or a crop oil concentrate at 1% v/v. • Apply by air in 5 gal water/A or by ground in 20-40 gal of water/A. • If growth is lush and vigorous, make either a single application of the higher rate of *Gramoxone SL 2.0*; or split applications at the lower rates. Split applications may improve vine coverage. DO NOT exceed 2.0 pt/A of *Gramoxone SL 2.0*. • Do not harvest within 7 days of application.
	paraquat *(Parazone)* + surfactant	0.5	1.33 pt 3SL + 0.25%	• *Parazone* is a restricted-use pesticide. • *Parazone* contains the same active ingredient as *Gramoxone SL 2.0* (paraquat), but is at a different concentration. • See the Remarks and Limitation section for *Gramoxone SL 2.0*.
	saflufenacil *(Sharpen)* + methylated seed oil + ammonium sulfate	0.023	1 oz 2.85L + 1% + 17 lb/100 gal	• Apply when crop is mature – at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type) beans of the leaves are still green. • *Sharpen* can be applied at rates up to 2 oz/A. • Dry beans can be harvested 2 days after application. However, it generally takes 7 days to reach maximum desiccation activity. • *Sharpen* is an effective desiccant. • DO NOT apply to beans grown for seed. • DO NOT graze or feed desiccation-treated hay or straw to livestock. • Refer to label and Table 12 for crop rotation restrictions. DO NOT include time in the rotation interval when the ground is frozen.

(Continued on next page)

Preharvest Treatments in Dry Edible Beans *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Preharvest	flumioxazin *(Valor)* OR (*Valor EZ)* + methylated seed oil	0.05	1.5 oz 51WG OR 1.5 oz 4L + 1 qt	• Apply when crop is mature – at least 80% of the pods are yellowing and mostly ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • *Valor/Valor EZ* can be applied at rates up to 2 oz/A. • Dry beans can be harvested 5 days after *Valor* application. However, it generally takes 7 to 14 days to reach maximum desiccation activity. • Dry bean desiccation is similar to that from *Gramoxone* and glyphosate; however, the spectrum of weed control is not as broad. • *Valor* provides residual activity that may reduce winter annual growth. • Follow sprayer clean-up instructions — residues of *Valor* can be trapped in poly-tanks and hoses if not adequately cleaned. • Crop rotation restrictions are dependent on rainfall, *Valor* use rate and tillage. • Rotation restrictions for 2 oz or less of *Valor/Valor EZ* are 1 month with 1 inch of rain for corn and winter wheat. Dry bean and barley may be planted after 3 months, and alfalfa, oats and sugar beets may be planted after 4 months if the ground is tilled prior to planting or 8 months if no tillage is performed. Note: In Michigan research trials, planting sugar beet no-till the spring following a *Valor* preharvest treatment resulted in major sugar beet stand reduction. Tillage reduced the effect of *Valor* on sugar beet; however, slight injury may occur on sandier soils. • Refer to label and Table 12 for crop rotation restrictions.
	carfentrazone *(Aim)* + methylated seed oil	0.03	2 oz 2EC + 1% v/v	• Apply when crop is mature – at least 80% of the pods are yellowing and most ripe and no more than 40% (bush-type beans) or 30% (vine-type beans) of the leaves are still green. • *Aim* alone is not as effective as *Sharpen*, glyphosate, *Gramoxone*, or *Valor* for dry bean desiccation. • Tank mixtures with *Gramoxone* or glyphosate will improve dry bean desiccation and is needed to improve the spectrum of weed desiccation. • Thorough spray coverage is required – sequential applications may be needed. • The preharvest interval is 0 days for *Aim* alone.

TABLE 6A –Weed Response to Herbicides in Potatoes*

			ANNUAL BROADLEAVES										ANNUAL GRASSES								PERENNIALS				
	SITE OF ACTION	CROP TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	WILD BUCKWHEAT	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																									
EPTAM	8	1	P	P	**G**	F	F	F	F	F	F	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	N	N	N	F	F
Preemergence																									
BOUNDARY	5/15	2	F	F	**E**	F	**E**	**G**	**E**	**G**	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	**G**
DUAL MAGNUM/PARALLEL/OTHERS	15	2	N	N	P	F	**G**	P	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	**G**
LOROX/LINEX	7	1	P	P	**G**	F	**E**	**G**	**G**	F	**G**	F	F	F	F	F	F	F	F	P	N	N	N	N	N
MATRIX	2	1	**G**	F	F	P	**E**	F	F	F	**E**	F	**G**	F	**G**	**G**	**G**	F	F	P	N	N	P	P	P
METRIBUZIN	5	2	F	F	**E**	N	**E**	**G**	**E**	**G**	**E**	**G**	P	F	**G**	**G**	**G**	F	F	P	N	N	N	N	N
OUTLOOK[a]	15	2	N	N	P	**G**	**G**	P	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	P	N	N	N	N	F
PROWL H_20/PROWL	3	1	N	N	**G**	P	F	P	P	F	P	P	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	N	N
REFLEX	14	2	P	F	P	**G**	**E**	**G**	P	P	**E**	N	N	N	N	N	N	N	N	N	N	N	N	N	N
SEQUENCE	9/15	2	N	N	P	F	**G**	P	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	F	N	N	N	N	**G**
Postemergence																									
MATRIX[a]	2	1	**G**	P	F	F	**E**	F	F	F	**E**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	F	F	F
METRIBUZIN	5	2	**G**	F	**E**	N	**G**	**E**	**E**	**G**	**E**	F	P	P	F	F	F	F	F	P	N	N	N	N	N
POAST	1	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	F	N
SELECT MAX/																									
SELECT/ARROW	1	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	**G**	N

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied—cold, wet: foliar applied—hot, humid); 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label; 4=Risk of severe crop injury is high.

[a] Fair to good control of hairy nightshade.

TABLE 6B – Potato herbicides – Remarks and Limitations

Potatoes – Preplant Incorporated Only

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	EPTC *(Eptam)*	4	4.5 pt 7EC	• **Apply preplant incorporated only.** • Refer to Table 6A for weed control and crop tolerance ratings. • Work into soil immediately after application. • Increase the rate to 6.75 pt/A for nutsedge control. • DO NOT exceed 14 pt/A *Eptam* per crop. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.

Potatoes – Soil Applied Herbicides

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	s-metolachlor *(Dual Magnum)* OR *(Dual II Magnum, Cinch)*	1.27	1.33 pt 7.62EC OR 1.33 pt 7.64EC	• **Apply preplant incorporated or preemergence following planting, hilling or drag-off.** • Refer to Table 6A for weed control and crop tolerance ratings. • Can be tank mixed with other soil-applied herbicides for improved control of certain weeds. • Can be applied postemergence after hilling or drag-off, but this application will not control emerged weeds. • DO NOT apply more than 3.6 pt/A per year. • DO NOT use on muck or peat soils. • DO NOT harvest potatoes within 60 days of preemeregence application and 40 days of postemergence applications. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.
	dimethenamid-P *(Outlook)*	0.66	14 oz 6L	• **Apply preemergence following planting, hilling or drag-off.** • Refer to Table 6A for weed control and crop tolerance ratings. • *Outlook* rates range from 12 to 18 oz/A (coarse textured soils) and 18 to 21 oz/A (medium- to fine-textured soils). • DO NOT incorporate. • DO NOT apply more than one application of *Outlook* per acre per year. • Under cold or wet conditions, applications of *Outlook* may result in delayed emergence or early season stunting. • DO NOT apply within 40 days of potato harvest. • Tank mixtures and/or sequential program are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.
	metolachlor *(Parallel)*	1.3	1.33 pt 7.8EC	• **Apply preplant incorporated or preemergence following planting, hilling or drag-off.** • *Parallel* contains the R and S-isomers of metolachlor. Rates would need to be increased to 2 pt/A to provide the same amount of s-metolachlor (the more active isomer) as the 1.33 pt/A rate of *Dual Magnum*. • Refer to the Remarks and Limitations section for *Dual Magnum*.

(Continued on next page)

Potatoes – Soil Applied Herbicides *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	pendimethalin *(Prowl H_2O)* OR (Prowl)	0.75	 1.6 pt 3.8CS OR 1.8 pt 3.3EC	• **Apply preemergence following planting, hilling or drag-off.** • Refer to Table 6A for weed control and crop tolerance ratings. • Can be tank mixed with other soil-applied herbicides for improved control of certain weeds. • Can be applied early postemergence to the 6-inch stage of growth, but this application will not control emerged weeds. • DO NOT apply more than one application of *Prowl H_2O/ Prowl* per acre per year. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + s-metolachlor *(Sequence)* + ammonium sulfate	1.64	3.5 pt 2.25L + 17 lb/100 gal	• **Apply preemergence following planting, hilling or drag-off.** • *Sequence* at 3.5 pt/A contains 0.9 lb a.e./A of glyphosate and 1.2 pt/A of *Dual Magnum*. • DO NOT apply to emerged potatoes – severe injury will occur. • Refer to Table 6A for residual weed control and crop tolerance ratings. • DO NOT apply more than 4 pt/A per season. • DO NOT apply within 60 days of potato harvest. • Refer to label and Table 12 for crop rotation restrictions.
Annual broadleaves	linuron *(Lorox DF)* OR *(Linex 4L)*	1	 2 lb 50DF OR 1 qt 4L	• **Apply preemergence immediately after hilling or drag-off.** • Refer to Table 6A for weed control and crop tolerance ratings. • Apply before grasses exceed 2 inches and broadleaves exceed 6 inches tall, but BEFORE POTATOES EMERGE – surfactant at 0.125% v/v can be added. • *Lorox/Linex* should be tank mixed with a soil-applied grass herbicide, such as *Dual Magnum* for control of grass weeds. • *Lorox/Linex* will provide some control of triazine-resistant common lambsquarters. • DO NOT exceed 3 pt/A per acre per crop season. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.
	rimsulfuron *(Matrix SG)*	0.023	1.5 oz 25WG	• **Apply preemergence immediately after hilling or drag-off.** • Refer to Table 6A for weed control and crop tolerance ratings. • Rainfall or irrigation of 1/3 to 1 inch is needed within 5 days of application to achieve the greatest activity. • *Matrix* may be tank mixed with other soil-applied herbicides for improved control of certain weeds. • DO NOT exceed 2.5 oz/A per acre per crop season. • DO NOT apply *Matrix* within 30 days of potato harvest. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.

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Potatoes – Soil Applied Herbicides *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	metribuzin (*Metribuzin*, others)	0.5	0.67 lb 75DF	• **Apply preemergence immediately after hilling or drag-off.** • Refer to Table 6A for weed control and crop tolerance ratings. • Under adverse weather conditions (cool-wet) – crop injury can occur and may be more pronounced with specific varieties. • *Metribuzin* may be tank mixed with other soil-applied herbicides for improved control of certain weeds. • *Metribuzin* will not provide control of triazine-resistant common lambsquarters. • Can be applied in split-applications (once preemergence and once postemergence). • DO NOT exceed 1.33 lb/A per acre per crop season. • DO NOT apply within 60 days of potato harvest. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.
	fomesafen *(Reflex)*	0.25	1 pt 2L	• **Apply preemergence following planting, hilling or drag-off.** • Refer to Table 6A for weed control and crop tolerance ratings. • DO NOT apply to emerged potato plants – severe crop injury will occur. • Potato varieties may vary in their response to *Reflex* – consult seed company. • *Reflex* may be tank mixed with other soil-applied herbicides for improved control of certain weeds. • DO NOT apply *Reflex* to the same field in consecutive years. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses **Annual broadleaves**	s-metolachlor + metribuzin *(Boundary 6.5EC)*	1.22	1.5 pt 6.5EC	• **Apply preemergence following planting, hilling or dragoff.** • Refer to Table 6A for weed control and crop tolerance ratings. • *Boundary 6.5EC* at 1.5 pt/A contains 1 pt/A *Dual Magnum* + 5 oz/A *Metribuzin*. • Potato varieties can vary in their response to *Metribuzin* – consult seed company. • *Boundary 6.5EC* may be tank mixed with other soil-applied herbicides for improved control of certain weeds. • DO NOT apply more than 1 lb a.i./A per year of metribuzin. • DO NOT use on muck or peat soils. • DO NOT apply *Boundary 6.5EC* within 60 days of potato harvest. • Tank mixtures and/or sequential program are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.

Potatoes – Postemergence Herbicides

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Volunteer cereals**	sethoxydim *(Poast)* + crop oil concentrate	0.19	1 pt 1.5SC + 1 qt	• Refer to Table 6A for weed control and crop tolerance ratings. • Apply to grasses up to 8 inches tall (crabgrass up to 6 inches). • *Poast* at 0.75 pt/A will control 1 to 4 inch tall barnyardgrass, green and giant foxtails, and fall panicum. • Volunteer cereals need to be treated before tillering (up to 4 inches tall). • DO NOT apply within 30 days of potato harvest. • Refer to label and Table 12 for crop rotation restrictions.
	clethodim *(Select Max)* OR *(Select/Arrow)* + crop oil concentrate	 0.068 0.094	 9 oz 0.97EC OR 6 oz 2EC + 1%	• Refer to Table 6A for weed control and crop tolerance ratings. • Apply to grasses up to 8 inches tall (crabgrass up to 6 inches). • *Select Max* at 6 oz/A or *Select/Arrow* at 4 oz/A will control 1 to 4 inch tall barnyardgrass, green and giant foxtails, and fall panicum. • Volunteer cereals need to be treated between 2 to 6 inches tall. • The addition of ammonium sulfate (2.5 to 4 lb/A) has been shown to improve control of difficult weeds – e.g., quackgrass, Johnsongrass, and volunteer cereals. • There is more adjuvant flexibility with *Select Max* tank-mixtures. Consult label. • DO NOT apply within 30 days of potato harvest. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses **Annual broadleaves**	rimsulfuron *(Matrix SG)* + surfactant	0.016	1 oz 25WG + 0.25%	• Refer to Table 6A for weed control and crop tolerance ratings. • Apply to small weeds (<1 inch in height or diameter). • *Matrix* may cause some temporary yellowing. • *Matrix* can be tank mixed with *Metribuzin* at 0.25 to 0.67 lb/A for improved control of certain weeds – apply with 0.125% v/v non-ionic surfactant. Refer to the remarks and limitations section for *Metribuzin*. • Apply at 1.5 oz/A for quackgrass control (4-8 inches tall). • DO NOT exceed 2.5 oz/A per acre per crop season. • DO NOT apply *Matrix* within 30 days of potato harvest. • Refer to label and Table 12 for crop rotation restrictions.
	metribuzin (*Metribuzin*, others)	0.25	0.33 lb 75DF	• Refer to Table 6A for weed control and crop tolerance ratings. • Apply to small weeds (<1 inch in height or diameter). • NOT RECOMMENDED on early maturing smooth skinned white and all red skinned varieties. Atlantic, Bellchip, Centennial, Chipbelle, Shepody, and Superior varieties are all sensitive to postemergence applications of metribuzin. • *Metribuzin* can be tank mixed with (Matrix) at 1 oz/A for improved control of certain weeds – apply with 0.125% v/v non-ionic surfactant. • *Metribuzin* will not provide control of triazine-resistant common lambsquarters. • Can be applied in split-applications (once preemergence and once postemergence). • DO NOT exceed 1.33 lb/A per acre per crop season. • DO NOT apply within 60 days of potato harvest. • Tank mixtures and/or sequential programs are needed for a complete weed control program. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 6C –Vine Desiccation in Potatoes

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Potato Vine Desiccation	carfentrazone *(Aim)* + methylated seed oil	0.047	3.2 oz 2EC + 1%	• Apply from 3.2 to 5.8 oz/A for best results. • Crop oil concentrate (1%) or surfactant (0.25%) may be used instead of methylated seed oil. • DO NOT apply more than 11.6 oz/A per year. • *Aim* is not as effective as *Reglone* or *Rely*. • Sequential applications may be needed — thorough coverage is required. • DO NOT harvest within 7 days of application.
	diquat *(Reglone)* + surfactant	0.25–0.5	1–2 pt 2L + 0.25%	• Make a second application of 1-2 pt/A a minimum of 5 days later if vine growth is dense. • A total of 4 pt/A may be applied, with no more than 2 pt/A at a single application. Allow 5 days between applications. • Apply at 50 psi or less in 20-100 gal. clean water/A. Greater water volumes will provide more thorough coverage of heavy vine growth. • Apply at least 7 days before harvest. • DO NOT apply to drought-stressed potatoes. • No soil persistence. A cover crop can be planted immediately.
	glufosinate *(Rely)* + ammonium sulfate	0.375	3 pt/A 1L + 17 lb/100 gal	• DO NOT use to desiccate potatoes that are being used for seed. • Apply at a total volume of 20-100 gal. water/A with ground equipment. • Increase spray volume to at least 30 gal. water/A when the potato vine canopy is dense or under cool and dry conditions. • Requires a rainfree period for 4 hours after application. • DO NOT make more than one application per harvest. • Apply at least 9 days before harvest.
	pyraflufen ethyl *(Vida)* + crop oil concentrate	0.009	5.5 oz 0.21EC + 1%	• Apply from 2.5 to 5.5 oz/A for best results. • *Vida* is not as effective as *Reglone* or *Rely*. • Use an approved agricultural buffering agent buffering to pH 7.5 or less if using *Vida* in a water source of > pH 7.5. • A total of 11 oz/A may be applied, with no more than 5.5 oz/A at a single application. Allow 7 days between applications. • Make a second application a minimum of 7 days later if vine growth is dense. • Tank mixing or sequential applications with other vine desiccation products result in enhanced control. • Apply in 20 to 50 gal water/A with ground equipment. • Apply at least 7 days before harvest.

TABLE 7A –Weed Response to Herbicides in Sugar Beets*

			ANNUAL BROADLEAVES										ANNUAL GRASSES							PERENNIALS					
	SITE OF ACTION	CROP RESPONSE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (BLACK)	PIGWEED	RAGWEED (COMMON)	SMARTWEED	VELVETLEAF	WILD MUSTARD	WILD BUCKWHEAT	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	BINDWEED (FIELD)	BINDWEED (HEDGE)	CANADA THISTLE	PERENNIAL SOWTHISTLE	QUACKGRASS	YELLOW NUTSEDGE
Preplant Incorporated																									
RO-NEET	8	2	P	P	F	F	**G**	F	P	**G**	P	F	**G**	**G**	**G**	**G**	**G**	**G**	**G**	N	N	N	N	F	**G**
Preemergence																									
NORTRON	16	2	F	F	**G**	**G**	**G**	P	**G**	F	**G**	**G**	P	F	**G**	F	F	P	P	N	N	N	N	N	P
Postemergence																									
BETAMIX	5	2	F	F	**G**	F	**G**	**G**	F	P	**G**	F	P	P	F	F	F	P	P	N	N	N	N	N	N
BETANEX	5	2	F	F	F	F	**E**	F	F	P	**G**	P	P	P	P	P	P	P	P	N	N	N	N	N	N
DUAL MAGNUM/CINCH[a]	15	2	N	N	P	F	**G**	P	P	N	P	N	**E**	**E**	**E**	**E**	**E**	**G**	**G**	N	N	N	N	N	P
OUTLOOK[a]	15	2	N	N	P	**G**	**G**	P	P	N	P	P	**E**	**E**	**E**	**E**	**E**	**G**	**G**	N	N	N	N	N	P
WARRANT[a]	15	2	P	N	F	**G**	**G**	F	P	P	P	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	N	N	N	N	N	P
NORTRON	16	2	P	P	F	**G**	F	P	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	N	N	N	P
UPBEET	2	2	F	–	P	F	F	F	F	**G**	**E**	F	P	P	F	F	F	P	P	N	N	P	N	N	P
PROGRESS	5/16	2	F	F	F/**G**	**G**	**G**	**G**	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	N	N	N	P
STINGER	4	1	**E**	**G**	P	F	P	**E**	F	P	P	F	N	N	N	N	N	N	N	P	P	**G**	**G**	N	N
BETAMIX + UPBEET	2/5	2	F	F	**G**	F	**E**	**G**	**G**	**G**	**E**	**G**	P	P	**G**	F	F	P	P	N	N	P	P	N	P
BETAMIX + STINGER	4/5	2	**E**	**G**	**G**	F	**G**	**E**	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	F	F	N	N
BETAMIX + UPBEET + STINGER	2/4/5	2	**E**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**E**	**G**	P	P	**G**	F	F	P	P	N	N	F	F	N	P
PROGRESS + UPBEET	2/5/16	3	F	F	F/**G**	**G**	**E**	**G**	**G**	**G**	**E**	**G**	P	P	**G**	F	F	P	P	N	N	P	P	N	P
PROGRESS + STINGER	4/5/16	3	**E**	**G**	F/**G**	**G**	**E**	**E**	**G**	P	**G**	**G**	P	P	F	F	F	P	P	N	N	F	F	N	P
PROGRESS + UPBEET + STINGER	2/4/5/16	3	**E**	**G**	**G**	**E**	**E**	**E**	**G**	**G**	**E**	**E**	P	P	**G**	F	F	P	P	N	N	F	F	N	P
ASSURE II/TARGA	1	1	N	N	N	N	N	N	N	N	N	N	**G**	**G**	**E**	**E**	**G**	**E**	**E**	N	N	N	N	**E**	N
FUSILADE DX	1	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	N	N	**G**	N
POAST	1	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	N	N	F	N
SELECT/SELECT MAX/ARROW	1	1	N	N	N	N	N	N	N	N	N	N	**E**	**G**	**E**	**E**	**E**	**E**	**E**	N	N	N	N	**G**	N
Glyphosate-Resistant Sugar Beets																									
GLYPHOSATE[b]	9	1	**E**	**E**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**E**	F
SEQUENCE[b]	9/15	2	**E**	**E**	**G**	**G**	**E**	**G**	**G**	**G**	**G**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**E**	**G**	**G**	**G**	**G**	**E**	F

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions; 3=Severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label.

[a] *Dual Magnum, Cinch*, *Outlook* and *Warrant* will not control emerged weeds, but will provide residual control of the above listed species.

[b] Use only on glyphosate-resistant sugar beets. Glyphosate will provide better control of most broadleaf weeds compared with current postemergence sugar beet broadleaf herbicides. Weed response ratings are based on experiences with glyphosate and should not be compared with other postemergence sugar beet broadleaf herbicides.

TABLE 7B – Sugar Beet Herbicides – Remarks and Limitations

Sugar Beets – Preplant Incorporated

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	cycloate *(Ro-Neet)*	3	2 qt 6L	• Refer to Table 7A for weed control and crop tolerance ratings. • Incorporate immediately to 2-3 inches. • DO NOT apply *Nortron* preemergence. • Injury can occur when *Betamix, Betanex,* or *Progress* is applied at standard rates prior to 6-leaf sugar beets if *Ro-Neet* was applied. • The risk of injury is reduced if *Betamix, Betanex,* or *Progress* is applied at micro- or split-application rates. • *Ro-Neet* can be applied preplant incorporated prior to postemergence glyphosate applications in glyphosate-resistant sugar beet. • *Ro-Neet* provides good velvetleaf suppression. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	ethofumesate *(Nortron)*	1.5	3 pt 4SC	• Refer to Table 7A for weed control and crop tolerance ratings. • *Nortron* will provide some suppression of annual grasses. • Increase *Nortron* rate to 4 pt/A on clay soils if weed pressure is heavy. • *Nortron* can be applied preemergence prior to post-emergence glyphosate applications in glyphosate-resistant sugar beet. • The rotation interval is reduced to 6 months if less than 12 oz/A is applied. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Micro-Rate Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	desmedipham + phenmedipham *(Betamix)*	0.08	8 oz 1.3L	• Refer to Table 7A for weed control and crop tolerance ratings. • Micro-rate applications may be applied to sugar beets at any growth stage. TIME THE FIRST MICRO-RATE application when weeds are less than 0.125 inch tall. This can be as early as 14 days after sugar beet planting. • Make the second micro-rate application when emerging weeds are less than 0.125 inch tall. This will be 5-14 days later, depending on temperature and moisture. • Continue TIMELY micro-rate applications (usually every 7 days) as needed until beet canopy closure. • Reduce the number of micro-rate applications and minimize sugar beet injury by timing micro-rate applications using growing degree-days. See the next section on TIMING MICRO-RATE APPLICATIONS USING GROWING DEGREE-DAYS (GDD). • The *Betamix* rate may be increased up to 12 oz/A when sugar beets are in the cotyledon to 4-leaf growth stage, and increased up to 16 oz/A if the smallest sugar beet plants in the field are in the 4-true-leaf stage. Use caution when using higher rates on early 2-leaf sugar beets — injury may occur. • IF WEEDS EXCEED 0.25 inch, return to standard herbicide application rates. • *Select/Arrow* at 2 oz/A, *Select Max* at 3 oz/A, *Assure II/Targa* at 4 oz/A, or *Poast* at 5.3 oz/A can be added to each micro-rate application OR wait until grasses reach 2–3 inches tall and add one of these herbicides at standard rates to one of the micro-rate applications. • Apply micro-rates in 10–12 gal. water/A. The methylated seed oil concentration must be a minimum of 1 pt/A in spray volumes of 4–8 gal. water/A. • Micro-rates can be applied at any time of day. • DO NOT tank mix micro-rates with *Quadris*. • Refer to label and Table 12 for crop rotation restrictions.
	+	+	+	
	triflusulfuron methyl *(UpBeet)*	0.0039	0.125 oz 50WG	
	+	+	+	
	clopyralid *(Stinger)*	0.0235	1 oz 3L	
	+		+	
	methylated seed oil		1.5%	
		AND REPEAT		
	desmedipham + phenmedipham ethofumesate *(Progress)*	0.08	5.7 oz 1.8L	• Refer to Table 7A for weed control and crop tolerance ratings. • SEE ALL REMARKS IN THE *BETAMIX* MICRO-RATE SECTION. • *Betamix* micro-rate applications will provide more consistent pigweed control. • The *Progress* rate may be increased up to 8.7 oz/A when sugar beets are in the cotyledon to 4-leaf growth stage, and increased up to 11.6 oz/A if the smallest sugar beet plants in the field are in the 4-true-leaf stage. Use caution when using higher rates on early 2-leaf sugar beets — injury may occur. • DO NOT tank mix micro-rates with *Quadris*. • Refer to label and Table 12 for crop rotation restrictions.
	+	+	+	
	triflusulfuron methyl *(UpBeet)*	0.0039	0.125 oz 50WG	
	+	+	+	
	clopyralid *(Stinger)*	0.0235	1 oz 3L	
	+		+	
	methylated seed oil		1.5%	
		AND REPEAT		

Sugar Beets – Timing Micro-Rate Applications Using Growing Degree-Days (GDD)

$$\text{GDD formula} = \frac{(\text{High Temp.} + \text{Low Temp.})}{2} - 34°\text{F}$$

EXAMPLE CALCULATION:

Day 1 = (75 + 55) / 2 – 34°F = 31 GDD
Day 2 = (80 + 60) / 2 – 34°F = 36 GDD

Two-day accumulation 67 GDD

- Timing micro-rate applications on GDD may reduce the number of herbicide applications during periods of cool weather.

GENERAL GUIDELINES:

- After the first micro-rate application, apply a micro-rate when 225 GDD have accumulated for average weed pressures on most soils. REPEAT.
- If soils are sandy, have high weed pressure, or are high in organic matter, adjust application timings to 175 GDD, particularly when pigweed is the target weed.
- Early in the season, when lambsquarters is the predominant species, micro-rate timings may be extended to 275 GDD. However, when pigweeds start to emerge, switch to 175 or 225 GDD.
- Delayed applications will result in reduced weed control.

Sugar Beets – Early Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	desmedipham phenmedipham *(Betamix)*	0.5	3 pt 1.3L	• Refer to Table 7A for weed control and crop tolerance ratings. • Split low rates of *Betamix* + *UpBeet* followed by *Betamix* + *UpBeet* + *Stinger* may be applied to sugar beets at early growth stages (less than the 4-true-leaf stage) to control weed seedlings at the cotyledon stage. Weeds not completely controlled by the first treatment will be checked and controlled by the second application. • The second application MUST BE MADE AT LEAST 7 days but not more than 10 days AFTER the first application. • Growing degree-day recommendations for split low-rate applications: 400 GDD prior to the first application and 350 to 400 GDD prior to the second application. • The rate of *Betamix* in the second application can be increased to 4.6 pt/A. • Adding *Stinger* to the second application will control cocklebur and common and giant ragweed and improve lambsquarters control. • Add surfactant at 0.25% v/v to THE SECOND APPLICATION ONLY. • DISPERSE *UpBeet* thoroughly in the tank before adding other herbicides. • Rainfall within 6 hours of application may reduce control. • If *Stinger* is added, DO NOT plant dry beans for 18 months if organic matter is less than 2%. • Refer to label and Table 12 for crop rotation restrictions.
	+	+	+	
	triflusulfuron-methyl *(UpBeet)*	0.0156	0.5 oz 50WG	
	FOLLOWED BY:			
	desmedipham + phenmedipham *(Betamix)*	0.5	3 pt 1.3L	
	+	+	+	
	triflusulfuron-methyl *(UpBeet)*	0.0156	0.5 oz 50WG	
	+	+	+	
	clopyralid *(Stinger)*	0.094	0.25 pt 3L	

(Continued on next page)

Sugar Beets – Early Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	desmedipham + phenmedipham + ethofumesate *(Progress)*	0.25	1.13 pt 1.8L	• Refer to Table 7A for weed control and crop tolerance ratings. • DISPERSE *UpBeet* thoroughly in the tank before adding other herbicides. • Split (low-rate) applications of *Progress* plus *UpBeet* followed by *Progress* plus *UpBeet* plus *Stinger* may be applied to sugar beets at early growth stages (cotyledon to 4-true-leaf stage) to control weed seedlings at the cotyledon stage. • The second application MUST BE MADE AT LEAST 7 days but not more than 10 days AFTER the first application. • Growing degree-day recommendations for split low-rate applications: 400 GDD prior to the first application, and 350 to 400 GDD prior to the second application. • The rate of *Progress* in the second application can be increased to 2 pt/A if sugar beets are at 2-leaf pairs or larger. • Adding *UpBeet* to *Progress* results in velvetleaf control and provides more consistent control of pigweed, mustard, smartweed and wild buckwheat. • *Stinger* added to the second application controls cocklebur and common and giant ragweed. • DO NOT tank mix *Progress* split-rates with *Quadris*. • Rainfall within 6 hours of application may reduce control. • If *Stinger* is added, DO NOT plant dry beans for 18 months if organic matter is less than 2%. • Refer to label and Table 12 for crop rotation restrictions.
	+	+	+	
	triflusulfuron-methyl *(UpBeet)*	0.0156	0.5 oz 50WG	
	FOLLOWED BY:			
	desmedipham + phenmedipham + ethofumesate *(Progress)*	0.33	1.5 pt 1.8L	
	+	+	+	
	triflusulfuron methyl *(UpBeet)*	0.0156	0.5 oz 50WG	
	+	+	+	
	clopyralid *(Stinger)*	0.094	0.25 pt 3L	

Sugar Beets – Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses	s-metolachlor *(Dual Magnum, EverpreX)*	1.27	1.33 pt 7.62 EC	• Refer to Table 7A for weed control and crop tolerance ratings. • *Dual Magnum, Dual II Magnum* or *Cinch* should be applied to sugar beets after they have **2 true leaves**. • Sugar beets MUST HAVE 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction. • Crop safety is greater when *Dual Magnum, Dual II Magnum* or *Cinch* applications are made after beets reach the 4-leaf stage. • *Dual Magnum, Dual II Magnum* or *Cinch* may be tank mixed with micro-rate or standard-split herbicide applications, or with glyphosate for residual weed control in glyphosate-resistant sugar beets. • *Dual Magnum, Dual II Magnum* or *Cinch* will not control emerged weeds, but will provide residual control of annual grasses and some broadleaf weeds. • MSU **does not** recommend preplant incorporated or premergence applications of *Dual Magnum, Dual II Magnum* or *Cinch* — severe stand reductions can occur. • More than one postemergence application can be made, but the total should not exceed 2.6 pt/A. • Refer to label and Table 12 for crop rotation restrictions.
	OR		OR	
	(Dual II Magnum, Cinch)		1.33 pt 7.64 EC	

(Continued on next page)

Sugar Beets – Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses	dimethenamid-P *(Outlook)*	0.75	16 oz 6L	• Refer to Table 7A for weed control and crop tolerance ratings. • Sugar beets MUST HAVE 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction. • Crop safety is greater when *Outlook* applications are made after beets reach the 4-leaf stage. • Apply *Outlook* before sugar beets exceed the 8-leaf stage. • *Outlook* may be tank mixed with micro-rate or standard-split herbicide applications, or with glyphosate for residual weed control in glyphosate-resistant sugar beets. • *Outlook* will not control emerged weeds, but will provide residual control of annual grasses and some broadleaf weeds. • More than one application of *Outlook* can be made; maintain a minimum of 14 days between applications, and the total should not exceed 21 oz/A. • Refer to label and Table 12 for crop rotation restrictions.
	acetochlor *(Warrant)*	1.125	3 pt 3SC	• Refer to Table 7A for weed control and crop tolerance ratings. • Apply *Warrant* postemergence to sugar beet from the 2-leaf up to the 8-leaf stage. • Sugar beets MUST HAVE 2-fully expanded true leaves before application; applications prior to this stage will result in significant crop injury and possible stand reduction. • Crop safety is greater when *Warrant* applications are made after beets reach the 4-leaf stage. • *Warrant* may be tank mixed with other herbicides labeled for use in sugarbeet including glyphosate for residual weed control in glyphosate-resistant sugarbeet. • *Warrant* applied alone will not control emerged weeds, but will provide residual control of annual grasses and some small seeded broadleaf weeds, e.g., pigweed and nightshade. • More than one postemergence application can be made, but the total should not exceed 4 qt/A of *Warrant* per season. • If a sugarbeet stand is lost, replanting sugarbeet after a *Warrant* application is not recommended and may result in significant crop injury. • Refer to label and Table 12 for crop rotation restrictions.

Sugar Beets – Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Velvetleaf	triflusulfuron-methyl *(UpBeet)* + surfactant	0.0156	0.5 oz 50WG + 0.25% AND REPEAT	• SEE TABLE ON NEXT PAGE, "Guidelines for Velvetleaf Control with UpBeet." • *UpBeet* provides better velvetleaf control than *Pyramin* postemergence. • DISPERSE *UpBeet* thoroughly in the tank before adding surfactant. • A MINIMUM OF Two applications are needed For velvetleaf CONTROL. • Apply to velvetleaf at the 1-true-leaf stage. REPEAT application 7-10 days later. • Add 2 qt/A 28% liquid nitrogen or 2.5 lb ammonium sulfate in addition to surfactant if velvetleaf plants have 1 to 2 true leaves and beets are at 2-leaf-pair stage. • A third application of 0.5 oz/A of *UpBeet* + surfactant can be made. • The maximum amount of *UpBeet* that can be applied in 1 year is 2.5 oz/A. • *UpBeet* can be tank mixed with *Betamix, Progress* or glyphosate. • Rainfall within 6 hours of application may reduce control. • Allow at least 60 days between *UpBeet* application and sugar beet harvest. • Refer to label and Table 12 for crop rotation restrictions.

Guidelines for Velvetleaf Control with UpBeet

Beet Size	Velvetleaf Size	Other Weeds?	UpBeet Application*
cotyledon	coty — 1st true leaf	No	UpBeet + NIS
> cotyledon	coty — 2nd true leaf	No	UpBeet + 28% N + NIS
coty — 1st leaf pair	coty — 1st true leaf	Yes	UpBeet + Betamix
coty — 1st leaf pair	coty — 1st true leaf	Yes	UpBeet + Progressa
≥ 2nd leaf pair	coty — 1st true leaf	Yes	UpBeet + Betamix + NIS
≥ 2nd leaf pair	coty — 1st true leaf	Yes	UpBeet + Progress[a]

* UpBeet at 0.5 oz/A. NIS—nonionic surfactant.

[a] DO NOT use if RoNeet was applied.

Sugar Beets – Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Cocklebur **Ragweeds** **Jimsonweed** **Volunteer alfalfa** **Sweet clover** **Canada thistle** **Perennial sowthistle**	clopyralid *(Stinger)* + crop oil concentrate	0.09-0.18	0.25-0.5 pt 3L + 1%	• Refer to Table 7A for weed control and crop tolerance ratings. • DO NOT use on sands, loamy sands, or permeable soils where water tables are shallow because of potential groundwater contamination. • Apply 0.25 pt/A to control cocklebur, giant ragweed, jimsonweed, volunteer alfalfa and sweet clover up to the 6-leaf stage and common ragweed up to the 5-leaf stage. • Smartweed, wild buckwheat, and nightshade up to the 3-leaf stage will be suppressed at 0.25 pt/A. • Tank mix with other postemergence herbicides to control other annual broadleaf weeds • After sugar beets have reached the third leaf pair, apply 0.33 pt/A to Canada thistle (just prior to flowering) for control. Increase the rate to 0.5 pt/A under drought conditions. DO NOT include crop oil concentrate if 0.5 pt/A is tank mixed with *Betamix* or *Progress*. • After sugar beets have reached the third leaf pair, apply 0.5 pt/A for perennial sowthistle control. Increase the rate to 0.67 pt/A under drought conditions. DO NOT tank mix with other herbicides for perennial thistle control. • DO NOT apply within 45 days of beet harvest. • DO NOT plant dry beans for 18 months if soil organic matter is less than 2%. • Refer to label and Table 12 for crop rotation restrictions.
Annual grasses **Volunteer corn** **Cereals** **Quackgrass**	quizalofop-P-methyl *(Assure II/Targa)* + crop oil concentrate + ammonium sulfate	0.03-0.06	5-10 oz 0.88L + 1% + 2.5 lb	• Refer to Table 7A for weed control and crop tolerance ratings. • Apply 7 oz/A to actively growing annual grasses up to 4 inches tall; 8 oz/A is required for barnyardgrass and crabgrass control. • Apply 5 oz/A for control of volunteer corn up to 18 inches tall. • Apply 8 oz/A to control spring-seeded cereals up to 4 inches tall. • Apply 10 oz/A to control fall-seeded cereals. • Make an application of 10 oz/A to 6- to 8-inch-tall quackgrass. A second application of 7 oz/A may be required 14-21 days later. • Surfactant may be used instead of crop oil concentrate. Ammonium sulfate is not required for all *Assure II/Targa* applications. • Grass control may be reduced if *Assure II/Targa* is tank mixed with *Betamix, Progress*, or *UpBeet*. Apply 5 days later. • DO NOT include ammonium sulfate with *Betamix, Progress, UpBeet*, or *Stinger* tank mixes. • *Assure II/Targa* at 4 oz/A can be added to each micro-rate application for annual grass control. • DO NOT apply within 45 days of beet harvest. • Refer to label and Table 12 for crop rotation restrictions.
	fluazifop-P-butyl *(Fusilade DX)* + crop oil concentrate	0.188	12 oz 2L + 1%	• Refer to Table 7A for weed control and crop tolerance ratings. • Apply 6 oz/A of *Fusilade DX* to control volunteer corn. • Apply 8 oz/A to control spring seeded cereals up to 6 inches tall. • Two applications 7-14 days apart are usually needed for control of perennial grasses. • DO NOT apply more than 48 oz/A of *Fusilade DX* per season. • DO NOT apply within 90 days of sugarbeet harvest. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Sugar Beets – Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual grasses **Volunteer corn** **Cereals** **Quackgrass**	sethoxydim *(Poast)* + crop oil concentrate + ammonium sulfate	0.19-0.29	1-1.5 pt 1.5SC + 1% + 2.5 lb	• Refer to Table 7A for weed control and crop tolerance ratings. • *Poast* is not as effective as the other postemergence grass herbicides. • For foxtails, barnyardgrass, and fall panicum 8 inches or less and crabgrass 4 inches or less, apply 1 pt/A. The rate can be reduced to 0.75 pt/A if grasses are 1-4 inches tall. • Apply 1 pt/A for control of volunteer corn up to 20 inches tall. • Apply 1.5 pt/A to cereals prior to tillering (less than 4 inches tall). • Make an application of 1.5 pt/A to 6- to 8-inch-tall quackgrass. A second application of 1 pt/A may be required 14-21 days later. • Grass control may be reduced if *Poast* is tank mixed with *Betamix, Progress* or *UpBeet*. Apply 5 days later. • DO NOT include ammonium sulfate with *Betamix, Progress, UpBeet* or *Stinger* tank mixes. • DO NOT apply within 60 days of beet harvest. • Refer to label and Table 12 for crop rotation restrictions.
	clethodim *(Select/Arrow)* + crop oil concentrate + ammonium sulfate	0.09-0.25	6-16 oz 2EC + 1% + 2.5 lb	• Refer to Table 7A for weed control and crop tolerance ratings. • For foxtails, barnyardgrass, and fall panicum 8 inches or less and crabgrass 4 inches or less, apply 6 oz/A. The rate can be reduced to 4-5 oz/A if grasses are 1-4 inches tall. • Apply 6 oz/A for control of volunteer corn up to 18 inches tall. The rate can be reduced to 4 oz/A if corn is 4-12 inches tall. • Oats can be controlled with 8 oz/A. • Spring-seeded cereals are labeled for control at 8 oz/A. However, 16 oz/A will provide more consistent control. • Apply 16 oz/A to control fall-seeded cereals. Cereals should not exceed 6 inches tall. • Two applications of 8 oz/A, 14-21 days apart, are generally needed for quackgrass control. • Grass control may be reduced if *Select/Arrow* is tank mixed with *Betamix, Progress* or *UpBeet*. Apply 5 days later. • *Select/Arrow* at 2 oz/A can be added to each micro-rate application for annual grass control. • DO NOT include ammonium sulfate with *Betamix, Progress, UpBeet* or *Stinger* tank mixes. • DO NOT apply within 40 days of beet harvest. • Refer to label and Table 12 for crop rotation restrictions.
	clethodim *(Select Max)* + surfactant + ammonium sulfate	0.07-0.18	6-16 oz 0.97EC + 0.25% + 2.5 lb	• Refer to Table 7A for weed control and crop tolerance ratings. • For foxtails, barnyardgrass, and fall panicum 8 inches or less and crabgrass 4 inches or less, apply 9 oz/A. The rate can be reduced to 6 oz/A if grasses are 1-4 inches tall. • Apply 6 oz/A for volunteer corn control. • Oats can be controlled with 12 oz/A. • Apply 24 oz/A to for consistent control of cereals. Cereals should not exceed 6 inches tall. • Two applications of 12 oz/A 14-21 days apart are generally needed for quackgrass control. • Grass control may be reduced if *Select Max* is tank mixed with *Betamix, Progress* or *UpBeet*. Apply 5 days later. • *Select Max* at 3 oz/A can be added to each micro-rate application for annual grass control. • DO NOT include ammonium sulfate with *Betamix, Progress, UpBeet* or *Stinger* tank mixes. • DO NOT apply within 40 days of beet harvest. • Refer to label and Table 12 for crop rotation restrictions.

Weed Control in Glyphosate-Resistant Sugar Beets

Sugar beets that are resistant to glyphosate are designated *Roundup Ready* sugar beets. Glyphosate products labeled for postemergence use on glyphosate-resistant sugar beets can be broadcast applied postemergence on glyphosate-resistant sugar beets only. Read carefully all remarks and limitations written below and on the labels for each of the glyphosate products registered for use in glyphosate-resistant sugar beets. See Table 10 for a list of glyphosate products registered for use in glyphosate-resistant sugar beets.

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual grasses **Annual broadleaves** **Suppression of** **Perennials**	glyphosate (See Table 10) + ammonium sulfate	0.75–1.13 a.e.	22–32 oz 5.5L + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT SUGAR BEETS ONLY.** • Refer to Table 7A for weed control and crop tolerance ratings. • Many glyphosate products are registered for application to glyphosate-resistant sugar beets. Read the label and see Table 10 to determine application rates and additives needed for different products. • Glyphosate should be applied at a minimum rate of 0.75 lb a.e./A (22 oz of a 4.5 lb a.e./gal glyphosate products, see Table 10). • Always add ammonium sulfate (17 lb/100 gal) to maximize glyphosate performance and reduce antagonism from hard water. • Glyphosate-resistant sugar beets should be planted in a weed-free seedbed. • The first glyphosate application should be made before annual weeds exceed 2 inches tall. Subsequent applications should be made before additional weed flushes are 4 inches tall to maximize weed control and sugar beet yield. • Two to four applications of glyphosate will be needed for season-long weed control and to maximize sugar beet yield. • Maximum in crop glyphosate applications include two applications prior to 8-leaf sugar beets totaling 1.9 lb a.e./A (56 oz/A) and two applications after the 8-leaf stage until 30 days prior to harvest totaling 1.5 lb a.e./A (44 oz/A). • Increase the glyphosate rate up to 1.1 lb a.e./A (32 oz/A) to control hard-to-control weeds. This rate can only be used prior to 8-leaf sugar beets. • *Dual Magnum, Dual II Magnum, Cinch*, *Outlook* or *Warrant* can be tank mixed with subsequent glyphosate applications to provide residual control of late-emerging grasses and pigweed. Sugar beets should have at least 4 true leaves. See product descriptions. • Postemergence grass herbicides may be tank mixed with glyphosate to control VOLUNTEER GLYPHOSATE-RESISTANT CORN. Consult the volunteer corn remarks section for specific products and rates. • *Stinger* at 2 to 4 oz/A should be tank-mixed with glyphosate to control VOLUNTEER GLYPHOSATE-RESISTANT SOYBEAN. • Tank mix *Stinger* with glyphosate to control glyphosate-resistant horseweed. Use a minimum of two applications of *Stinger* at 3 oz/A. Best results have been observed with three applications of *Stinger* at 2 oz/A followed by 4 oz/A followed by 4 oz/A tank-mixed with glyphosate. *Stinger* has a preharvest interval of 45 days. It is important not to exceed a total of 10.7 fl oz of *Stinger* and to be mindful of crop rotation restrictions. • The addition of micronutrient fertilizers (e.g., manganese) to glyphosate can cause a reduction in weed control. For best results, apply glyphosate and the fertilizers separately or use a full-chelated form of the fertilizer, and always include ammonium sulfate (17 lb/100 gal).

(Continued on next page)

Weed Control in Glyphosate-Resistant Sugar Beets *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued) **Annual grasses** **Annual broadleaves** **Suppression of** **Perennials**				• Continuous use of the same herbicide can lead to the development of herbicide-resistant weeds. Keep this in mind when planning weed management strategies for the full crop rotation. Glyphosate may be best utilized in glyphosate-resistant sugar beets. Include herbicides with other modes of action and/or tillage in other crops of the rotation to help minimize the development of glyphosate-resistant weeds. • Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + s-metolachlor *(Sequence)* + ammonium sulfate	1.64	2.5 pt 5.25L + 17 lb/100 gal	• **APPLY TO GLYPHOSATE-RESISTANT SUGAR BEET ONLY.** • Refer to Table 7B for weed control and crop tolerance ratings. • Apply to sugar beet from the 2-true leaf stage to canopy closure. • DO NOT apply within 60 days of beet harvest. • *Sequence* is designed to control existing weeds and provide residual control of grasses and some small-seeded broadleaf weeds, including pigweeds and nightshade. • On fine and medium textured soils, *Sequence* can be applied at 3 pt/A prior to 8-true leaf sugar beet. • *Sequence* at 2.5 pt/A contains 22 fl oz/A of *Touchdown Total* (0.7 lb a.e./A of glyphosate) and 0.98 pt/A of *Dual Magnum*. • DO NOT exceed total maximum glyphosate use rate restrictions for glyphosate-resistant sugar beet when using *Sequence*. • DO NOT apply more than 7 pt/A of *Sequence* per season. • Refer to label and Table 12 for crop rotation restrictions.

TABLE 8 – Weed Response to Herbicides in Forage Sorghum*

			ANNUAL BROADLEAVES												ANNUAL GRASSES								PERENNIALS				
Soil Applied	SITE OF ACTION	SORGHUM TOLERANCE**	COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	T-R LAMBSQUARTERS[a]	NIGHTSHADE (E. BLACK)	PIGWEED (REDROOT)	RAGWEED (COMMON)	RAGWEED (GIANT)	SMARTWEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEDGE	JOHNSONGRASS (seedling)	JOHNSONGRASS (rhizome)
Photosynthesis Inhibitors																											
ATRAZINE	5	1	F	F	**E**	N	**E**	**G**	**E**	**G**	**G**	F	**E**	**G**	P	F	F	**G**	P	P	P	F	F	F	N	N
Others																											
DUAL II MAGNUM/CINCH/PARALLEL[c]	15	1	N	N	P	P	F	**G**	P	N	P	N	P	**E**	**E**	**E**	**E**	**E**	**E**	**E**	F	N	N	F[b]	P	N
Postemergence																											
Photosynthesis Inhibitors																											
ATRAZINE	5	1	**G**	**G**	**E**	N	**G**	**E**	**E**	**G**	**G**	F	**E**	F	P	F	**G**	**G**	P	P	P	F	F	F	N	N
Others																											
2,4-D AMINE	4	3	**G**	F	**G**	**G**	**G**	**G**	**G**	**G**	P	F	**G**	N	N	N	N	N	N	N	N	F	N	N	N	N
BASAGRAN/BROADLOOM	6	1	**E**	**G**	F	F	P	P	F	P	**G**	F	**E**	N	N	N	N	N	N	N	N	**G**	N	**G**	N	N
BUCTRIL/MOXY/OTHERS	6	2	**G**	**G**	**E**	**E**	**G**	F	**G**	**G**	**G**	**G**	F	N	N	N	N	N	N	N	N	P	N	N	N	N
HUSKIE	6/27	2	**G**	**G**	**E**	**E**	**G**	**G**	**G**	**G**	**G**	**G**	F	N	N	N	N	N	N	N	N	F	N	N	N	N

Herbicide Site of Action: The site of action key is located on pages 15-16.

Herbicide Effectiveness: P = Poor; F = Fair; **G** = Good; **E** = Excellent; N = None; – = Not enough information to rank

* *The above ratings are a relative comparison of herbicide effectiveness. Weather conditions greatly influence the herbicide's effectiveness, and weed control may be better under favorable conditions or poorer under unfavorable conditions.*

** Crop Tolerance: 1=Minimal risk of crop injury; 2=Crop injury can occur under certain conditions (soil applied – cold, wet: foliar applied – hot, humid); 3=severe crop injury can occur. Follow precautions under Remarks and Limitations and on the label.

[a] Triazine-resistant lambsquarters

[b] Control of yellow nutsedge will be increased if the treatment is incorporated in the top 2-3 inches of soil.

[c] The recommended use rate of *Parallel* on forage sorghum is a lower rate of the active ingredient when compared to the rate of *Dual II Magnum* and *Cinch*. Level of weed control may be affected.

TABLE 9 –Weed Control in Forage Sorghum

Forage Sorghum — Preemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	atrazine (*AAtrex*, others)	2	2 qt 4L	• DO NOT use on sands, loamy sands, sandy clay loams or any soil with less than 1% organic matter. • Heavy rains following application may cause injury. • May be applied preplant incorporated. • DO NOT apply to sudangrass. • See label for details.
Annual broadleaves **Annual grasses**	atrazine (*AAtrex*, others) + s-metolachlor *(Dual II Magnum, Cinch)*	1 + 1.27	1 qt 4L + 1.33 pt 7.6L	• CAUTION: Seed must be treated with *(Concep II* or *Screen)* herbicide antidote. • See label for additional restrictions. • Commercial prepackaged mix *(Bicep II Magnum)* is available. See Table 1C. • May be applied preplant incorporated. • DO NOT apply to sudangrass or sorghum-sudangrass hybrids.
	atrazine (*AAtrex*, others) + metolachlor *(Parallel)*	1.2 + 0.98	1.2 qt 4L + 1 pt 7.8L	• This is a low rate of the active ingredient when compared to the rate of *Dual II Magnum* and *Cinch*. Level of weed control may be affected. • CAUTION: Seed must be treated with *(Concep II* or *Screen)* herbicide antidote. • See label for additional restrictions. • May be applied pre-plant incorporated. • DO NOT apply to sudangrass or sorghum-sudangrass. • DO NOT apply on medium soils with less than 1.5% organic matter.

Forage Sorghum — Postemergence

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Annual broadleaves	atrazine (*AAtrex*, others) + crop oil concentrate	1.2	1.2 qt 4L + 1 qt	• Apply after sorghum has reached the 3-leaf stage but before it exceeds 12 inches in height. • Apply before common lambsquarters and redroot pigweed reach 6 inches and other broadleaf weeds 4 inches • Heavy rainfall following application may cause injury. • Do not apply on sands or loamy sands. • Do not graze or cut for feed for 21 days following application. • Do not apply to sudangrass.
	2,4-D amine	0.5	1 pt 4L	• Apply when sorghum is 6-8 inches tall. • If sorghum is planted in rows, drop nozzles can be used when the crop is 8-15 inches tall. • Do not graze or harvest for forage for 14 days after treatment. • See remarks and limitations for 2,4-D under “Corn – Postemergence.” • Do not apply to sudangrass or sorghum-sudangrass hybrids. • Consult the 2,4-D label for clearance on forage sorghum.

(Continued on next page)

Forage Sorghum — Postemergence *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
(continued)				
Annual broadleaves	bromoxynil (*Buctril, Moxy*, others)	0.375	1.5 pt 2L	• Apply to weeds less than 4 inches tall for effective control. • Do not mix with spray additives or liquid fertilizers. • Some leaf burn may occur, especially under cool and cloudy or hot and humid conditions. • Do not cut for feed or graze for 45 days after application. • Do not apply to sudangrass or sorghum-sudangrass hybrids.
	bentazon *(Basagran/Broadloom)* + atrazine (commercial product) + crop oil concentrate	0.75 + 0.75	0.75 qt 4L + 0.75 qt 4L + 1 qt	• Do not apply to sorghum that is headed out. • Do not graze treated area or feed treated forage to livestock for 21 days following application. • Do not make more than one application per season. • Urea ammonium nitrate (28% liquid nitrogen) may be used at 1 gal/A instead of crop oil concentrate. Do not use urea ammonium nitrate if common lambsquarters is present. • Do not apply to sudangrass or sorghum-sudangrass hybrids.
	pyrasulfotole + bromoxynil *(Huskie)*	0.21	13 oz 2.06L	• Refer to Table 8 for weed control and crop tolerance ratings. • Apply to weeds less than 4 inches tall. • *Huskie* can be applied at rates ranging from 12.8-16 oz/A; with a maximum of 32 oz/A per year. A minimum interval of 11 days is needed between applications. • Under challenging conditions, the addition of 1 lb/A of ammonium sulfate is recommended. • Good spray coverage is essential; a minimum of 10 gallons or more of water per acre is needed. • Expect some transitory leaf burn from *Huskie* applications. • DO NOT tank-mix *Huskie* with *Lorsban*. • DO NOT graze or cut for forage 7 days following application. • DO NOT harvest for grain or stover within 60 days of application. • DO NOT apply to sudangrass or sorghum-sudangrass hybrids.

TABLE 10 – Glyphosate Products Registered for Postemergence Applications in Glyphosate-Resistant Crops

			Product Rate Equivalent to:				
Trade name	**Manufacturer**	**Glyphosate formulation (lb/gal)[a]**	**0.75 lb a.e.**	**1.13 lb a.e.**	**1.5 lb a.e.**	**Surfactant is needed?[b]**	**Registered crops[c]**
Abundit Edge	DuPont	4.5 a.e.	22 fl oz	32 fl oz	44 fl oz	N	A, C, S, SB
Alecto 41UL 4L	Ritter Chemical, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	A, C, S, SB
Alecto 41S 4L	Ritter Chemical, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	A, C, S, SB
Buccaneer 4L	Tenkoz, Inc.	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	A, C, S, SB
Buccaneer Plus 4L	Tenkoz, Inc.	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	A, C, S, SB
Buccaneer 5 5L	Tenkoz, Inc.	3.75 a.e.	26 fl oz	39 fl oz	52 fl oz	Y	A, C, S, SB
Cinco 5.4L	Loveland	4 a.e.	24 fl oz	30 fl oz	48 fl oz	Y	C, S
Clearout 41 Plus 4L	Chemical Product Technologies, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S, SB
Cornerstone 4L	Winfield Solutions, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	A, C, S, SB
Cornerstone Plus 4L	Winfield Solutions, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	A, C, S, SB
Cornerstone 5 Plus 5.4SC	Winfield Solutions, LLC	4 a.e.	24 fl oz	30 fl oz	48 fl oz	N	A, C, S, SB
Credit 3.4L	Nufarm	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S, SB
Credit Extra 3.4L	Nufarm	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S, SB
Credit 41 4L	Nufarm	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S, SB
Credit 41 Extra 4L	Nufarm	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S, SB
Credit Xtreme 5.5L	NuFarm	4.5 a.e.	22 fl oz	32 fl oz	44 fl oz	N	A, C, S, SB
Duramax 5.4L	Dow Agro	4 a.e.	24 fl oz	30 fl oz	48 fl oz	N	A, C, S, SB
Durango DMA 5.4L	Dow Agro	4 a.e.	24 fl oz	30 fl oz	48 fl oz	N	A, C, S, SB
Extra Credit 5	Nufarm	3.7 a.e.	26 fl oz	39 fl oz	52 fl oz	Y	C, S, SB
Four Power Plus 4L	Loveland	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	A, C, S, SB
Gly-4 4L	Universal Crop Protection	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S
Gly-4 Plus 4L	Universal Crop Protection	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S
Gly Star Gold 4L	Albaugh	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	A, C, S, SB
Gly Star Original 4L	Albaugh	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S, SB
Gly Star Plus 4L	Albaugh	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	A, C, S, SB
Glyfine Plus	Aceto	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S
Glyfine 5 Plus	Aceto	4 a.e.	24 fl oz	30 fl oz	48 fl oz	N	A, C, S, SB
Glyfos X-tra 4L	Cheminova	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
Glyphogan 4L	Makhteshim-Agan	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S, SB
Glyphogan Plus 4L	Makhteshim-Agan	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
Glyphosate 4 4L	Alligare, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S
Glyphosate 4 Plus 4L	Alligare, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S
Glyphosate 41 Plus 4L	Cropsmart	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S
Glyphosate 41% Plus 4L	Consus Chemicals	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
Glyphosate Plus 4L	Quali-Pro	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
GlySupreme Plus 4L	MEY Corporation	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
Helosate Plus Advanced	Helm Agro	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	A, C, S, SB
Honcho 4L	Monsanto	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	A, C, S, SB
Honcho Plus 4L	Monsanto	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	A, C, S, SB

(Continued on next page)

[a] a.e. = acid equivalent, lb of glyphosate acid per gallon.

[b] Y = Yes, surfactant is needed; S = Sometimes under certain conditions additional surfactant may improve control; N = No surfactant is needed. For products that may need a surfactant, a non-ionic surfactant at 0.25 to 1% v/v is the typical recommendation. Consult the herbicide label to verify the type and rate of surfactant to include. AMS should be included at 17 lb/100 gal to improve glyphosate activity.

[c] Labeled for over-the-top applications in glyphosate-resistant *(Roundup Ready)* A = Alfalfa, C = corn, S = soybean and SB = sugar beets.

TABLE 10 – Glyphosate Products Registered for Postemergence Applications in Glyphosate-Resistant Crops *(continued)*

			Product Rate Equivalent to:				
Trade name	**Manufacturer**	**Glyphosate formulation (lb/gal)[a]**	**0.75 lb a.e.**	**1.13 lb a.e.**	**1.5 lb a.e.**	**Surfactant is needed?[b]**	**Registered crops[c]**
Hoss Ultra 4L	Helena	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S
Mad Dog 4L	Loveland	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	A, C, S, SB
Mad Dog Plus	Loveland	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	A, C, S, SB
Makaze 4L	Loveland	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	A, C, S, SB
Makaze Yield Pro	Loveland	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	A, C, S, SB
MEYCHEM 41% Glyphosate 4L	MEY Corporation	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S, SB
Mirage 4L	UAP/Platte	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S
Mirage Plus 4L	UAP/Platte	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S
Rascal 4L	Winfield Solutions, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S
Rascal Plus 4L	Winfield Solutions, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
Rascal Plus Herbicide EX 3.4L	Winfield Solutions, LLC	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
Rattler 4L	Helena	3 a.e.	32 fl oz	48 fl oz	64 fl oz	Y	C, S
Rattler Plus 4L	Helena	3 a.e.	32 fl oz	48 fl oz	64 fl oz	S	C, S
Roundup OriginalMax 5.5L	Monsanto	4.5 a.e.	22 fl oz	32 fl oz	44 fl oz	S	A, C, S, SB
Roundup PowerMAX 5.5L	Monsanto	4.5 a.e.	22 fl oz	32 fl oz	44 fl oz	S	A, C, S, SB
Roundup WeatherMax 5.5L	Monsanto	4.5 a.e.	22 fl oz	32 fl oz	44 fl oz	N	A, C, S, SB
Showdown 3.97L	Helena	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB
Touchdown HiTech	Syngenta	5 a.e.	20 fl oz	30 fl oz	40 fl oz	Y	A, C, S, SB
Touchdown Total	Syngenta	4.17 a.e.	24 fl oz	35 fl oz	48 fl oz	N	A, C, S, SB
Traxion	Syngenta	4.17 a.e.	24 fl oz	35 fl oz	48 fl oz	N	A, C, S, SB
Wise Up Plus 4L	MEY Corporation	3 a.e.	32 fl oz	48 fl oz	64 fl oz	N	C, S, SB

[a] a.e. = acid equivalent, lb of glyphosate acid per gallon.

[b] Y = Yes, surfactant is needed; S = Sometimes under certain conditions additional surfactant may improve control; N = No surfactant is needed. For products that may need a surfactant, a non-ionic surfactant at 0.25 to 1% v/v is the typical recommendation. Consult the herbicide label to verify the type and rate of surfactant to include. AMS should be included at 17 lb/100 gal to improve glyphosate activity.

[c] Labeled for over-the-top applications in glyphosate-resistant *(Roundup Ready)* A = Alfalfa, C = corn, S = soybean and SB = sugar beets.

TABLE 11 –Rain-free Period for Postemergence Herbicide Applications

HERBICIDE	RAIN-FREE PERIOD (in hours)	HERBICIDE	RAIN-FREE PERIOD (in hours)
2,4-D Amine	6–8	Fierce XLT	1
2,4-D Ester	1	FirstRate	2
Accent Q	4	Flexstar	1
Affinity BroadSpec	several	Flexstar GT	1
Afforia	1	Fusilade DX	1
Aim	1	Fusion	1
Anthem MAXX	4	glyphosate (many)	1-6**
Anthem ATZ	4	Gramoxone SL 2.0	0.5
Armezon/Impact	4	GrazonNext HL	2
Armezon PRO	1	Halex GT	NL
Assure II/Targa	1	Harmony Extra	Several
Atrazine	1–2*	Harmony	1
Autumn Super	2	Hornet WDG/Stanza	2
Axial XL	0.5	Huskie	1
Banvel	NL	Impact	1
Basagran/Broadloom	4	Instigate	1
Basis Blend	4	Laudis	1
Beacon	4	Liberty	4
Betamix	6	Marvel	1
Betanex	6	Matrix	4
Buctril/Moxy	1	MCPA	4
Butyrac (2,4-DB)	NL	Milestone	NL
Cadet	4	Nimble	Several
Callisto	1	OpTill	1
Callisto GT	NL	OpTill PRO	1
Callisto Xtra	1	Osprey	4
Canopy/Canopy Blend	1	Permit	4
Canopy EX	2	Phoenix	2
Capreno	1	Poast/Poast Plus	1
Celebrity Plus	4	PowerFlex HL	4
Cheetah	4	Progress	6
Cheetah Max	4	Puma	NL
Cimarron Plus	4	Pursuit	1
Clarity	4	Quelex	4
Classic	1	Raptor	1
Cobra	0.5	Realm Q	4
Curtail	6	Reflex	1
DiFlexx	4	Reglone	NL
DiFlexx Duo	4	Resolve	4
Elevore	4	Resolve Q	4
Engenia	4	Resource	1
Enlist Duo	NL	Revulin Q	4
Enlist One	NL	Select/Arrow/Select Max	1
Express	Several	Sharpen	1
Extreme	NL	Solstice	1
FeXapan	4	Spartan Charge	1
Fierce	1	Status	4

(Continued on next page)

NL – not listed on label.

*Rainfall will improve control from root uptake.

**Rainfall within 6 hours after application may reduce effectiveness. Heavy rainfall within 2 hours after application may wash the chemical off foliage and a repeat treatment may be required.

TABLE 11 –Rain-free Period for Postemergence Herbicide Applications *(continued)*

HERBICIDE	RAIN-FREE PERIOD (in hours)	HERBICIDE	RAIN-FREE PERIOD (in hours)
Steadfast Q	4	Valor/Valor EZ/Rowel	1
Stinger	6	Varisto	4
Surveil	2	Verdict	1
Synchrony XP	1	Vida	1
Talinor	1	Warrant Ultra	1
Trivence	1	WideMatch	6
Ultra Blazer	4	XtendiMax	4
UpBeet	4	Yukon	4

NL – not listed on label.

*Rainfall will improve control from root uptake.

**Rainfall within 6 hours after application may reduce effectiveness. Heavy rainfall within 2 hours after application may wash the chemical off foliage and a repeat treatment may be required.

TABLE 12 – Herbicide Crop Rotation Restrictions

	(in months)													
	SOIL pH RESTRICTIONS	SOYBEANS	FIELD CORN	SEED CORN	WHEAT	OATS	BARLEY	RYE	ALFALFA	DRY BEANS	SUGAR BEETS	POTATOES	CUCUMBERS	TOMATOES
2,4-D amine, 2,4-D ester	None	*	0*	0*	–	FS	FS	–	FS	FS	FS	FS	FS	FS
Accent Q	Yes*	0.5	0	0	4	8	8	4	12	10	10/18*	10/18*	10/18*	10/18*
Acuron	None	10	0	0	4	4	4	4	18	18	18	10	18	18
Acuron Flexi	None	10	0	0	4	4	4	4	10	18	18	10	18	18
Affinity BroadSpec	None	7d	0.5	0.5	0	1.5	0	1.5	1.5	1.5	2	1.5	1.5	1.5
Afforia (2.5 oz)	>7.9	1 d*	1	1	1	4/8*	3	3	4/8*	3	4/8*	4/8*	4/8*	4/8*
Afforia (>2.5-3.75 oz)	>7.9	7 d*	1	1	2	5/10*	4	4	5/10*	4	5/10*	6/12*	6/12*	6/12*
Aim	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthem MAXX	None	0	0	0	4/6*	11/18*	11/18*	11/18*	10	11	15	4	18	18
Anthem ATZ	None	FS	0	0	18	18	18	18	18	18	18	18	18	18
Armezon/Impact	None	9	0	0	3	3	3	3	9	9/18*	18	9	18	18
Armezon PRO	None	9	0	0	4	4	4	4	9	9	18	9	18	18
Assure II/Targa	None	0	4	4	4	4	4	4	4	0	0	4	4	4
Atrazine (1 lb a.i./A)	None	10	0	0	3	21	21	3	15	21	21	10	21	21
Atrazine (2 lb a.i./A)	None	18	0	0	15	21	21	15	21	21	33	18	33	33
Authority Assist	None	0	10	10	4	18	9.5	4	12	12	40*	26	40*	40*
Authority First/Sonic	None	0	10	10	4	12	12	12	12	12	30*	18	30*	30*
Authority MAXX*	>6.8	0	10/18	10/18	4	12/18	4	4	12/18	12/18	36	36	18	15/18
Authority MTZ*	>7.0	0	10/4*	10/4*	4	18	18	18	12	12	24*	12	18	0*
Authority XL	≤6.8	0	10	10	4	12	4	4	12	12	36	36	18	12**
Authority XL*	>6.8	0	10/18*	10/18*	4	18	4	4	18	18	36	36	18	18*
Autumn Super	>7.5	2	1	9	3	18	9	18	18	18	18	18	18	18
Axial XL	None	4	4	4	0	4	0	4	4	4	1	4	4	4
Balance Flexx*	None	6	0	0	4	18	6	18	10/18*	18	10/18*	6	18	18
Basagran/Broadloom	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Basis Blend	None	10	0	10	3	9	3	3	10	10	10	1	10	1
Beacon	None	8	0.5	0.5	3	8	3	3	8	8	18	8	18	18
Betamix	None	0	4	4	4	4	4	4	0	0	0	0	0	0
Betanex	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicep II Magnum/ Cinch ATZ/Parallel Plus	> 8.0	10	0	0	15	21	21	15	21	21	21	10	21	21
Bicep Lite II Magnum/ Cinch ATZ Lite	> 8.0	10	0	0	4.5	21	21	3	15	21	21	10	21	21
Boundary	None	0	4	4	4.5	12	4.5	12	4.5	12	18	8	12	12
BroadAxe XC	>7.2	0	10	10	4.5	12	4.5	4.5	12*	12*	36	4	12*	4
Buctril/Moxy	None	1	1	1	1	1	1	1	1	1	1	1	1	1
Butyrac 200	None	–	–	–	–	–	–	–	–	–	–	–	–	–
Cadet	None	0	0	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Callisto	None	10	0	0	4	0	4	4	10	18	18	10	18	18
Callisto GT	None	10	0	0	4	4	4	4	10	18	18	10	18	18
Callisto Xtra	None	FS	0	0	FS	18	FS	18	FS	18	18	FS	18	18
Canopy*	>7	0	10	10	4	4	4	4	10	12	30	30	18	10*

See legend on page 186.

(Continued on next page)

TABLE 12 – Herbicide Crop Rotation Restrictions *(continued)*

	(in months)													
	SOIL pH RESTRICTIONS	SOYBEANS	FIELD CORN	SEED CORN	WHEAT	OATS	BARLEY	RYE	ALFALFA	DRY BEANS	SUGAR BEETS	POTATOES	CUCUMBERS	TOMATOES
Canopy Blend*	>7.0	0/4*	10	10	4	4	4	4	10	18	30	30	18	10*
Canopy EX*	>7.0	0	10	10	4	4	4	4	10	12	30	30	18	10*
Capreno*	>7.5	10	0	0	4	18	10	18	18	18	18	18	18	18
Cheetah Max	None	0	10	10	4	4	4	4	18	6	18	2.5	18	6
Clarity/Banvel[a]	None	4	0	0	1	1	1	1	4	4	4	4	4	4
Classic*	>7	0	9	9	3	3	3	3	12	9	30	30	18	9/15*
Cobra/Phoenix	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Command*	<5.9	0	9	9	12	16	16	16	16	9	9	9	9	9/12*
Corvus*	≥7.5	9	0	0	4	17*	9	17*	17*	17*	17*	17*	17*	17*
Curtail*	None	10.5/18*	1	1	1	1	1	1	10.5	10.5/18*	12	18	18	18
Degree Xtra/FulTime NXT	None	FS	0	0	15	15	15	15	15	15	15	15	21	21
DiFlexx	None	2	0	0	2	2	2	4	4	4	4	4	4	4
DiFlexx DUO	None	8	0	0	4	4	4	4	10	10/18*	10*	10	18	10
Dual Magnum/Dual II Magnum/Cinch/ EverpreX	None	0	0	0	4.5	4.5	4.5	4.5	4	0	0	0	FS	0*
Elevore	None	0.5	0.5	0.5	0.5	0.5	0.5	0.5	9	9	15	15	15	15
Engenia[a]	None	1*	0*	0*	1	1	1	1	4	4	4	4	4	4
Enlist Duo	None	*	0*	0*	-	FS	FS	-	FS	FS	FS	FS	FS	FS
Enlist One	None	*	0*	0*	-	FS	FS	-	FS	FS	FS	FS	FS	FS
Envive*	>7.0	0	10	10	4	10	4	4	10	12	30	30	18	12*
Eptam	None	10	1	10	3	10	10	3	0	0	10	10	10	10
Expert	None	10	0	0	10	18	18	10	18	18	18	18	18	18
Express	None	7d	0.5	1.5	0	1.5	0	1.5	1.5	1.5	2	1.5	1.5	1.5
Extreme	None	0	8.5	8.5	3	18	9.5	4	4	4	40*	26	40*	40*
FeXapan[a]	None	1*	0*	0*	1/2*	1/2*	1/2*	1/2*	4	4	4	4	4	4
Fierce	None	0	7/30 d*	7/30 d*	1/2	11/12	11/12	11/12	10	11	15	4	18	18
Fierce XLT	None	0	10	10	10	18	18	18	18	18	30	30	18	18*
FirstRate	None	0	9	9	4	9	12	12	9	9	30*	18	18	18
Flexstar	None	0	10	10	4	4	4	4	18	0	18	0	12	10/12*
Flexstar GT 3.5	None	0	10	10	4	4	4	4	18	0	18	0	12	10/12*
Fultime	None	FS	0	0	15	15	15	15	15	15	15	15	21	21
Fusilade DX	None	0	2	2	2	2	2	2	0	0	0	0	0	0
Fusion	None	0	2	2	2	2	2	2	0	0	0	0	0	0
Glyphosate	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Gramoxone SL 2.0/ Parazone	None	0	0	0	0	0	0	0	0	0	0	0	0	0
GrazonNext HL	None	12	12	12	12	12	12	12	24	24	24	24	24	24
Halex GT	None	10	0	0	4	4	4	4	10	18	18	10	18	18
Harmony Extra	None	0.5	0.5	0.5	0	0	0	1.5	1.5	1.5	2	1.5	1.5	1.5
Harmony	None	0	0	1.5	0	0	0	1.5	1.5	1.5	1.5	1.5	1.5	1.5

See legend on page 186.

(Continued on next page)

TABLE 12 – Herbicide Crop Rotation Restrictions *(continued)*

	(in months)													
	SOIL pH RESTRICTIONS	**SOYBEANS**	**FIELD CORN**	**SEED CORN**	**WHEAT**	**OATS**	**BARLEY**	**RYE**	**ALFALFA**	**DRY BEANS**	**SUGAR BEETS**	**POTATOES**	**CUCUMBERS**	**TOMATOES**
Harness/Surpass NXT/ Breakfree NXT	None	FS	0	0	4	FS	FS	FS	9	FS	FS	FS	18	18
Harness MAX	None	10	0	0	4	FS	FS	FS	10	18	18	18	18	18
Harness Xtra/ Keystone NXT/ Keystone LA NXT/ Breakfree NXT ATZ/ Breakfree NXT Lite	None	FS	0	0	15	15	15	15	15	15	15	15	21	21
Hornet WDG/Stanza	>7.8	10.5	0	0	4	4	4	4	10.5	10.5	26*	18	26*	26*
Huskie	None	4	9	9	1	1	1	1	4*	9	9	9	12*	12*
Instigate	None	10	0	10	4	9	9	4	10	18	18	10	18	18
Kerb	None	12	12	12	12	12	12	12	12	12	12	12	12	12
Laudis*	None	8	0	0	4	4	4	4	10	10/18*	10/18*	10	18	10
Lexar EZ	None	10	0	0	15	10	10	10	18	18	18	18	18	18
Liberty/Rely	None	0	0	0	2.5	2.5	2.5	2.5	6	6	0	2.5	6	6
Lorox/Linex	None	4	4	4	4	4	4	4	4	4	4	4	4	4
Lumax EZ	None	10	0	0	4.5	10	4.5	4.5	18	18	18	18	18	18
Marvel	None	0	10	10	4	4	4	4	18	0	18	0	18	4
Matrix	None	4	0	0	4	9	9	4	4*	10	18*	0	10	0
MCPA	None	–	–	–	–	–	–	–	–	–	–	–	–	–
Metribuzin	≥ 7.0	4	4	4	4	4	4	12	4	12	18	4	12	12
Milestone	None	12*	12*	12*	12*	12*	12*	12*	12*	12*	12*	12*	12*	12*
Nimble	>7.9	0.25*	0.5*	0.5*	0	0	0	1.5	1.5	1.5	2	1.5	1.5	1.5
Nortron*	None	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	0	6/12	6/12	6/12
OpTill	None	0/1*	8.5	8.5	4	18	9.5	4	4	4	40*	26	40*	40*
OpTill PRO	None	0/1*	8.5	8.5	4	18	9.5	4	9	4	40*	26	40*	40*
Osprey	None	1	12	12	7d	10	1	10	10	3	10	10	10	10
Outlook	None	0	0	0	4	4	4	4	10	0	10	10	10	10
Parallel/Parallel PCS	None	10	0	0	4.5	4.5	4.5	4.5	4	10	10	10	10	6
Peak	>7.8	22*	1	1	0	0	0	0	22*	22*	22*	22*	22*	22*
Permit/Sandea	None	9	1	2	2	2	2	2	9	0	21	9	9	8
Poast/Poast Plus*	None	0	1*	1*	1*	1*	1*	1*	0	0	0	0	0	0
PowerFlex HL	None	5	9	9	1	9	9	9	9	9	9	9	12	12
Prefix	None	0	10	10	4.5	4.5	4.5	4.5	18	0	18	18	12	10/12*
Prequel*	None	10	0	10	4	9	4	4	10	18*	10	6	18	18
Princep	None	FS*	0	0	15	21	21	15	21	21	21	21	21	21
Progress	None	0	4	4	4	4	4	4	0	0	0	0	0	0
Prowl, Prowl H_2O	None	0	10	10	4	10	4	10	10	0	12	10	10	10
Puma	None	0	0	0	0	0	0	0	0	0	0	0	0	0
Pursuit	None	0	8.5	8.5	4	18	9.5	4	4	4	40*	26	40*	40*
Python/Accolade	> 7.8	0	0	0	4	4	4	4	4	4	26*	12	26*	26*
Quelex	None	3	3	3	0	3	0	3	9	9	15*	15*	15*	15*

See legend on page 186.

(Continued on next page)

TABLE 12 – Herbicide Crop Rotation Restrictions *(continued)*

	(in months)													
	SOIL pH RESTRICTIONS	SOYBEANS	FIELD CORN	SEED CORN	WHEAT	OATS	BARLEY	RYE	ALFALFA	DRY BEANS	SUGAR BEETS	POTATOES	CUCUMBERS	TOMATOES
Raptor	> 6.2	0	8.5	8.5	3	9	9	4	3	0	18*	9*	9	9
Reflex	None	0	10	10	4	4	4	4	18	0	18	0	12	10/12*
Realm Q	None	10	0	0	4	9	9	4	10	18	18	10	18	18
Resicore	None	10.5	0	0	4	10.5	10.5	10.5	10.5	18	18	18	18	18
Resolve	None	10	0	0	4	9	9	4	10/18*	10	10/18*	0	10	1
Resolve Q	None	10	0	–	3	9	9	9	10/18*	10	10/18*	0	10	1
Resource	None	0	0	0	4	4	4	4	1	1	1	1	1	1
Revulin Q	None	10	0	0	4	8	4	4	10*	18	18	10*	18	18
Ro-Neet	None	–	–	–	–	–	–	–	–	–	–	–	–	–
Select/Arrow/Select Max	None	0	1	1	1	1	1	1	0	0	0	0	0	0
SelectMax (≤6 oz)	None	0	6 d	1	1	1	1	1	0	0	0	0	0	0
Sequence	None	0	0	0	4.5	4.5	4.5	4.5	4	0	FS	0	FS	6
Sharpen (1 oz)[a]	None	0/1*	0	0	0	0	0	0	4	4	4	4	4	4
Sharpen (2.5 oz)[a]	None	2/3*	0	0	0	0	0	0	6	6	6	6	6	6
Sinbar	None	24	24	24	24	24	24	24	24	24	24	24	24	24
Solstice	None	10	0	0	18	18	18	18	18	18	18	18	18	18
Sonalan	None	0	FS	FS	10	10	10	10	10	0	8/13*	FS	FS	FS
Spartan	None	0	10	10	4	4	4	4	12	12	30	30	18	30
Spartan Charge	None	0	4	12	4	12	4	4	12	4	24*	4	12*	12*
Starane Ultra	None	10	4	4	4	4	4	4	4	10	4	10	10	10
Status*	None	1/4	0.25	0.25	1/4	1/4	1/4	1/4	1/4	4	4	4	4	4
Steadfast Q	Yes*	0.5	0	10	4	8	8	4	10	10	10/18*	10/18*	10/18*	10/18*
Stinger*	None	10.5	0	0	0	0	0	0	10.5	10.5	0	18	18	18
SureStart II/TripleFlex II	>7.8	FS	0	0	4	FS	FS	FS	FS	FS	26*	18	26*	26*
Surveil	None	0	9	9	3	9	30*	30*	10	9	30*	18	30*	30*
Synchrony XP*	>7	0	9	9	3/4	3/4	3/4	3/4	12	9/12	30	30	18	9/15
Talinor	None	10	0	0	1	3	1	9	9	12	15	9	18	18
Trifluralin	None	0	5	5	5	5	5	5	5	0	12*	5	5	5
Trivence	>7	0/4*	10	10*	4	18	4	12	10	18	30	30	18	12*
Ultra Blazer	None	0	0	0	0	0	0	0	0	0	4	4	0	0
Upbeet	None	0.5	0.75	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5
Valor/Valor EZ/Rowel (2 oz)	None	0	1*	1*	1*	4/8*	3	3	4/8*	3	4/8*	4/8*	4/8*	4/8*
Valor/Valor EZ/Rowel (>2-3 oz)	None	0	1*	1*	2*	5/10*	4	4	5/10*	4	5/10*	12	12	12
Valor XLT/Rowel FX*	>6.8	0	10	10	4	12	4	4	12	12	30	30	18	12*
Varisto	≥6.2	0	8.5	8.5	3	9	9	4	3	0	18*	9	9	9
Velpar	None	24	12	12	24	24	24	24	24	24	12	12	24	24
Verdict (5 oz)	None	0/1*	0	0	4	FS	4	4	FS	FS	9	FS	FS	FS
Verdict (>10 oz)	None	1-4*	0	0	4	FS	4	4	FS	FS	9	FS	FS	FS

See legend on page 186.

(Continued on next page)

TABLE 12 – Herbicide Crop Rotation Restrictions *(continued)*

		(in months)												
	SOIL pH RESTRICTIONS	SOYBEANS	FIELD CORN	SEED CORN	WHEAT	OATS	BARLEY	RYE	ALFALFA	DRY BEANS	SUGAR BEETS	POTATOES	CUCUMBERS	TOMATOES
Vida	None	0	0	0	0	1d	1d	1d	1d	1d	1d	0	1d	1d
Warrant	None	0*	FS	FS	4	FS	FS	FS	9	FS	FS	FS	–	–
Warrant Ultra	None	0	10	10	4	4	4	4	18	FS	18	FS	18	18
WideMatch	None	10.5	0	0	0	0	0	0	10.5	10.5	4	18	18	18
XtendiMax[a]	None	1*	0*	0*	1/2*	1/2*	1/2*	1/2*	4	4	4	4	4	4
Yukon	None	9	1	2	2	2	2	2	9	9	21	9	9	8
Zemax	None	10	0	0	4.5	10	4.5	4.5	18	18	18	10	18	18
Zidua/Zidua SC	None	0/4*	0	0	4/6*	11/18*	11/18*	11/18*	10	11	15	4	18	18
Zidua PRO	None	0/1*	8.5	8.5	4	18	11	11	10	11	40*	26	40*	40*

This table contains general guidelines for crop rotation restrictions following herbicide application. Herbicide persistence and carryover potential are variable and dependent upon soil and environmental characteristics.

[a] DO NOT include time in the rotation interval when the soil is frozen.

– No information was given on the label.

* Consult the Remarks and Limitations sections in this guide and the herbicide label for further information.

FS = rotational crops may be planted the following spring (FS).

TABLE 13 – Toxicity, Solubility, Adsorptivity and Persistence of Herbicides

Herbicide	Toxicity[1] LD_{50} mg/kg Oral	Dermal	Water Solubility (ppm at 25°C)	Adsorptivity to Soil	Soil Persistence at Standard Rate (months)	Runoff/[2] Leaching Potential	Restricted[3] Entry Interval
Accent Q	>5000	>2000	70 (pH 7.0)	weak–moderate	1–10	3/1	4 hrs
Affinity BroadSpec	>5000	>2000	*	*	0.5	2/2	12 hrs
Aim	>5000	>5000	22	strong	–	–/–	12 hrs
Armezon/Impact	>2000	>4000	15,000 ppm@20° C	moderate	1–8	–/–	12 hrs
Assure II/Targa	4100–5900	>2000	<1	moderate	0.5	1/2	12 hrs
Atrazine	1075–4346	>3100	33	strong	2–8	2/1	12 hrs
Authority XL	1750	>5000	–	strong	2–10	2/1	12 hrs
Balance Flexx	>2000	>2000	6.8	strong	–	-/-	12 hrs
Banvel/Clarity	2629–3512	>2000	4500	weak	1–6	3/1	24 hrs
Basagran	2063	>10,000	500	weak	0.5	3/1	4–8 hrs
Basis Blend	>5000	>2000	–	–	–	–/–	4 hrs
Beacon	>5050	>2010	18,000 (pH 7.2)	weak	1–5	2/1	12 hrs
Betamix	4059	>1980	1	moderate	1	1/3	24 hrs
Betanex	3960	>9900	7	moderate	1	1/3	24 hrs
Buctril/Moxy	780	2000	50	moderate	0.5	2/3	12 hrs
Cadet	>5050	>2000	850	strong	–	–	12 hrs
Callisto	>5000	>5000	–	–	–	–	12 hrs
Canopy/Canopy Blend	>5000	>5000	300	strong	1–10	2/1	12 hrs
Canopy EX	>5000	>2000	286	strong	1–10	2/1	12 hrs
Capreno	>2000	>2000	–	–	–	–	12 hrs
Classic	>5000	>2000	300	strong	1–10	2/1	12 hrs
Cobra	2400–2600	>2000	0.1	strong	0.5	2/3	12 hrs
Command	2084–5000	2000–5000	1100	v. strong	3–6	2/2	12 hrs
2,4-D	375–1492	>2000	900	weak	1	2/2	12–48 hrs
2,4-DB	>1706	2000	insoluble	weak	1	2/3	48 hrs
Define	1365	5000	56	moderate	–	–	12 hrs
Reglone	600–810	260–315	infinite	v. strong	–	1/3	24 hrs
Dual II Magnum/ Cinch/Parallel	2672–2952	>2020	530	strong	1–3	2/1	24 hrs
Eptam	1325–5000	1500–5000	370	strong	1.5–2	2/3	12 hrs
Express	>5000	>2000	286	–	0.5	2/2	12 hrs
FirstRate	>5000	>2000	184	moderate	1–4	–/–	12 hrs
Fusion	3154	>2000	2 to 0.9	moderate	0.5	1/3	24 hrs
glyphosate**	>5000	>5000	900,000 (pH 7.0)	v. strong	1	1/3	SL
Gramoxone SL 2.0	310	>2000	infinite	v. strong	1	1/3	24 hrs
Harmony Extra	>5000	>2000	*	*	0.5	2/2	12 hrs
Harmony	>5000	>2000	2400	–	0.25	2/2	4 hrs
Harness	1249–2948	4166–5000	223	moderate	1–2	2/2	12 hrs
Hornet WDG	>5000	>5000	–	–	–	3/1	48 hrs
Kerb	>5000	>2000	15	strong	2–9	2/1	24 hrs
Laudis	1750	5000	–	–	–	1/1	12 hrs
Liberty	2119-2030	1390-5319	–	–	–	-/-	12 hrs
Lorox	3600–4833	>2000	75	v. strong	2–4	1/2	24 hrs
Matrix	>5000	>2000	–	–		–/–	4 hrs
MCPA	800	1500	insoluble	v. weak	1–4	1/3	48 hrs
Metribuzin	1500–2794	>5000	1200	moderate	2–4	2/1	12 hrs
Nortron SC	>2100	>4100	110	strong	1–4	2/2	12 hrs
Optill	>2000	>2000	–	weak	2-8	–	12 hrs
Osprey	>2000	>2000	–	–	–	–/–	4 hrs

See legend on next page.

(Continued on next page)

TABLE 13 – Toxicity, Solubility, Adsorptivity and Persistence of Herbicides *(continued)*

Herbicide	Toxicity[1] LD_{50} mg/kg Oral	Dermal	Water Solubility (ppm at 25°C)	Adsorptivity to Soil	Soil Persistence at Standard Rate (months)	Runoff/[2] Leaching Potential	Restricted[3] Entry Interval
Outlook	695	>2000	1174	moderate	1–2	2/2	12 hrs
Permit	1287	>5000	15	–	–	2/2	12 hrs
Poast	2200–4100	2000–5000	48	moderate	0.25	2/3	12 hrs
Princep/Prowl/	>5000	2000–2500	5	strong	2–8	2/1	12 hrs
Prowl H_20	3956	>2200	<1	v. strong	3–6	1/3	24 hrs
Pursuit	3506–5000	>2000	1,400	weak	2–8	1/1	12–24 hrs
Python	>5000	>2000	49	moderate	2–8	3/1	12 hrs
Raptor	>5000	>4000	–	weak	1–2	–/–	4 hrs
Require Q	1611	>2000	–	–	–	–	4 hrs
Reflex/Flexstar	3683–8160	>1000	600,000	weak	6	2/1	24 hrs
Resolve	>5000	>2000	–	–	–	–/–	4 hrs
Resolve Q	1611	>2000	–	–	–	1/1	24 hrs
Resource	3200–4100	>2000	.189	strong	–	3/2	12 hrs
Ro-Neet	3160–3690	>4640	85	strong	1–3	2/2	12 hrs
Select/Arrow	2920–3610	>5000	infinite	moderate	0.25	3/3	24 hrs
Sharpen	>2000	>5000	2100	weak	0.5	–	12 hrs
Sinbar	5000–7500	>5000	710	moderate	5–6	2/1	12 hrs
Sonalan	3300–5000	>5000	1	v. strong	3–5	1/3	24 hrs
Spartan	2416	>5000	110	moderate	2–8	–/–	12 hrs
Steadfast Q	>5000	>2000	–	–	–	–	4 hrs
Stinger	>5000	>5000	1000	moderate	1–10	3/1	12 hrs
Surpass NXT	1249–2948	4165–5000	223	moderate	1–2	2/2	12 hrs
Synchrony XP	>5000	>2000	300	strong	1–10	2/1	12 hrs
Trifluralin	3738	>2000	<1	v. strong	3–6	1/3	12 hrs
Ultra Blazer	4790	3250	infinite	strong	1	2/2	48 hrs
Upbeet	>5000	>2000	110 (pH 7.0)	weak	–	–/–	4 hrs
Valor/Rowel	>5000	>2000	1.78	–	–	–	12 hrs
Velpar	1100–4120	>5000	33,000	strong	4–6	2/1	24 hrs
Verdict	>2000	>5000	–	moderate	1-2	2/2	12 hrs
Vida	>5000	>2000	–	–	–	–	12 hrs
Warrant	>5000	>5000	223	moderate	1-2	2/2	12 hrs
WideMatch	>5000	>5000	1000	moderate	1-10	3/1	12 hrs
Zidua	>2000	>2000	3.49 @ 20° C	weak	1-2	–/–	12 hrs
(Table Salt)	3320	–	360,000	–	–	–	–
(Aspirin)	1200	–	2,500	–	–	–	–

– No information available.

Sources: *Herbicide Handbook*.

[1] The LD_{50} is a standard toxicological term which indicates the number of milligrams (mg) of pesticide per kilogram (kg) of test animal body weight required to kill 50% of a test animal population. Values less than 10 indicate extremely high toxicity to mammals. The LD_{50} data have been obtained from the Material Data Safety Sheets.

[2] The runoff/leaching potential ratings are from the ARS/NRCS pesticide properties database and were developed for use with the NRCS soils ratings for water quality in the NRCS "Soil-Pesticide Interaction Ratings." 1=high, 2=medium, 3=low.

[3] Read and follow label directions. Post areas or give oral warnings that areas have been treated to warn workers not to enter until the REI has elapsed as required by the label. SL=See Label.

* Combination of *Express* and the active ingredient in *Harmony*.

** Glyphosate IPA salt; active ingredient in products in Table 10.

TABLE 14 – Glossary of Chemical Names

TRADE NAME** AND (MANUFACTURER)	COMMON NAME	CONCENTRATION COMMERCIAL FORMULATION†
ACCENT Q (DuPont)	NICOSULFURON (+ SAFENER)	54.5% WG
ACCOLADE (FMC)	FLUMETSULAM	80% WG
ACURON (Syngenta)	S-METOLACHLOR (+ SAFENER) + ATRAZINE + MESOTRIONE + BICYCLOPYRONE	3.44 lb/gal ZC (2.14 + 1 + 0.24 + 0.06)
ACURON FLEXI (Syngenta)	S-METOLACHLOR (+ SAFENER) + MESOTRIONE + BICYCLOPYRONE	3.26 lb/gal ZC (2.86 + 1 + 0.32 + 0.08)
AFFINITY BROADSPEC (DuPont)	THIFENSULFURON + TRIBENURON	50% WG (25 + 25)
AFFORIA (DuPont)	THIFENSULFURON + TRIBENURON + FLUMIOXAZIN	50.8% WG (5 + 5 + 40.8)
ANTHEM MAXX (FMC)	PYROXASULFONE + FLUTHIACET-METHYL	4.3 lb/gal SE (4.174 + 0.126)
ANTHEM ATZ (FMC)	PYROXASULFONE + FLUTHIACET-METHYL + ATRAZINE	4.5 lb/gal L (0.485 + 0.014 + 4.006)
AIM (FMC)	CARFENTRAZONE	2.0 lb/gal L
ARMEZON (BASF)	TOPRAMEZONE	4 lb/gal L
ARMEZON PRO (BASF)	TOPRAMEZONE + DIMETHENAMID-P	5.35 lb/gal L (0.1 + 5.25)
ARROW 2EC (Makhteshim-Agan)	CLETHODIM	2.0 lb/gal L
ASSURE II (DuPont)	QUIZALOFOP-P-ETHYL	0.88 lb/gal L
ATRAZINE (several)	ATRAZINE	4 lb/gal L; 90% DF
AUTHORITY ASSIST (FMC)	SULFENTRAZONE + IMAZETHAPYR	4 lb/gal L (3.33 + 0.67)
AUTHORITY FIRST (FMC)	SULFENTRAZONE + CLORANUSULAM	70% DF (62.1 + 7.9)
AUTHORITY MAXX (FMC)	SULFENTRAZONE + CLHORIMURON-ETHYL	66% WG (0.62 + 0.04)
AUTHORITY MTZ (FMC)	SULFENTRAZONE + METRIBUZIN	45% DF (18.0 + 27.0)
AUTHORITY XL (FMC)	SULFENTRAZONE + CHLORIMURON-ETHYL	70% DG (62.22 + 7.78)
AUTUMN SUPER (Bayer CropScience)	IODOSULFURON + THIENCARBAZONE	51% WG (6 + 45)
AXIAL XL (Syngenta)	PINOXADEN	0.42 lb/gal L
BALANCE FLEXX (Bayer CropSciences)	ISOXAFLUTOLE (+ SAFENER)	2 lb/gal L
BANVEL (Arysta)	DICAMBA	4 lb/gal L
BASAGRAN (Winfield Solutions, LLC)	BENTAZON	4 lb/gal L
BASIS BLEND (DuPont)	RIMSULFURON + THIFENSULFURON	30% WG (20 + 10)
BEACON (Syngenta)	PRIMISULFURON	75% WG
BETAMIX (Bayer CropSciences)	DESMEDIPHAM+PHENMEDIPHAM	1.3 lb/gal L (0.65 + 0.65)
BETANEX (Bayer CropSciences)	DESMEDIPHAM	1.3 lb/gal L
BICEP II MAGNUM (Syngenta)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	5.5 lb/gal L (3.1 + 2.4)
BICEP LITE II MAGNUM (Syngenta)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	6 lb/gal L (2.67 + 3.33)
BOUNDARY 6.5EC (Syngenta)	S-METOLACHLOR + METRIBUZIN	6.5 lb/gal (5.25 + 1.25)
BREAKFREE NXT (DuPont)	ACETOCHLOR (+ SAFENER)	7 lb/gal L
BREAKFREE NXT ATZ (DuPont)	ACETOCHLOR (+ SAFENER) + ATRAZINE	5.6 lb/gal L
BREAKFREE NXT LITE (DuPont)	ACETOCHLOR (+ SAFENER) + ATRAZINE	6 lb/gal L
BROADAXE XC	SULFENTRAZONE + S-METOLACHLOR	7 lb/gal L (0.7 + 6.3)
BROADLOOM (United Phosphorus, Inc.)	BENTAZON	4 lb/gal L
BUCTRIL (Bayer CropSciences)	BROMOXYNIL	2 lb/gal L
BUTYRAC (Albaugh)	2,4-DB	2 lb/gal L
CADET (FMC)	FLUTHIACET-METHYL	0.91 lb/gal L
CALLISTO (Syngenta)	MESOTRIONE	4 lb/gal SC
CALLSITO GT (Syngenta)	MESOTRIONE + GLYPHOSATE	4.18 lb/gal L (0.38 + 3.8 ae)
CALLISTO XTRA (Syngenta)	MESOTRIONE + ATRAZINE	3.7 lb/gal SC (0.5 + 3.2)
CANOPY (DuPont)	CHLORIMURON + METRIBUZIN	75% WG (10.7 + 64.3)
CANOPY BLEND (DuPont)	CHLORIMURON + METRIBUZIN	58.3% WG (8.3 + 50)
CANOPY EX (DuPont)	CHLORIMURON + TRIBENURON	29.5%DG (22.7 + 6.8)
CAPRENO (Bayer CropSciences)	TEMBOTRIONE + THIENCARBAZONE (+ SAFENER)	3.45 lb/gal SC (2.88 + 0.57)
CHEETAH (NuFarm Inc.)	GLUFOSINATE	2.34 lb/gal L
CHEETAH MAX (NuFarm Inc.)	GLUFOSINATE + FOMESAFEN	3 lb/gal L (2 + 1)
CIMARRON PLUS (DuPont)	METSULFURON + CHLORSULFURON	63% WG (48 + 15)
CINCH (DuPont)	S-METHOLACHLOR (+ SAFENER)	7.64 lb/gal L

See legend on page 192.

(Continued on next page)

TABLE 14 – Glossary of Chemical Names *(continued)*

TRADE NAME** AND (MANUFACTURER)	COMMON NAME	CONCENTRATION COMMERCIAL FORMULATION†
CINCH ATZ (DuPont)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	5.5 lb/gal L (3.1 + 2.4)
CINCH ATZ LITE (DuPont)	ATRAZINE + S-METOLACHLOR (+ SAFENER)	6.0 lb/gal L (2.67 + 3.33)
CLARITY (BASF)	DICAMBA	4 lb/gal L
CLASSIC (DuPont)	CHLORIMURON ETHYL	25% DF
COBRA (Valent)	LACTOFEN	2 lb/gal L
COMMAND (FMC)	CLOMAZONE	3 lb/gal ME
CORVUS (Bayer CropSciences)	ISOXAFLUTOLE + THIENCARBAZONE-METHYL (+ SAFENER)	2.63 lb/gal L (1.88 + 0.75)
CROSSBOW (Dow AgroScienes)	2,4-D ESTER + TRICLOPYR	3 lb/gal L (2 + 1)
CURTAIL (Dow AgroSciences)	CLOPYRALID + 2,4-D	2.38 lb/gal L (0.38 + 2.0)
2,4-D (Several)	2,4-D	various
DEGREE XTRA (Monsanto)	ACETOCHLOR (+ SAFENER) + ATRAZINE	4.0 lb/gal L (2.7 + 1.3)
DIFLEXX (Bayer CropSciences)	DICAMBA (+ SAFENER)	4 lb/gal SC
DIFLEXX DUO (Bayer CropSciences)	TEMBOTRIONE + DICAMBA (+ SAFENER)	2.13 lb/gal SC (0.27 + 1.86)
DUAL MAGNUM (Syngenta)	S-METOLACHLOR	7.62 lb/gal L
DUAL II MAGNUM (Syngenta)	S-METOLACHLOR (+ SAFENER)	7.64 lb/gal L
ELEVORE (Dow AgroSciences)	HALAUXIFEN	0.572 lb/gal L
ENGENIA (BASF)	DICAMBA	5 lb/gal L
ENLIST DUO (Dow AgroSciences)	2,4-D CHOLINE + GLYPHOSATE	3.13 lb/gal L (1.6 + 1.7)
ENLIST ONE (Dow AgroSciences)	2,4-D CHOLINE	3.8 lb/gal L
EVERPREX (DuPont)	S-METOLACHLOR	7.62 lb/gal EC
ENVIVE (DuPont)	CHLORIMURON + FLUMIOXAZIN + THIFENSULFURON	41.3% WG (9.2 + 29.2 + 2.9)
EPTAM (Syngenta)	EPTC	7 lb/gal L; 10% G
EXPERT (Syngenta)	ATRAZINE + S-METOLACHLOR + GLYPHOSATE	4.88 lb/gal L (2.14 + 1.74 + 0.75ae)
EXPRESS SG (DuPont)	TRIBENURON-METHYL	50% WG
EXTREME (BASF)	IMAZETHAPYR + GLYPHOSATE	2.17 lb/gal (ae)
FIELDMASTER (Monsanto)	ACETOCHLOR (+ SAFENER) + ATRAZINE + GLYPHOSATE	4.06 lb/gal L (2 + 1.5 + 0.56 (ae))
FIERCE (Valent)	FLUMIOXAZIN + PYROXASULFONE	76% WG (33.5 + 42.5)
FIERCE XLT (Valent)	CHLORIMURON + FLUMIOXZIN + PYROXASULFONE	62.41% WG (6.67 + 24.57 + 31.17)
FIRSTRATE (Dow AgroSciences)	CLORANSULAM METHYL	84% WG
FLEXSTAR (Syngenta)	FOMESAFEN	1.88 lb/gal L
FLEXSTAR GT (Syngenta)	FOMESAFEN + GLYPHOSATE	3.29 lb/gal L (0.66 + 2.63)
FULTIME NXT (Dow AgroSciences)	ACETOCHLOR (+ SAFENER) + ATRAZINE	4 lb/gal L (2.7 + 1.34)
FUSILADE DX (Syngenta)	FLUAZIFOP-P-BUTYL	2.0 lb/gal L
FUSION (Syngenta)	FLUAZIFOP-P-BUTYL + FENOXAPROP	2.66 lb/gal L (2.0 + 0.66)
GLYPHOSATE (Several)	GLYPHOSATE	3, 4, 4.17, 4.5 lb/gal L (ae), 65% (ae)
GRAMOXONE SL 2.0 (Syngenta)	PARAQUAT	2 lb/gal L (ae)
GRAZONNEXT HL (Dow AgroSciences)	AMINOPYRALID + 2,4-D AMINE	3.74 lb/gal L (0.41 + 3.33)
HALEX GT (Syngenta)	S-METOLACHLOR + GLYPHOSATE + MESOTRIONE	4.38 lb/gal (2.09 + 2.09 ae + 0.209)
HARMONY EXTRA SG (DuPont)	THIFENSULFURON + TRIBENURON	50% WG (33.33 + 16.67)
HARMONY SG (DuPont)	THIFENSULFURON	50% WG
HARNESS (Monsanto)	ACETOCHLOR (+ SAFENER)	7 lb/gal L
HARNESS MAX (Monsanto)	ACETOCHLOR + MESOTRIONE	3.85 lb/gal L (3.52 + 0.33)
HARNESS XTRA 5.6L (Monsanto)	ACETOCHLOR (+ SAFENER) + ATRAZINE	5.6 lb/gal L (3.1 + 2.5)
HORNET WDG (Dow AgroSciences)	FLUMETSULAM + CLOPYRALID	68.5% WG (18.5 + 50)
HUSKIE (Bayer CropSciences)	PYRASULFOTOLE + BROMOXYNIL	2.14 lb/gal EC
IMPACT (AMVAC)	TOPRAMEZONE	2.8 lb/gal SC
INSTIGATE (DuPont)	MESOTRIONE + RIMSULFURON	45.8% WG (41.6 + 4.2)
KERB (Dow AgroSciences)	PRONAMIDE	50% WP (in soluble pouches)
KEYSTONE NXT (Dow AgroSciences)	ACETOCHLOR (+ SAFENER) + ATRAZINE	5.6 lb/gal L (3.1 + 2.5)
KEYSTONE LA NXT (Dow AgroSciences)	ACETOCHLOR (+ SAFENER) + ATRAZINE	6 lb/gal L (4.3 + 1.7)
LAUDIS (Bayer CropSciences)	TEMBOTRIONE	3.5 lb/gal SC

See legend on page 192.

(Continued on next page)

TABLE 14 – Glossary of Chemical Names *(continued)*

TRADE NAME** AND (MANUFACTURER)	COMMON NAME	CONCENTRATION COMMERCIAL FORMULATION†
LEXAR EZ (Syngenta)	S-METOLACHLOR (+SAFENER) + ATRAZINE + MESOTRIONE	3.7 lb/gal ZC (1.74 + 1.47 + 0.224)
LIBERTY (Bayer CropSciences)	GLUFOSINATE	2.34 lb/gal L
LINEX (NovaSource)	LINURON	4 lb/gal L
LOROX (NovaSource)	LINURON	50% DF
LUMAX EZ (Syngenta)	S-METOLACHLOR (+SAFENER) + ATRAZINE + MESOTRIONE	3.67 lb/gal ZC (2.49 + 0.935 + 0.249)
MARVEL (FMC)	FLUTHIACET-METHYL + FOMESAFEN	3 lb/gal L (0.117 + 2.883)
MATRIX (DuPont)	RIMSULFURON	25% DF
MCPA (Several)	MCPA	Various L
MILESTONE (Dow AgroSciences)	AMINOPYRALID	2 lb/gal L
METRIBUZIN (Several)	METRIBUZIN	75% WG
MOXY (Winfield Solutions, LLC)	BROMOXYNIL	2 lb/gal L
NIMBLE (Cheminova)	THIFENSULFURON + TRIBENURON	75% WG (50 + 25)
NORTRON SC (Bayer CropSciences)	ETHOFUMESATE	1½ lb/gal L; 4 lb/gal SC
OPTILL (BASF)	SAFLUFENACIL + IMAZETHAPYR	68% WG (17.8 + 50.2)
OPTILL PRO (BASF)	SAFLUFENACIL + IMAZETHAPYR + DIMETHENAMID-P	68% WG (17.8 + 50.2) + 6 lb/gal EC
OSPREY (Bayer CropSciences)	MESOSULFURON-METHYL	4.5% WG
OUTLOOK (BASF)	DIMETHENAMID-P	6 lb/gal
PARALLEL (Makhteshim-Agan)	METOLACHLOR (+ SAFENER)	7.8 lb/gal L
PARALLEL PCS (Makhteshim-Agan)	METOLACHLOR	8.0 lb/gal L
PARAZONE (Makhteshim-Agan)	PARAQUAT	3 lb/gal L
PEAK (Syngenta)	PROSULFURON	57% WG
PERMIT (Gowan)	HALOSULFURON	75% WG
PHOENIX (Valent)	LACTOFEN	2 lb/gal
POAST (BASF)	SETHOXYDIM	1.53 lb/gal L
POAST PLUS (BASF)	SETHOXYDIM + DASH	1.0 lb/gal L
PREFIX (Syngenta)	S-METOLACHLOR + FOMESAFEN	5.29 lb/gal L
PREQUEL (DuPont)	RIMSULFURON + ISOXAFLUTOLE	45% DF (15 + 30)
PRINCEP (Syngenta)	SIMAZINE	4 lb/gal L; 80% WP; 90% WG
PROGRESS (Bayer CropSciences)	DESMEDIPHAM + PHENMEDIPHAM + ETHOFUMESATE	1.8 lb/gal L (0.6 + 0.6 + 0.6)
PROWL (BASF)	PENDIMETHALIN	3.3 EC
PROWL H2O (BASF)	PENDIMETHALIN	3.8 lb/gal ACS
PUMA (Bayer CropSciences)	FENOXAPROP-P-ETHYL	1 lb/gal EC
PURSUIT (BASF)	IMAZETHAPYR	2 lb/gal L
PYTHON (Dow AgroSciences)	FLUMETSULAM	80% WG
QUELEX (Dow AgroSciences)	HALAUXIFEN + FLORASULAM	20% WG (10 + 10)
RAPTOR (BASF)	IMAZAMOX	1 lb/gal L
REALM Q (DuPont)	RIMSULFURON + MESOTRIONE (+ SAFENER)	38.75% WG (7.5 + 31.25)
REFLEX (Syngenta)	FOMESAFEN	2 lb/gal L
REGLONE (Syngenta)	DIQUAT	2 lb/gal L
RESICORE (Dow AgroSciences)	ACETOCHLOR (+SAFENER) + MESOTRIONE + CLOPYRALID	3.29 lb/gal SE (2.8 + 0.3 +0.19)
RESOLVE (DuPont)	RIMSULFURON	25% DF
RESOLVE Q (DuPont)	RIMSULFURON + THIFENSULFURON (+ SAFENER)	22.4% WG
RESOURCE (Valent)	FLUMICLORAC	0.86 lb/gal L
REVULIN Q (DuPont)	NICOSULFURON (+ SAFENER) + MESOTRIONE	51.2% WG (14.4 + 36.8)
RO-NEET (Helm)	CYCLOATE	6 lb/gal L; 10% G
ROWEL (Monsanto)	FLUMIOXAZIN	51% WG
ROWEL FX (Monsanto)	FLUMIOXAZIN + CHLORIMURON	40.3% WG (30 + 10.3)
SANDEA (Gowan)	HALOSULFURON	75% DG

See legend on page 192.

(Continued on next page)

TABLE 14 – Glossary of Chemical Names *(continued)*

TRADE NAME** AND (MANUFACTURER)	COMMON NAME	CONCENTRATION COMMERCIAL FORMULATION†
SELECT (Valent)	CLETHODIM	2 lb/gal L
SELECT MAX (Valent)	CLETHODIM	0.97 lb/gal EC
SEQUENCE (Syngenta)	GLYPHOSATE + S-METOLACHLOR	5.25 lb/gal L (2.25 + 3)
SHARPEN (BASF)	SAFLUFENACIL	2.85 lb/gal L
SINBAR (DuPont)	TERBACIL	80% WP
SOLSTICE (FMC)	FLUTHIACET + MESOTRIONE	4 lb/gal L (0.216 + 3.784)
SONALAN (Gowan)	ETHALFLURALIN	3 lb/gal L
SONIC (Dow AgroSciences)	SULFENTRAZONE + CLORANUSULAM	70% DF (62.1 + 7.9)
SPARTAN (FMC)	SULFENTRAZONE	4 lb/gal L
SPARTAN CHARGE (FMC)	CARFENTRAZONE + SULFENTRAZONE	3.5 lb/gal L (0.35 + 3.15)
STARANE ULTRA (Dow AgroSciences)	FLUROXYPYR	2.8 lb/gal L
STATUS (BASF)	DIFLUFENZOPYR + DICAMBA (+ SAFENER)	56% WG (16.0 + 40.0)
STANZA (FMC)	FLUMETSULAM + CLOPYRALID	68.5% WG (18.5 + 50)
STEADFAST Q (DuPont)	NICOSULFURON + RIMSULFURON (+ SAFENER)	37.7% WG (25.2 + 12.5)
STINGER (Dow AgroSciences)	CLOPYRALID	3 lb/gal L
SURPASS NXT (Dow AgroSciences)	ACETOCHLOR (+SAFENER)	7.0 lb/gal L
SURESTART II (Dow AgroSciences)	ACETOCHLOR (+ SAFENER) + FLUMETSULAM + CLOPYRALID	4.16 lb/gal L (3.75 + 0.12 + 0.29 ae)
SURVEIL (Dow AgroSciences)	CLORANSULAM-METHYL + FLUMIOXAZIN	48% WG (12 + 36)
SYNCHRONY XP (DuPont)	CHLORIMURON ETHYL+THIFENSULFURON METHYL	28.4% WG (3:1)
TALINOR (Syngenta)	BICYCLOPYRONE + BROMOXYNIL	1.77 lb/gal EC (0.31 + 1.46)
TARGA (Gowan)	QUIZALOFOP-P-ETHYL	0.88 lb/gal L
TRIFLURALIN (Several)	TRIFLURALIN	4 lb/gal L; 10% G
TRIPLEFLEX II (Monsanto)	ACETOCHLOR (+ SAFENER) + FLUMETSULAM + CLOPYRALID	4.16 lb/gal L (3.75 + 0.21 + 0.29 ae)
TRIVENCE (DuPont)	CHLORIMURON + FLUMIOXAZIN + METRIBUZIN	61.3% WG (3.9 +12.8 + 44.6)
ULTRA BLAZER (United Phosphorus, Inc)	ACIFLUORFEN	2 lb/gal
UPBEET (DuPont)	TRIFLUSULFURON METHYL	50% DF
VALOR (Valent)	FLUMIOXAZIN	51% WG
VALOR EZ (Valent)	FLUMIOXAZIN	4 lb/gal L
VALOR XLT (Valent)	FLUMIOXAZIN + CHLORIMURON	40.3% WG (30 + 10.3)
VARISTO (BASF)	IMAZAMOX + BENTAZON	4.18 lb/gal L (0.187 + 4)
VELPAR (DuPont)	HEXAZINONE	2 lb/gal L; 90% SP, 75% DF
VERDICT (BASF)	SAFLUFENACIL + DIMETHENAMID-P	5.57 lb/gal EC (0.57 + 5.0)
VIDA (Gowan)	PYRAFLUFEN ETHYL	0.2 lb/gal L
WARRANT (Monsanto)	ACETOCHLOR	3 lb/gal SC
WARRANT ULTRA (Monsanto)	ACETOCHLOR + FOMESAFEN	3.45 lb/gal L (2.82 + 0.63)
WIDEMATCH (Dow AgroSciences)	CLOPYRALID + FLUROXYPYR	1.5 lb/gal L (0.75 + 0.75)
XTENDIMAX (Monsanto)	DICAMBA	2.9 lb/gal L
YUKON (Gowan)	HALOSULFURON+DICAMBA	67.5% WG (12.5+55)
ZEMAX (Syngenta)	S-METOLACHLOR (+SAFENER) + MESOTRIONE	3.67 lb/gal ZC (3.34 + 0.33)
ZIDUA (BASF)	PYROXASULFONE	85% WG
ZIDUA SC (BASF)	PYROXASULFONE	4.17 lb/gal SC
ZIDUA PRO (BASF)	SAFLUFENACIL + IMAZETHAPYR + PYROXASULFONE	4.09 lb/gal SC (0.48 + 1.33 + 2.28)

** "Several" means there are numerous trade names for the chemical. The mention of trade names does not imply that they are endorsed or recommended over those of similar nature not listed.

† CS – aqueous capsule suspension, DC – dry concentrate, DF – dry flowable, DG – dispersible granule, DS – dry soluble granule, EC – emulsifiable concentrate, EW – emulsifiable concentrate G – granular, L – liquid, WG – water-dispersible granules, WP – wettable powder, WSP – wettable soluble powder, ZC – Zeon concentrate.

TABLE 15 – Glossary of EPA Registration Numbers

2,4-D	many	many
AAtrex 4L	Syngenta	100-497
AAtrex 90	Syngenta	100-585
Abundit Edge	DuPont	524-549-352
Accent Q	DuPont	352-773
Accolade	FMC	62719-277-279
Acuron	Syngenta	100-1466
Acuron Flexi	Syngenta	100-1568
Affinity BroadSpec	DuPont	352-661
Afforia	DuPont	352-889
Aim	FMC	279-3241
Alecto 41UL Glyphosate	Ritter Chemical, LLC	9468-33
Alecto 41S Glyphosate	Ritter Chemical, LLC	9468-33
Anthem MAXX	FMC	279-3468
Anthem ATZ	FMC	279-3449
Armezon	BASF	7969-262
Armezon PRO	BASF	7969-372
Arrow 2EC	Makhteshim-Agan	66222-60
Assure II	DuPont	352-541
Authority Assist	FMC	279-3330
Authority First	FMC	279-3246
Authority MAXX	FMC	279-9560
Authority MTZ	FMC	279-3326
Authority XL	FMC	279-3413
Autumn Super	Bayer CropScience	264-1134
Axial XL	Syngenta	100-1256
Balance Flexx	Bayer CropSciences	264-1067 MI-140001
Banvel	Arysta	51036-289
Basagran	Winfield Solutions, LLC	7969-45-1381
Basis Blend	DuPont	352-854
Beacon	Syngenta	100-705
Betamix	Bayer CropSciences	264-621
Betanex	Bayer CropSciences	264-620
Bicep II Magnum	Syngenta	100-817
Bicep Lite II Magnum	Syngenta	100-827
Boundary 6.5EC	Syngenta	100-1162
Breakfree NXT	DuPont	62719-672-352
Breakfree NXT ATZ	DuPont	62719-671-352
Breakfree NXT Lite	DuPont	62719-670-352
BroadAxe XC	Syngenta	279-3442-100
Broadloom	UPI	70506-306
Buccaneer	Tenkoz	524-445-55467
Buccaneer	Tenkoz	55467-10
Buccaneer Plus	Tenkoz	524-454-55467
Buccaneer Plus	Tenkoz	55467-9
Buccaneer 5	Tenkoz	71368-43-55467
Buctril	Bayer CropSciences	264-437
Butyrac 200	Albaugh	42 750-38
Cadet	FMC	279-3338
Callisto	Syngenta	100-1131
Callisto GT	Syngenta	100-1470
Callisto Xtra	Syngenta	100-1359
Canopy	DuPont	352-444
Canopy Blend	DuPont	352-886
Canopy EX	DuPont	352-635
Capreno	Bayer CropSciences	264-1063
Cheetah	NuFarm Inc.	71368-112
Cheetah Max	NuFarm Inc.	71368-111
Cimarron Plus	DuPont	352-670
Cinch	DuPont	100-818-352
Cinch ATZ	DuPont	100-817-352
Cinch ATZ Lite	DuPont	100-827-352
Cinco	Loveland	34704-929
Clarity	BASF	7969-137
Classic	DuPont	352-436
ClearOut 41 Plus	Chemical Products Technologies	70829-3
Cobra	Valent	59639-34
Command 3ME	FMC	279-3158
Cornerstone	Winfield Solutions, LLC	1381-191
Cornerstone	Winfield Solutions, LLC	1381-201
Cornerstone Plus	Winfield Solutions, LLC	1381-192
Cornerstone Plus	Winfield Solutions, LLC	524-454-1381
Cornerstone 5 Plus	Winfield Solutions, LLC	42750-59-1381
Cornerstone 5 Plus	Winfield Solutions, LLC	1381-241
Corvus	Bayer CropSciences	264-1066 MI-140002
Credit	Nufarm	71368-20
Credit	Nufarm	71368-65
Credit Extra	Nufarm	71368-20
Credit Extra	Nufarm	71368-65
Credit 41	Nufarm	71368-25
Credit 41 Extra	Nufarm	71368-25
Credit Xtreme	NuFarm	71368-81
Crossbow	Dow AgroSciences	62719-260
Curtail	Dow AgroSciences	62719-48
Degree Xtra	Monsanto	524-511
DiFlexx	Bayer CropSciences	264-1173
DiFlexx DUO	Bayer CropSciences	264-1184
Dual Magnum	Syngenta	100-816
Dual II Magnum	Syngenta	100-818
Duramax	Dow AgroSciences	62719-556
Durango DMA	Dow AgroSciences	62719-556
Elevore	Dow AgroSciences	62719-718
Engenia	BASF	7969-345
Enlist Duo	Dow AgroSciences	62719-649
Enlist One	Dow AgroSciences	62719-695
EverpreX	DuPont	352-923
Envive	DuPont	352-756
Eptam 7-E	Syngenta	10182-220
Expert	Syngenta	100-1161
Express SG	DuPont	352-632
Extra Credit 5	Nufarm	71368-43
Extreme	BASF	241-405
FeXapan	DuPont	352-913
Fierce	Valent	59639-193
Fierce XLT	Valent	59639-194
FirstRate	Dow AgroSciences	62719-275
Flexstar	Syngenta	10182-418
Flexstar GT 3.5	Syngenta	100-1385
Four Power Plus	Loveland	34704-890
FulTime NXT	Dow AgroSciences	62719-668
Fusilade DX	Syngenta	100-1070
Fusion	Syngenta	10182-343
Gly Star Original	Albaugh	42750-60
Gly Star Plus	Albaugh	42750-61
Gly-4	Universal Crop Protection	42750-60-72693
Gly-4 Plus	Universal Crop Protection	42780-61-72693
Glyfine Plus	Aceto	2749-537

(Continued on next page)

TABLE 15 – Glossary of EPA Registration Numbers *(continued)*

Glyfine 5 Plus	Aceto	2749-552
Glyfos X-tra	Cheminova	4787-23
Glyphogan	Makhteshim-Agan	66222-105
Glyphogan Plus	Makhteshim-Agan	66222-176
Glyphosate 4	Alligare, LLC	81927-34
Glyphosate 4 Plus	Alligare, LLC	81927-9
Glyphosate Plus	Quali-Pro	66222-176
Glyphosate 41 Plus	Cropsmart	42750-61-72693
Glyphosate 41 Plus	Cropsmart	74530-4-72693
Glyphosate 41% Plus	Consus Chemicals	86828-1
Gly Star Gold	Albaugh	42750-61
GlySupreme Plus	MEY Corporation	80967-1
Gramoxone SL 2.0	Syngenta	100-1431
GrazonNext HL	Dow AgroSciences	62719-628
Halex GT	Syngenta	100-1282
Harmony Extra SG	DuPont	352-714
Harmony SG	DuPont	352-633
Harness	Monsanto	524-473
Harness MAX	Monsanto	524-636
Harness Xtra 5.6L	Monsanto	524-485
Harness Xtra	Monsanto	524-480
Helosate Plus Advanced	Helm Agro U.S., Inc.	74530-4
Honcho 4L	Monsanto	524-445
Honcho Plus 4L	Monsanto	524-454
Hornet WDG	Dow AgroSciences	62719-315
Hoss Ultra	Helena	42750-61-5905
Huskie	Bayer CropSciences	264-1023
Impact	AMVAC	5481-524
Instigate	DuPont	352-873
Kerb 50-W	Dow AgroSciences	707-159
Keystone NXT	Dow AgroSciences	62719-671
Keystone LA NXT	Dow AgroSciences	62719-670
Laudis	Bayer CropSciences	264-860
Lexar EZ	Syngenta	100-1414
Liberty	Bayer	264-829
Linex	NovaSource	61842-21
Lorox DF	NovaSource	61842-23
Lumax EZ	Syngenta	100-1442
Mad Dog	Loveland	34704-889
Mad Dog Plus	Loveland	34704-890
Makaze	Loveland Products, Inc.	34704-890
Makaze Yield Pro	Loveland	34704-1033
Marvel	FMC	279-3455
MCPA Amine	many	many
Metribuzin	many	many
MEYCHEM 41% Glyphosate	MEY Corporation	80967-1
Milestone	Dow AgroSciences	62719-519
Mirage	UAP	524-445-34704
Mirage Plus 4L	UAP/Platte	524-454-34704
Moxy	Terra	51036-256-9779
Nimble	Cheminova	67760-78
Nortron SC	Bayer CropSciences	264-613
OpTill	BASF	7969-280
OpTill PRO	BASF	7969-332
Option	Bayer CropSciences	264-685
Osprey	Bayer CropSciences	264-802
Outlook	BASF	7969-156
Parallel	Makhteshim-Agan	66222-87
Parallel PCS	Makhteshim-Agan	66222-86
Parazone	Makhteshim-Agan	66222-130
Peak	Syngenta	100-763
Permit	Gowan	81880-2-10163
Phoenix	Valent	59639-118
Poast	BASF	7969-58
Poast Plus	BASF	7969-88
Prefix	Syngenta	100-1268
Prequel	DuPont	352-779
Princep 4L	Syngenta	100-526
Princep Caliber 90	Syngenta	100-603
Progress	Bayer CropSciences	264-815
Prowl 3.3EC	BASF	241-337
Prowl H2O	BASF	241-418
Puma	Bayer CropSciences	264-666
Pursuit	BASF	241-310
Pursuit Plus EC	BASF	241-331
Python	Dow AgroSciences	62719-277
Quelex	Dow AgroSciences	62719-661
Raptor	BASF	241-379
Rascal	Winfield Solutions, LLC	1381-191
Rascal Plus	Winfield Solutions, LLC	1381-192
Rascal Plus Herbicide EX	Winfield Solutions, LLC	71368-65-1381
Rattler	Helena	524-445-5905
Rattler Plus 4L	Helena	524-454-5905
Realm Q	DuPont	352-837
Reflex	Syngenta	10182-83
Reglone	Syngenta	10182-353
Rely	Bayer CropSciences	264-652
Resicore	Dow AgroSciences	62719-693
Resolve	DuPont	352-556
Resolve Q	DuPont	352-759
Resource	Valent	59639-82
Revulin Q	DuPont	352-900
Ro-Neet 6-E	Helm	10182-178
Roundup OriginalMax 5.5L	Monsanto	524-539
Roundup PowerMAX	Monsanto	524-539
Roundup WeatherMax	Monsanto	524-537
Rowel	Monsanto	59639-99-524
Rowel FX	Monsanto	59639-117-524
Sandea	Gowan	10163-254
Select 2EC	Valent	59639-3
Select Max	Valent	59639-132
Sequence	Syngenta	100-1185
Sharpen	BASF	7969-278
Showdown	Helena	71368-25-5905
Sinbar	DuPont	352-317
Solstice	FMC	279-3461
Sonalan HFP	Gowan	62719-188
Sonic	Dow AgroSciences	279-3246-62719
Spartan	FMC	279-3189
Spartan Charge	FMC	279-3337
Starane Ultra	Dow AgroSciences	62719-577
Status	BASF	7969-242
Stanza	FMC	62719-315-279
Steadfast	DuPont	352-608
Steadfast ATZ	DuPont	352-619
Steadfast Q	DuPont	352-774
Stinger	Dow AgroSciences	62719-73

(Continued on next page)

TABLE 15 – Glossary of EPA Registration Numbers *(continued)*

Stout	DuPont	352-667
SureStart II	Dow AgroSciences	62719-679
Surpass NXT	Dow AgroSciences	62719-672
Surveil	Dow AgroSciences	62719-689
Synchrony XP	DuPont	352-648
Talinor	Syngenta	100-1570
Targa	Gowan	33906-9-81880
Touchdown HiTech	Syngenta	100-1182
Touchdown Total	Syngenta	100-1169
Traxion	Syngenta	100-1169
Treflan TR-10	Dow AgroSciences	62719-131
TripleFLEX II	Monsanto	524-614
Trivence	DuPont	352-887
Ultra Blazer	United Phosphorus, Inc.	70506-60
Upbeet	DuPont	352-569
Valor	Valent	59639-99
Valor EZ	Valent	71368-113-59639
Valor XLT	Valent	59639-117
Varisto	BASF	241-447
Velpar DF	DuPont	352-581
Velpar L	DuPont	352-392
Verdict	BASF	7969-279
Vida	Gowan	71711-7-10163
Warrant	Monsanto	524-591
Warrant Ultra	Monsanto	524-620
WideMatch	Dow AgroSciences	62719-512
Wise Up Plus	MEY Corporation	80967-1
XtendiMax	Monsanto	524-617
Yukon	Gowan	81880-6-10163
Zemax	Syngenta	100-1410
Zidua	BASF	7969-338
Zidua SC	BASF	7969-374
Zidua PRO	BASF	7969-365

TABLE 16 – Glossary of Restricted-Use Pesticides, Groundwater Advisories, Signal Words and Restricted Entry Intervals

Trade Name	Restricted Use Pesticide	Groundwater Advisory	Signal Word	Restricted Entry Interval
2,4-D amine	No	No	Danger	48 hrs
2,4-D ester	No	No	Caution	12 hrs
Accent	No	No	Caution	4 hrs
Accent Q	No	No	Caution	4 hrs
Accolade	No	**Yes**	Caution	12 hrs
Acuron	**Yes**	**Yes**	Caution	24 hrs
Acuron Flexi	**Yes**	**Yes**	Caution	24 hrs
Affinity BroadSpec	No	No	Caution	12 hrs
Afforia	No	No	Caution	12 hrs
Aim	No	No	Caution	12 hrs
Anthem MAXX	No	**Yes**	Caution	12 hrs
Anthem ATZ	**Yes**	**Yes**	Warning	12 hrs
Armezon	No	No	Caution	12 hrs
Armezon PRO	No	**Yes**	Caution	12 hrs
Arrow	No	No	Caution	24 hrs
Assure II	No	No	Danger	12 hrs
atrazine (many names)	**Yes**	**Yes**	Caution	12 hrs
Authority Assist	No	No	Caution	12 hrs
Authority First	No	**Yes**	Caution	12 hrs
Authority MAXX	No	**Yes**	Caution	12 hrs
Authority MTZ	**Yes**	**Yes**	Danger	12 hrs
Authority XL	No	**Yes**	Caution	12 hrs
Autumn Super	No	No	Caution	12 hrs
Axial XL	No	No	Caution	48 hrs
Balance Flexx	**Yes**	**Yes**	Caution	12 hrs
Banvel	No	**Yes**	Warning	24 hrs
Basagran	No	No	Caution	48 hrs
Basis Blend	No	No	Caution	4 hrs
Beacon	No	No	Caution	12 hrs
Betamix	No	No	Warning	24 hrs
Betanex	No	No	Caution	24 hrs
Bicep II Magnum	**Yes**	**Yes**	Caution	24 hrs
Bicep Lite II Magnum	**Yes**	**Yes**	Caution	24 hrs
Boundary	No	**Yes**	Caution	12 hrs
Breakfree NXT	No	**Yes**	Warning	12 hrs
Breakfree NXT ATZ	**Yes**	**Yes**	Caution	12 hrs
Breakfree NXT Lite	**Yes**	**Yes**	Caution	12 hrs
BroadAxe XC	No	**Yes**	Caution	24 hrs
Broadloom	No	No	Caution	48 hrs
Buctril	No	No	Warning	24 hrs
Butoxone 200	No	**Yes**	Danger	48 hrs
Butyrac 200	No	**Yes**	Danger	48 hrs
Cadet	No	No	Warning	12 hrs
Callisto	No	No	Caution	12 hrs
Callisto GT	No	No	Caution	24 hrs
Callisto Xtra	**Yes**	**Yes**	Caution	12 hrs

(Continued on next page)

TABLE 16 – Glossary of Restricted-Use Pesticides, Groundwater Advisories, Signal Words and Restricted Entry Intervals *(continued)*

Trade Name	Restricted Use Pesticide	Groundwater Advisory	Signal Word	Restricted Entry Interval
Canopy	No	No	Caution	12 hrs
Canopy Blend	No	**Yes**	Caution	12 hrs
Canopy EX	No	No	Caution	12 hrs
Capreno	No	**Yes**	Caution	12 hrs
Cheetah	No	No	Warning	12 hrs
Cheetah Max	No	**Yes**	Warning	24 hrs
Cimarron Plus	No	No	Caution	4 hrs
Cinch	No	**Yes**	Caution	24 hrs
Cinch ATZ	**Yes**	**Yes**	Caution	24 hrs
Cinch ATZ Lite	**Yes**	**Yes**	Caution	24 hrs
Clarity	No	**Yes**	Caution	24 hrs
Classic	No	No	Caution	12 hrs
Cobra	No	No	Danger	12 hrs
Command	No	No	Caution	12 hrs
Corvus	**Yes**	**Yes**	Caution	12 hrs
Crossbow	No	No	Caution	–
Curtail	No	**Yes**	Danger	48 hrs
Degree Xtra	**Yes**	**Yes**	Caution	12 hrs
DiFlexx	No	No	Caution	24 hrs
DiFlexx DUO	No	No	Caution	24 hrs
Dual Magnum	No	**Yes**	Caution	24 hrs
Dual II Magnum	No	**Yes**	Caution	24 hrs
Elevore	No	**Yes**	Caution	12 hrs
Engenia	**Yes**	No	Caution	24 hrs
Enlist Duo	No	No	Warning	48 hrs
Enlist One	No	No	Warning	48 hrs
Envive	No	No	Caution	12 hrs
Eptam	No	No	Warning	12 hrs
EverpreX	No	**Yes**	Caution	24 hrs
Expert	**Yes**	**Yes**	Caution	24 hrs
Express	No	No	Caution	12 hrs
Extreme	No	**Yes**	Warning	48 hrs
FeXapan	**Yes**	No	Caution	24 hrs
Fierce	No	**Yes**	Caution	12 hrs
Fierce XLT	No	**Yes**	Caution	12 hrs
FirstRate	No	**Yes**	Caution	12 hrs
Flexstar	No	**Yes**	Warning	24 hrs
Flexstar GT 3.5	No	**Yes**	Caution	24 hrs
ForeFront HL	No	No	Danger	48 hrs
Fultime NXT	**Yes**	**Yes**	Caution	12 hrs
Fulilade DX	No	No	Caution	12 hrs
Fusion	No	No	Caution	24 hrs
glyphosate (see Table 10)	No	No	Caution	4 hrs
Gramoxone SL 2.0	**Yes**	No	Danger/Poison	12 hrs
GrazonNext HL	No	No	Danger	48 hrs
Halex GT	No	**Yes**	Caution	24 hrs

(Continued on next page)

TABLE 16 – Glossary of Restricted-Use Pesticides, Groundwater Advisories, Signal Words and Restricted Entry Intervals *(continued)*

Trade Name	Restricted Use Pesticide	Groundwater Advisory	Signal Word	Restricted Entry Interval
Harmony	No	No	Caution	4 hrs
Harmony Extra	No	No	Caution	12 hrs
Harness	No	**Yes**	Warning	12 hrs
Harness MAX	No	**Yes**	Caution	12 hrs
Harness Xtra	**Yes**	**Yes**	Caution	12 hrs
Hornet	No	**Yes**	Warning	48 hrs
Huskie	No	**Yes**	Warning	12 hrs
Impact	No	No	Caution	12 hrs
Instigate	No	No	Caution	12 hrs
Kerb	**Yes**	No	Caution	24 hrs
Keystone NXT	**Yes**	**Yes**	Caution	12 hrs
Keystone LA NXT	**Yes**	**Yes**	Caution	12 hrs
Laudis	No	No	Caution	12 hrs
Lexar EZ	**Yes**	**Yes**	Caution	24 hrs
Liberty	No	No	Warning	12 hrs
Linex	No	**Yes**	Caution	24 hrs
Lorox	No	**Yes**	Caution	24 hrs
Lumax EZ	**Yes**	**Yes**	Caution	24 hrs
Marvel	No	**Yes**	Warning	24 hrs
Matrix	No	No	Caution	4 hrs
MCPA	No	No	Danger	48 hrs
Metribuzin	No	**Yes**	Caution	12 hrs
Milestone	No	No	Caution	48 hrs
Moxy	No	No	Warning	24 hrs
Nimble	No	No	Caution	12 hrs
Nortron	No	No	Caution	12 hrs
Olympus	No	No	Caution	12 hrs
OpTill	No	**Yes**	Caution	12 hrs
OpTill PRO	No	**Yes**	Warning	12 hrs
Osprey	No	No	Caution	4 hrs
Outlook	No	**Yes**	Warning	12 hrs
Parallel	No	**Yes**	Caution	12 hrs
Parallel PCS	No	**Yes**	Caution	12 hrs
Parazone	**Yes**	No	Danger/Poison	12 hrs
Peak	No	**Yes**	Caution	12 hrs
Permit	No	**Yes**	Caution	12 hrs
Phoenix	No	No	Caution	12 hrs
Poast	No	No	Warning	12 hrs
Poast Plus	No	No	Caution	12 hrs
Prefix	No	**Yes**	Warning	24 hrs
Prequel	**Yes**	**Yes**	Caution	12 hrs
Princep	No	**Yes**	Caution	12 hrs
Progress	No	No	Danger	48 hrs
Prowl	No	No	Caution	24 hrs
Prowl H2O	No	No	Caution	24 hrs
Puma	No	No	Warning	24 hrs

(Continued on next page)

TABLE 16 – Glossary of Restricted-Use Pesticides, Groundwater Advisories, Signal Words and Restricted Entry Intervals *(continued)*

Trade Name	Restricted Use Pesticide	Groundwater Advisory	Signal Word	Restricted Entry Interval
Pursuit	No	**Yes**	Caution	12 hrs
Python	No	**Yes**	Caution	12 hrs
Quelex	No	**Yes**	Caution	12 hrs
Raptor	No	No	Caution	4 hrs
Realm Q	No	No	Caution	12 hrs
Reflex	No	**Yes**	Danger	24 hrs
Reglone	No	No	Warning	24 hrs
Rely	No	No	Warning	12 hrs
Resicore	No	**Yes**	Caution	12 hrs
Resolve	No	No	Caution	4 hrs
Resolve Q	No	No	Caution	4 hrs
Resource	No	No	Warning	12 hrs
Revulin Q	No	No	Caution	12 hrs
Ro-Neet	No	No	Caution	12 hrs
Rowel	No	No	Caution	12 hrs
Rowel FX	No	No	Caution	12 hrs
Sandea	No	**Yes**	Caution	12 hrs
Select	No	No	Warning	24 hrs
Select Max	No	No	Caution	24 hrs
Sencor	No	**Yes**	Caution	12 hrs
Sequence	No	**Yes**	Caution	24 hrs
Sharpen	No	**Yes**	Caution	12 hrs
Sinbar	No	**Yes**	Caution	12 hrs
Solstice	No	**Yes**	Caution	12 hrs
Sonalan	No	No	Danger	24 hrs
Sonic	No	**Yes**	Caution	12 hrs
Spartan	No	**Yes**	Caution	12 hrs
Spartan Charge	No	**Yes**	Caution	12 hrs
Starane Ultra	No	No	Warning	12 hrs
Stanza	No	**Yes**	Warning	48 hrs
Status	No	**Yes**	Caution	24 hrs
Steadfast Q	No	No	Caution	4 hrs
Stinger	No	**Yes**	Caution	12 hrs
SureStart II	No	**Yes**	Warning	12 hrs
Surpass NXT	No	**Yes**	Warning	12 hrs
Surveil	No	**Yes**	Caution	12 hrs
Synchrony XP	No	No	Caution	12 hrs
Talinor	No	**Yes**	Caution	24 hrs
Targa	No	No	Danger	12 hrs
trifluralin (many names)	No	No	Warning	12 hrs
TripleFLEX II	No	**Yes**	Warning	12 hrs
Trivence	No	**Yes**	Caution	12 hrs
Ultra Blazer	No	**Yes**	Danger	48 hrs
UpBeet	No	No	Caution	4 hrs
Valor	No	No	Caution	12 hrs
Valor EZ	No	No	Caution	12 hrs

(Continued on next page)

TABLE 16 – Glossary of Restricted-Use Pesticides, Groundwater Advisories, Signal Words and Restricted Entry Intervals *(continued)*

Trade Name	Restricted Use Pesticide	Groundwater Advisory	Signal Word	Restricted Entry Interval
Valor XLT	No	No	Caution	12 hrs
Varisto	No	**Yes**	Caution	48 hrs
Velpar	No	**Yes**	Danger	24 hrs
Verdict	No	**Yes**	Warning	12 hrs
Vida	No	No	Danger	12 hrs
Warrant	No	**Yes**	Caution	12 hrs
Warrant Ultra	No	**Yes**	Danger	24 hrs
WideMatch	No	**Yes**	Caution	12 hrs
XtendiMax	**Yes**	No	Caution	24 hrs
Yukon	No	**Yes**	Caution	12 hrs
Zemax	No	**Yes**	Caution	24 hrs
Zidua	No	**Yes**	Caution	12 hrs
Zidua SC	No	**Yes**	Caution	12 hrs
Zidua PRO	No	**Yes**	Caution	12 hrs

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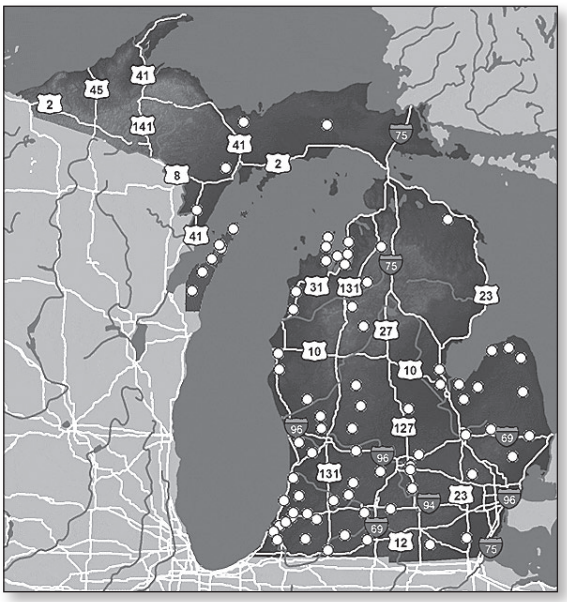
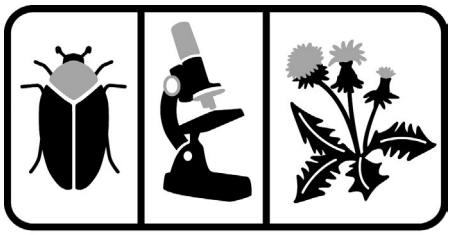
- Assessing apple maturity

A collaborative project between the Michigan Climatological Resources Program, MSU Integrated Pest Management Program, Project GREEEN and Michigan agriculture.



www.enviroweather.msu.edu

How to submit a sample to MSU Diagnostic Services



Diagnostic Services

Sample Submission

Collecting Plant Samples

It is best to send entire plants, although we recognize this is not always possible. Plants with root and crown rot diseases cannot be properly diagnosed unless root and crown tissue is submitted. Dig, rather than pull, plants from the ground to preserve the root integrity. Submit plants with symptoms that are in varying stages of decline. Avoid sending samples that contain only dead plants. Growers with larger crops/plantings are encouraged to submit multiple plants to ensure there is enough tissue for analyses by several diagnosticians with multiple methods. See below for instructions specific to various plant types.

Packaging Plant Samples

Do not add wet paper towel or other sources of moisture when packaging samples. Plant material should be wrapped in dry newspaper and then placed in a plastic bag to preserve the integrity of the sample. When root tissue is included, wrap the root balls in plastic to prevent the soil from coming in contact with the foliage. Large samples (ex. tree branches) can be cut in sections for easier packaging. Do not ship any type of sample that will leak contents from the packaging (ex. severely rotted fruit, loose soil, etc.). Almost all samples should be shipped in a box, rather than an envelope. Leaves and stems that are pressed and mailed in envelopes do not arrive in good condition. Include a completed copy of the submittal form, put the form in a separate re-sealable bag to prevent it from getting damp or soiled.

Shipping Plant Samples

Avoid shipping samples on Fridays; samples are not delivered to campus on weekends and may not arrive in the lab in good condition the following week. All major shipping companies deliver to the lab or campus. The shipping address is included on the top of the submittal form. Shipping containers/materials are not returned to clients unless previous special arrangements are made.

Images of Plant Samples

Images of the plants and the corresponding symptoms can be extremely helpful to the diagnostic staff. Images can be emailed to the lab. Please send multiple images including close up shots of the symptoms of concern, as well as images that show the entire plant/tree and its surroundings. In the email include your name and contact information, also indicate the date that the accompanying physical sample was or will be sent. Please note that out of focus images have limited or no value; we are not able to improve the focus of digital images. Images submitted to the lab may be used by lab staff, with proper photo credit, for educational purposes.

Out of State Clients

Clients submitting samples that are collected outside of Michigan must follow some additional packaging protocols. Samples must be double bagged and sealed (ex. two zip-lock freezer bags). Place the sealed bags in a sturdy shipping container. Our lab has USDA APHIS permits in place to accept samples from the continental U.S. Note, diagnostic fees are increased for out of state clients.

If you have any doubt about what or how to collect a good sample please contact the lab (517) 432-0988 or via pestid@msu.edu.

Submit samples to:

Michigan State University
Diagnostic Services
578 Wilson Rd., Rm. 107
East Lansing, MI 48824-6469
Phone: (517) 355-4536
Fax: (517) 432-0899

How to submit a sample to MSU Diagnostic Services *(continued)*

Crop Specific Details

Herbaceous Plants: When possible, send entire plants including roots and some soil. Roots and soil should be in a plastic bag tied off at the soil line to prevent soil from touching foliage. This plant material degrades fairly quickly; as a result plants should be dropped off in person or sent with overnight or priority shipping.

Plugs/Seedlings: It is tricky to get plugs submitted to the lab in good condition. Leave the plugs in the tray for shipping purposes. Entire trays are not required; a section of the tray can be cut and shipped. Submit a minimum of 12 plugs. Wrap the plug sheet in newspaper or add packing material that will prevent plugs from being dislodged from the tray. This plant material degrades fairly quickly; as a result plants should be dropped off in person or sent with overnight shipping.

Tree Samples with Leaf Spots: Select affected foliage, but wherever possible leave it attached to the branch. Send several affected samples representing the early and moderate stages of symptom progression. Although the sample may seem flat enough to package and ship in an envelope, please package and ship in a box. This protects the sample during the shipping process.

Trees with Suspected Vascular Wilt diseases including Verticillium Wilt, Dutch Elm Disease, Oak Wilt: Select branches that are partially wilted, with symptomatic leaves progressing from the tip of branches inward to the trunk. Be sure that branches are not totally wilted, dry, or dead. Select samples from up to three symptomatic branches per single tree. Branch samples should be at least 1 inch in diameter, cut into 6- to 8- inch lengths, and placed in large re-sealable plastic bags. Keep samples cool during sampling, shipping and storage, but do not freeze. Ship samples overnight mail (no later than Thursday) or deliver in person to the laboratory.

Vegetables: These samples may include plants, fruit, or both. If fruit rot is a concern select fruit that is in the initial stages of symptom development. Be sure to package in leak proof containers (ex. sealable plastic bags). Delivery personnel may not deliver packages that are leaking.

Residential Turf: Include a square of turf from the margin of the diseased area so that both healthy and diseased turf is included. Minimally, the turf square should be 6 inches x 6 inches. An intact layer of soil should remain on the root system. Wrap samples in newspaper and pack in a box for shipment. Do not add moisture to the turf prior to shipment. Provide a detailed description of cultural practices (irrigation, fertilization, pesticide application, etc.) and images of the symptoms in the lawn with the sample.

Please note that Diagnostic Services does not perform health analyses of golf course turf. Commercial turf samples are processed by the Turf Pathology Lab. Contact Dr. Joe Vargas, MSU Plant, Soil, and Microbial Sciences, at 517-353-9082 for further information on diagnosis of commercial turf samples. MSU Golf Turf Diagnostics Form.

Weed/Plant Samples

Herbaceous Plant Identification: Submit a representative sample containing vegetative structures, leaves and flowers. Plants may be pressed flat between papers or cardboard to prevent leaf crinkling. For best results, plants should be submitted immediately after taking the sample.

Woody Plant Identification: Submit a large section of the terminal end of the stem or branch. Where possible, include any flower or fruiting structures. Leaves may be pressed flat between papers or cardboard to prevent leaf crinkling. Woody plants may be wrapped in plastic to retain moisture.

Herbicide Resistance

Weed seed is required to conduct a whole plant bioassay in the greenhouse to screen for herbicide resistance. Mature, high quality seed or seedheads should be collected from suspicious plants in the late summer or fall; ideally pooled samples with seed/seedheads from 5 or more plants will ensure adequate seed quantity. For species specific information on correctly identifying mature seed and collection tips please review the herbicide resistance information on **pestid.msu.edu**. Place samples in sealed a paper bag. Do not submit samples in a plastic bag as mold and decay will compromise the sample. Screens will be designed by herbicide site of action (e.g. EPSP synthase inhibitor, ALS inhibitors, Photosynthesis inhibitors, etc.). Screening results are generally available 2-3 months after submission to allow for seed cleaning, dormancy breaking measures, greenhouse growth, herbicide application, and evaluation.

Nematode Samples

Always store nematode samples in plastic bags or other containers that retain moisture. Submit a pint to a quart of soil per sample. If nematode samples need to be stored prior to submission try to keep them cool.

Problem Diagnosis: Collect soil and roots (or foliage) from the margins of diseased areas. Submit samples of diseased and apparently healthy plants for comparison purposes.

How to submit a sample to MSU Diagnostic Services *(continued)*

Problem Avoidance: Collect soil and roots (if available) by walking a zigzag or w-shaped pattern. Try to collect 10-25 subsamples using a soil probe, trowel or shovel. One sample per field is adequate unless you can identify problem areas such as sandy locations, along ditch or river banks where flooding occurs, etc., then two or more samples are recommended.

Insect/Arthropod Samples

Precise identification of insect or other arthropods requires specimens to be undamaged upon arrival in the lab.

It is very important to kill and ship the specimens in a manner that will not damage the delicate structures that facilitate their identification. It is always best to include multiple specimens whenever possible.

Dried and unprotected insects crumble easily during the mail process. Kill and ship specimens in a small, leak proof container rubbing alcohol or white vinegar.

Moths/Butterflies: Place specimens in the freezer for half an hour to kill them and gently pack in a small box or vial with tissue paper.

Ants/Other Adult Arthropods: Ant specimens should only include worker ants (i.e. those without wings). Submit ants and all other hard-bodied specimens in vinegar.

Larvae (Caterpillar, grub, maggot, etc.): Whenever possible, soft-bodied larvae should be lightly boiled for a few minutes before placing them in vinegar. This prevents the specimens from shriveling and becoming discolored, however this only works if the larvae are alive when placed in the boiling water.

Images of Insects, Spiders, Ticks and other arthropods: We can often identify a specimen from an image provided that the image is taken in good light and it is in focus. Images of insects, spiders, ticks and other arthropods can emailed to the lab at pestid@msu.edu. Please remember that if the image looks dark or blurry to you, it's going to look dark and blurry to us when we receive it. We don't have any way to correct or improve the quality of an image. Images submitted to the lab may be used by lab staff, with proper photo credit, for educational purposes.

Pesticide Analysis Samples

MSU Diagnostic services does not test for pesticide residues in-house, however a list of recommended agencies who conduct such tests is available upon request.

Services and Fees for MSU Diagnostic Services

Note: Fees for out-of-state samples are triple. Contact lab for procedures not described below.

Plant Health Analysis

Routine plant analysis	$20.00
In-House ELISA tests:	$20.00
Bacterial ID (BIOLOG ®):	$25.00

Weeds/Plants

Plant ID	$10.00
Herbicide resistance in weeds	$90.00

– This test will include multiple sites of action, based on seed quantity and quality

– MI Soybean growers qualify for free testing of the following species courtesy of the Michigan Soybean Promotion Committee:

-Palmer amaranth
-Waterhemp
-Horseweed/marestail
-Common lambsquarters
-Common ragweed
-Giant ragweed

Nematodes

Basic nematode analysis:	$25.00
Foliar nematode analysis:	$25.00
Total nematode community analysis:	$50.00
Full-SCN type testing	$75.00
Mini-SCN type testing	$40.00
Verticillium analysis (potato soil or stems only)	
Wet sieving:	$25.00
Dilution plating:	$20.00
Both	$40.00

Insects/Arthropods

Common insect ID:	N/C
Keyout insect ID:	$20.00

Michigan State University
Diagnostic Services
578 Wilson Road
East Lansing, MI 48824-6469
Office: 517.355.4536
FAX: 517.432.0899
www.pestid.msu.edu

Lab Use Only
Case # _____
Date received _____
Amount paid _____
Check/receipt#_____
MSU account # _____
Diagnostic fee _____

Submitter

Name _____

Business _____

Address _____

City/State/Zip _____

Phone _____FAX _____

Email address _____

Send results to □ Submitter □ Grower/MSUE/Other

Grower/MSUE/Other (if different than submitter)

Name _____

Business _____

Address _____

City/State/Zip _____

Phone _____FAX _____

Email address _____

Send invoice to □ Submitter □ Grower/MSUE/Other

Plant or sample type:_____

County where sample was collected _____ Sample reference _____

Describe symptoms or injury _____

When did symptoms first appear? _____

Plant parts affected

□ Entire plant □ Trunk/stem
□ Leaves/needles □ Roots
□ Twigs/limbs □ Fruit
□ Bud □ Flower

Type of planting

□ Field □ Garden
□ Greenhouse □ Nursery
□ Other _____

Prevalence

□ Entire planting
□ Single area
□ Few scattered plants
□ Other _____

Soil type

□ Sandy □ Clay
□ Muck □ Silt loam
□ Soilless media

Other background information

Age of plant _____ How many plants affected? _____
Planting date_____ How often watered? _____
Height of plant _____ Sunny or Shaded? _____

Chemical history – list fertilizer, herbicide, insecticide, fungicide, and PGR applications including date and rate used

Insect/Arthropod Samples

Where was the insect found? _____ What was the insect doing there? _____
How many insects are there? _____ Do you have young children living with you? _____

Plant/Weed ID Samples

Plant type

□ Tree □ Groundcover
□ Shrub □ Herbaceous
□ Vine □ Grass

Plant size

Height _____
Width _____

Fruit

Color _____
Size _____
Month _____

Flowers

Color _____
Size _____

Plant Age

□ Annual
□ Perennial

For **diagnostic fee details** contact the lab or www.pestid.msu.edu

USE REVERSE SIDE TO PROVIDE ADDITIONAL INFORMATION MSU-DS-Form-012-001 version 3.0

Michigan State University
Diagnostic Services
578 Wilson Road
East Lansing, MI 48824-6469
Office: 517.355.4536
FAX: 517.432.0899
www.pestid.msu.edu

Lab Use Only
PDIS Case # _____
ID # _____
Date received _____
Amount paid _____
Check/receipt#_____
MSU account # _____
Diagnostic fee _____

SCREENING FOR HERBICIDE-RESISTANT WEEDS

- Mature, high quality seed is required. Please refer to "Tips for collecting weed seeds" on our website for collection details. The screening process takes 2-4 months to complete, depending on the species.
- Courtesy of the MI Soybean Promotion Committee, MI soybean growers qualify for free testing of the following species: Palmer amaranth, waterhemp, horseweed/marestail, common lambsquarters, common & giant ragweed.
- Screening of these weeds from rotations not including soybeans is available for $90/sample. Screening of other species may be possible in consultation with Diagnostic Services.

Submitter

Name _____
Business _____
Address _____
City/State/Zip _____
Phone _____FAX _____
Email address _____
Send results to □ Submitter □ Grower/MSUE/Other

Grower/MSUE/Other (if different than submitter)

Name _____
Business _____
Address _____
City/State/Zip _____
Phone _____FAX _____
Email address _____
Send invoice to □ MSPC □ Submitter □ Grower/Other

SPECIES to be screened:

SAMPLE LOCATION (GPS or nearest crossroads):_____

City/town where sample was collected: _____ County: _____

Field ID: _____ Number of Acres: _____

FIELD HISTORY

Year	Crop	Tillage	Herbicide(s)
			Burndown:
			PRE:
			POST:
			Burndown:
			PRE:
			POST:
			Burndown:
			PRE:
			POST:
			Burndown:
			PRE:
			POST:

For **diagnostic fee details** contact the lab or www.pestid.msu.edu

USE REVERSE SIDE TO PROVIDE ADDITIONAL INFORMATION MSU-DS-Form-HerbResist-Nov2017

Multiple herbicide-resistant Palmer amaranth & waterhemp in Michigan

Keys to management in soybean, corn and alfalfa

Christy Sprague, Extension Weed Science

www.MSUweeds.com
November 2015

MICHIGAN STATE UNIVERSITY WEED SCIENCE

MSUWS06-2015

Palmer amaranth (*Amaranthus palmeri*) and common waterhemp (*A. rudis*) are pigweed species that are becoming more prevalent in Michigan agronomic fields. Both species pose severe management challenges for Michigan growers with herbicide resistance being the greatest of these challenges. Palmer amaranth and waterhemp populations in Michigan range from being resistant only to glyphosate or ALS-inhibiting herbicides to many of these populations being **resistant to multiple herbicides** including **glyphosate** and **ALS-inhibitors**. In fact, we have a Palmer amaranth population in Michigan that is resistant to three herbicide sites of action, including glyphosate (Group 9), ALS-inhibiting herbicides (Group 2), and atrazine (Group 5). In other states, Palmer amaranth and waterhemp have evolved resistance to a combined seven different herbicide sites of action, including Groups 2, 3, 4, 5, 9, 14 and 27. This leaves very few herbicide options available for management. The ability of these species to emerge throughout the growing season, their rapid growth rates, prolific seed production, and their ability to evolve herbicide resistance quickly makes these species two of the more difficult weeds to manage.

Identifying characteristics:

Palmer amaranth and common waterhemp are dioecious, having separate male and female plants. The stem and leaf surfaces of both of these species are smooth and due to genetic variability within each species there are several variations in stem and flower structure color.

Palmer amaranth	Waterhemp
• Rounded leaves	• Long narrow leaves
• Leaves are in a symmetrical arrangement	• Open canopy
• Petioles are as long or longer than the leaf	• Leaves appear shiny or waxy
• Spiny bracts are at leaf axils on female plants	• No spiny bracts
• Flowering structures are thick, unbranched, and 1 to 2 feet long	• Flowering structures are slender, unbranched, and usually only 6 inches long

Long leaf petiole

Female plant spiny bracts

Flowering structure Palmer amaranth

Long narrow leaves

Flowering structure waterhemp

Multiple herbicide-resistant Palmer amaranth & waterhemp

Keys to successful management in soybean

Proper identification and early detection of Palmer amaranth and waterhemp will improve the opportunities for successful management. While there are several differences between these species, management options in soybean are often similar. The following steps outline the strategies for the best management of multiple-resistant Palmer amaranth and common waterhemp in soybean.

Step 1: Consider planting LibertyLink soybean.

Due to the limited postemergence herbicide options available, label restrictions, and lack of consistency observed with postemergence herbicides control of multiple-resistant Palmer amaranth and waterhemp is a challenge in Roundup Ready soybean. With LibertyLink soybean there is more flexibility in use rates and the number of Liberty applications that can be made.

Step 2: Start clean!!

Make sure that all Palmer amaranth or common waterhemp plants are controlled with tillage or an effective burndown herbicide, i.e., Gramoxone or Liberty, prior to planting soybean.

Step 3: Effective soil-applied (PRE) herbicides are essential.

Apply the ***full-rate*** of an effective soil-residual herbicide, prior to or soon after soybean planting. Valor and Fierce have been the most consistent control options. Valor XLT, Envive, Surveil and Trivence are also Valor (*flumioxazin*)-based products that have provided good control. Premixes that contain Spartan (*sulfentrazone*); Authority MTZ, Authority First/XL/MAXX/Assist, and Sonic have also shown some positive results. However, rates of these herbicides need to be equivalent to 8 fl oz/A of Spartan (0.25 lb ai/A of *sulfentrazone*). Adding *metribuzin* to Valor or Authority products (where allowed) may provide additional residual control of Palmer amaranth and waterhemp. Remember, higher rates of these herbicides also increase the likelihood for soybean injury.

Step 4: Timely postemergence herbicide applications.

Proper timing is everything!! Postemergence herbicides must be applied before Palmer amaranth and waterhemp are 3-inches tall. In Roundup Ready soybean, Flexstar, Cobra, or Ultra Blazer should be used. Flexstar has been the most consistent of these herbicides for Palmer amaranth control. In LibertyLink soybean, use a minimum rate of 32 fl oz/A of Liberty. Spray coverage is essential with any of these herbicides, so a minimum of 15 gallons per acre of spray solution should be used. Once plants exceed 3-inches tall, control with any of these postemergence herbicides is substantially reduced.

Step 5: Residual product tank-mixtures with postemergence herbicides.

A residual herbicide (i.e., Dual II Magnum, Warrant, Outlook, or Zidua) should be tank-mixed with the postemergence herbicide application. It is essential for the postemergence herbicide Flexstar, Cobra, Ultra Blazer, or Liberty (LibertyLink soybeans only) to have effective control of herbicide-resistant Palmer amaranth and waterhemp, since the residual herbicides will not control emerged plants. Prefix and Warrant Ultra are products where the postemergence herbicide Flexstar is premixed with residual herbicide.

Step 6: Additional postemergence herbicide applications if needed.

Follow-up postemergence herbicide applications may be needed. Make these applications when plants are 3-inches or less. In Roundup Ready soybean if Flexstar was used in the first postemergence application, Cobra or Ultra Blazer are the only herbicide options remaining. If plants are larger than 3-inches you will have to use 12.5 fl oz/A of Cobra. The use of a methylated seed oil (MSO) as the adjuvant with these mixes may also improve control. In LibertyLink soybean, Liberty should be applied at rates ranging from 32 to 43 fl oz/A, depending on weed height.

Step 7: Additional measures to stop seed production.

Additional cultural control measures, such as hand-weeding, should be implemented to prevent any remaining resistant Palmer amaranth and waterhemp plants from going to seed in the field, around field edges, or along ditch banks.

Financial support for this research was provided by the Michigan Soybean Promotion Committee.

Multiple herbicide-resistant Palmer amaranth & waterhemp

Multiple herbicide -resistant Palmer amaranth in a MI seed corn field

Keys to successful management in corn

Corn provides the best opportunity for management of Palmer amaranth and waterhemp. However, this can also be difficult since there are Palmer amaranth populations in Michigan that are not only resistant to glyphosate and ALS-inhibiting herbicides, but also to atrazine. In order for management strategies to be effective, careful planning is needed. In addition, due to Palmer amaranth and waterhemp's propensity to evolve herbicide resistance, it is important not to rely solely on one herbicide site of action for management. In fields with three-way resistance only relying on one herbicide site of action such as the HPPD-inhibiting (Group 27) herbicides like Callisto, Impact, or Laudis will quickly lead to additional resistances. The following steps should be followed to manage multiple-resistant Palmer amaranth and waterhemp in corn.

Step 1: Consider planting a Roundup Ready/LibertyLink stacked corn hybrid.

While there are several postemergence herbicides available in corn that have some activity on Palmer amaranth and waterhemp, planting a Roundup Ready/LibertyLink stack provides one more additional site of action, Liberty, that can be used to help control resistant Palmer amaranth and waterhemp.

"CORN PROVIDES THE BEST OPPORTUNITY FOR MANAGEMENT OF MULTIPLE-RESISTANT PALMER AMARANTH AND WATERHEMP."

Step 2: Plant into a clean seedbed.

Control all emerged Palmer amaranth and waterhemp plants prior to planting corn.

Step 3: Two-pass (sequential) herbicide programs are needed.

- ***PRE:*** Full-labeled rates of a minimum of **two effective herbicide sites of action** (Table 1) are required for initial control (i.e., Zidua + AAtrex).
- ***POST:*** Must be applied before plants are 3-inches tall and requires the use of at least **two effective POST herbicide sites of action** (Table 1). A Group 15 herbicide may also be tank-mixed for additional residual control.

Step 4: Hand-weed to eliminate any remaining resistant plants

Table 1. Effective herbicides for management of glyphosate/ALS-resistant Palmer amaranth and waterhemp. No single herbicide active ingredient is 100% effective and a minimum of two effective herbicides are needed PRE and POST.

Trade names*	Active ingredient	Group #	Application timing
AAtrex, others**	atrazine	5	PRE/POST
2,4-D amine, several	2,4-D amine	4	POST
Clarity, (Status)	dicamba (+ difluenzopyr)	4 (+19)	POST
Liberty **(LibertyLink corn)**	glufosinate	10	POST
Dual II Magnum, Cinch	*s*-metolachlor	15	PRE
Harness	acetochlor	15	PRE
Zidua	pyroxasulfone	15	PRE
Balance Flexx	isoxaflutole	27	PRE
Callisto	mesotrione	27	PRE/POST
Impact, Armezon	topramezone	27	POST
Laudis	tembotrione	27	POST

* Consult the 2017 Weed Control Guide for Field Crops (E-434) for premixtures of these herbicide active ingredients and product restrictions. DO NOT apply more than a maximum of 2 lb ai/A per application or 2.5 lb ai/A total of atrazine for all applications per season.

** If Palmer amaranth is resistant to atrazine, herbicides with other **effective** sites of action are required.

Financial support for corn research was provided by the Michigan Corn Marketing Program.

Multiple herbicide-resistant Palmer amaranth & waterhemp

Table 2. Example sequential corn herbicide programs and their effectiveness for management of glyphosate/ALS-resistant Palmer amaranth and waterhemp. In populations where atrazine resistance is present, the inclusion of atrazine POST with a Group 27 herbicide has improved Palmer amaranth control.

	Premergence	Postemergence	Group #	Effectiveness
1	atrazine + Group 15 (i.e., Harness Xtra, Bicep II Magnum)	Callisto Xtra	5+15 fb. 27+5	Good - Excellent
2	atrazine + Group 15 (i.e., Harness Xtra, Bicep II Magnum)	Armezon/Impact + atrazine	5+15 fb. 27+5	Good - Excellent
3	atrazine + Group 15 (i.e., Harness Xtra, Bicep II Magnum)	Laudis + Liberty ***(LibertyLink corn)***	5+15 fb. 27+10	Good - Excellent
4	Verdict	Laudis + Status	14+15 fb. 27+4	Good - Excellent
5	Lexar EZ/Lumax EZ/Acuron	Laudis + atrazine	5+15+27 fb. 27+5	Good - Excellent
6	Lexar EZ/Lumax EZ/Acuron	Liberty + Warrant ***(LibertyLink corn)***	5+15+27 fb. 10+15	Good - Excellent
7	atrazine + Group 15 (i.e., Harness Xtra, Bicep II Magnum)	Liberty ***(LibertyLink corn)***	5+15 fb. 10	Fair
8	atrazine + Group 15 (i.e., Harness Xtra, Bicep II Magnum)	Roundup PowerMax ***(RR corn)***	5+15 fb. 9	Poor

Keys to successful Palmer amaranth management in alfalfa

If not properly managed in alfalfa, Palmer amaranth can produce viable seed that can perpetuate the spread of this devastating weed. Seed heads of Palmer amaranth generally appear after the last cutting of alfalfa. In 2013, we were able to reduce the number of mature seed producing Palmer amaranth plants with the following.

Between-cutting applications:

- Apply Gramoxone 2.0 SL (paraquat) at 1 pt/A + surfactant at 0.25% v/v
- Application should be made within 5 days after cutting
- Best results occurred after the 3rd or 4th alfalfa harvest
- DO NOT cut or harvest within 30 days of application

Multiple herbicide-resistant Palmer amaranth in alfalfa

Herbicide-resistant horseweed (marestail) in Michigan

Keys to management in no-till soybean

Christy Sprague, Extension Weed Science

www.MSUweeds.com
November 2017

MICHIGAN STATE UNIVERSITY WEED SCIENCE
MSUWS08-2017

Horseweed (*Conyza canadensis*), also known as marestail, is an annual weed that can follow a winter or summer annual life cycle. While horseweed can emerge in the fall, we have recently been observing more and more horseweed emergence from early spring through the summer (March through August) in Michigan. Unlike other winter annuals, horseweed does not mature until late summer, allowing for greater competition with crops compared with other winter annual weeds. Horseweed plants start out as a rosette, generally bolt in April/May, flower in July, and set and disperse seed from August to October. These plants not only reduce soybean yield, but large mature plants can interfere with soybean harvest. Each plant can produce up to 200,000 seeds that travel long distances in the wind. Up to 86% of seeds produced can germinate right off the plant. Of fall emerging seedlings 59 to 91% can survive the winter, causing problems in the next spring's crop.

Michigan no-till soybean field infested with horseweed

Herbicide resistance in horseweed:

Horseweed populations in Michigan range from being resistant only to glyphosate (Group 9) or ALS-inhibiting (Group 2) herbicides to being **resistant to multiple herbicides** including **glyphosate** and **ALS-inhibitors**. These resistance profiles make it difficult to manage horseweed, since glyphosate will not control horseweed in the burndown application or postemergence in Roundup Ready soybean. If ALS-resistance is present the use of PRE or POST applications of Classic (*chlorimuron*), FirstRate (*cloransulam*), or other ALS-inhibitors will not effectively control horseweed. Horseweed management strategies will need to rely heavily on effective burndown treatments that include 6 to 8 weeks of residual control from PRE herbicides and the use of soybean with other herbicide-resistant traits (i.e., LibertyLink soybean) for POST herbicide options.

Fall emerging horseweed | Spring/summer (June) emerging horseweed | Horseweed bolting in spring | Seedhead prior to seed dispersal

Herbicide-resistant horseweed (marestail) in Michigan

Consider planting LibertyLink soybean.

LibertyLink soybeans are one of the most effective strategies for managing high populations of horseweed. *Glufosinate* (Liberty) applications in LibertyLink soybean are one of the only effective postemergence options for control of multiple-resistant horseweed, without several restrictions. However, the following recommendations need to be followed.

- Effective burndown and residual herbicides outlined below will be needed for horseweed control prior to planting LibertyLink soybean.
- Apply Liberty (32-43 oz) POST prior to horseweed exceeding 6-inches in height. Use the higher rate to control taller plants or plants that have escaped initial control. Follow with a second POST applications of Liberty as needed.

Steps for successful horseweed management in soybean

Step 1: Control emerged horseweed prior to planting!!

Tillage or effective burndown herbicide applications are the only two methods available to control emerged horseweed prior to planting soybean. For tillage to be effective it needs to be close to the time of planting thoroughly mixing the top few inches of soil to uproot any existing horseweed plants. Vertical tillage tools are not effective. However, due to horseweed being mostly a problem in no-till or reduced till fields most growers will need to use effective burndown treatments for horseweed control. In some cases, in fields with historical horseweed problems two applications may be needed (fall followed by spring applications).

Effective burndown treatments (Fall):

- Best applied when horseweed is in the rosette stage, prior to 4-inches tall.
- Fall treatments should be used to control emerged horseweed, but a spring burndown treatment will still be needed. These treatments reduce variability from spring only treatments.
  - Use 2,4-D, dicamba, or Sharpen as the base herbicides in fall treatments to control emerged horseweed. Tank-mixtures with other herbicides (i.e., glyphosate) will be needed to control other winter annual and perennial weeds.

Effective burndown treatments (Spring prior to soybean planting):

- Horseweed needs to be managed prior to planting.
- Preplant herbicide treatments should be applied when horseweed plants are less than 4-inches tall.
- Options for control include:
  - 2,4-D ester (1 pt) + glyphosate (7 days or more prior to planting)
  - 2,4-D ester + Gramoxone + *metribuzin* (7 days or more prior to planting)
  - 2,4-D ester (1 pt) + Sharpen (1 oz) + glyphosate + MSO (7 days or more prior to planting)
  - Liberty (32 to 43 oz) + *metribuzin*
  - Sharpen (1 oz) or Sharpen products (OpTill, OpTill PRO, Zidua PRO, or Verdict) + MSO + glyphosate or Liberty
  - Gramoxone + *metribuzin* (8 oz) + COC
  - XtendiMax, FeXapan (22 or 44 oz), or Engenia (12.8 oz) in **Roundup Ready 2 Xtend (dicamba-resistant) soybean only**. Several precautions and restrictions need to be followed, consult Table 2G in the MSU Weed Control Guide (E0434) and label.

Step 2: Include effective residual (PRE) herbicides with burndown treatment.

The use of effective residual herbicides with the burndown treatment is essential for horseweed control until the soybean canopy develops.

- Group 5 herbicides: *metribuzin* (at least 8 oz) and *metribuzin* premixes (i.e., Boundary, Canopy) can be applied with any of the burndown treatments. DO NOT exceed the recommended rate for the soil type.
- Group 14 herbicides can be applied with any of the burndown treatments, except Sharpen (*saflufenacil)* products unless applied 14 days prior to planting soybean. Group 14 herbicides include:
  - Valor/Rowel (*flumioxazin*) or *flumioxazin* products: Envive, Fierce, Rowel FX, Surveil, Trivence or Valor XLT
  - Spartan (*sulfentrazone*) or *sulfentrazone* products: Authority Assist/First/MAXX/MTZ/XL or Sonic
  - Sharpen (1.5 oz) can be applied, but only if applied 14 d prior to planting and soil O.M. >2%, see label.
- Best residual control of multiple-resistant horseweed will be from tank-mixtures or premixtures that contain two non-ALS (Group 2) herbicides (i.e., *metribuzin + flumioxazin or sulfentrazone*, Authority MTZ, Trivence, etc.)

Financial support for this research was provided by the Michigan Soybean Promotion Committee.

Common windgrass in Michigan

Keys to identification and management in winter wheat

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www.MSUweeds.com
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MICHIGAN STATE UNIVERSITY WEED SCIENCE

MSUWS04-2013

Common windgrass (*Apera spica-venti* L.) is a winter annual grass species that has become more of a weed problem in winter wheat production. In the past the distribution of common windgrass in Michigan has been limited. However, over the last several years this weed has been reported in several counties. Management of this weed can be difficult because the emergence pattern and growth closely coincide with winter wheat, and the availability of selective herbicides is limited.

Windgrass in a Michigan wheat field

Identifying characteristics:

- Fall emergence; threadlike appearance after emergence
- Overwinters with 2- to 3-leaves
- Produces several tillers similar to wheat
- Leaves smooth to slightly rough; smooth leaf sheath
- Membranous ligule that becomes jagged and lengthens with age
- Plants can be up to 5 feet tall
- Flowers the same time as wheat
- Flowering structure: open-branched, reddish panicle with fine branches
- Branch ends have a single spikelet with a long, straight awn
- Seeds often mature prior to wheat harvest

Common distribution of windgrass in Michigan

Threadlike appearance

Tillering of windgrass in wheat

Jagged membranous ligule

Open-branched, reddish panicle

Common windgrass in Michigan

Keys to successful windgrass management in wheat

Proper identification and early detection of common windgrass will improve the opportunity for successful management. The following steps outline the strategies for the best management of common windgrass in winter wheat.

Step 1: Start clean!!

Common windgrass present at the time of winter wheat planting needs to be controlled either by tillage or an appropriate burndown herbicide application. Glyphosate, combinations with glyphosate, or Gramoxone will provide good control of windgrass and other winter annuals that have emerged prior to planting wheat.

Step 2: Plant a competitive crop.

Practices that enhance the competitive ability of winter wheat with common windgrass will improve the consistency of the herbicides programs listed below. These practices include planting wheat at higher seeding rates and optimizing fertility for the crop.

Step 3: Apply an effective postemergence herbicide.

Windgrass is most effectively controlled by postemergence herbicide applications. MSU research sponsored by the Michigan Wheat Program has shown that both fall and spring herbicide applications can effectively manage windgrass in winter wheat (Table 1). However, fall applications have shown the greatest opportunity to reduce windgrass competition.

Approach A: Fall applications

These applications need to be made to ***emerged*** windgrass and ***emerged*** winter wheat. Typically applications will occur in early- to mid-November, when winter wheat has at least 3 leaves. Additional spring herbicide applications are needed to control summer annual weeds.

Table 1. Effectiveness of POST herbicides for windgrass control.

			Windgrass control	
Herbicide	Group #	Rate/A	Fall applied	Spring applied
PowerFlex HL*	2	2 oz	**Excellent**	**Excellent**
Osprey*	2	4.75 oz	**Good - Excellent**	**Excellent**
Axial XL	1	16.4 fl oz	--	Fair-**Good**
Puma	1	10.6 fl oz	--	Fair

*Include a non-ionic surfactant and a nitrogen source (AMS or 28% UAN)

Approach B: Spring applications

These applications should be made when windgrass is 2 to 4-inches tall and wheat is at Feeke's stage 4 or 5 (prior to jointing). Windgrass control with spring applications generally takes 3 to 4 weeks for maximum control. This slower kill may allow for more windgrass competition with wheat. Tank-mixtures with other herbicides will be needed for control of additional broadleaf weeds.

Step 4: Additional strategies to consider.

In high windgrass infested areas, consider a change in crop rotation. Windgrass can be effectively managed in many of our spring planted crops. It is also important to avoid spreading the windgrass seed from field to field with tillage and harvest equipment. If possible, harvest these fields last or try to clean equipment between fields. Weed-free wheat seed should also be planted. Using multiple tactics will provide greater control success and prevent the increased spread of windgrass.

Financial support for this research was provided by the Michigan Wheat Program.

Controlling White Campion in No-Tillage Systems

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DESCRIPTION OF WHITE CAMPION

White campion (*Silene alba*) or more commonly referred to as white cockle is a biennial or short-lived perennial weed. White campion is commonly found along roadsides, and is a weed of small grains and legume forage crops. However, with the general increase in no-tillage production systems white campion has more recently become a problem in no-tillage soybean and corn production. White campion grows from roots that overwinter, but only reproduces by seed. Seedlings can emerge in mid- to late spring and again in late summer. Since white campion is usually a biennial it produces only leaves its first year, then overwinters and produces flowers and seed the following year.

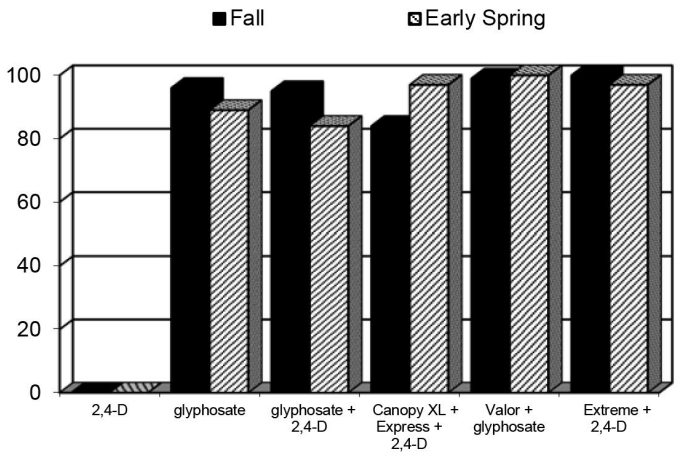
KEY IDENTIFYING CHARACTERISTICS

- Cotyledons are narrow to egg-shaped
- Young plants are hairy and form a rosette
- Leaves are soft, hairy and opposite
- Stems are hairy and swollen where the leaves are attached
- Flowers are generally white, but can also be light pink and appear from June to October

CONTROL OF WHITE CAMPION

Since white campion is primarily a problem in no-tillage productions fields, frequent tillage will stop the establishment of white campion. However, this strategy doesn't work in no-tillage production systems. To control white campion apply glyphosate at 1.13 lb a.e./A + ammonium sulfate (AMS) at 17 lb/100 gal in the late fall (late October – November) or early spring (Figure 1). These applications need to be made before white campion is much greater than 4 inches tall in the spring or control may be reduced. Late fall applications of Canopy XL (3.5 oz/A) + Express (1/6 oz/A) + 2,4-D ester (1 pt/A) + crop oil concentrate (1.0% v/v) also provided good to excellent control of white campion. 2,4-D ester alone will *NOT* control white campion.

Figure 1. White campion control in early June with fall and early spring applications of various herbicide programs.

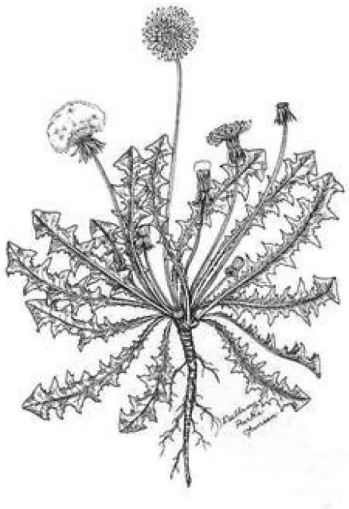


ACKNOWLEDGMENTS

Research supported by the Michigan Soybean Promotion Committee.

Controlling Dandelion

DANDELION is a simple perennial weed that is most often associated with undisturbed sites such as lawns and continuous no-till production fields. This species is most commonly recognized for its bright yellow flowers and mature seed heads that disperse seeds via the wind. Aboveground, the plant consists of leaves arranged in a rosette. Leaves vary in shape; their margins may either be smooth or toothed. Belowground, dandelion plants have a large taproot that allows the plant to over winter and to continue growing the following spring.



METHODS OF CONTROL

Mechanical Control

Dandelion is primarily a problem only in no-till production fields. Regular disturbance of the soil root zone by tillage will inhibit the establishment of dandelion plants. No-till fields that are infested with a dense population of dandelion may benefit from periodic cultivation.

Chemical Control

Herbicide applications of either glyphosate or 2,4-D ester are more effective in the fall than in the spring. Glyphosate applied at 1.13 a.e. lb/A plus ammonium sulfate (AMS) at 17 lb/100 gal effectively controlled dandelion when applied in the fall following crop removal. Spring applications were less effective. 2,4-D ester applied at 1 qt/A was less effective than glyphosate. Because of plant regrowth and new seedling germination, sequential applications of glyphosate applied postemergence in Roundup Ready corn or soybean will be needed to further reduce populations of dandelion. The use of a residual herbicide is often needed to control seedling dandelions that may emerge after glyphosate or 2,4-D ester applications.

PREPLANT STRATEGIES (CORN &SOYBEAN)

Herbicide Treatment	Timing	Effectiveness
glyphosate (1.13 lb ae) + AMS	LFALL	**Good**
glyphosate (1.13 lb ae) + AMS	EFALL	Fair-**Good**
Autumn Super (0.5 oz) + 2,4-D ester (1 pt) + COC + AMS	FALL	**Good**
glyphosate (0.75 lb ae) + AMS	ESPRING	Fair
2,4-D ester[a] (1 qt)	EFALL	Fair
2,4-D ester[a] (1 qt)	LFALL	Fair
2,4-D ester[a] (1 qt)	ESPRING	Poor
glyphosate (1.13 lb ae) + AMS	LSPRING	Poor
2,4-D ester[a] (1.0 qt)	LSPRING	Poor

BEFORE CORN

Herbicide Treatment	Timing	Effectiveness
Basis Blend (1.25 oz) + 2,4-D (1 pt) + atrazine + COC	SPRING	**Good**
Resolve Q (1.25 oz) + 2,4-D (1 pt) + atrazine + COC	SPRING	**Good**

BEFORE SOYBEAN

Herbicide Treatment	Timing	Effectiveness
Canopy[b] (2.25-4.0 oz) + Express (0.25 oz) + 2,4-D[a] (1 pt) + COC	FALL	**Good**
Canopy EX[b] (1.1-3.3 oz) 2,4-D[a] (1 pt) + COC	FALL	**Good**

POSTEMERGENCE[c]

Herbicide Treatment	Effectiveness
Corn only	
Callisto (3 fl oz) + COC + AMS	**Good**
Callisto (3 fl oz) + atrazine (1 pt) + COC + AMS	**Good**
Status (7.5 oz) + NIS + AMS	**Good**
Liberty[d] (32 fl oz) + atrazine (1 pt) + AMS	**Good**
Corn and soybean	
glyphosate[e] (1.13 lb ae) + AMS	**Good**
Liberty[d] (32 fl oz) + AMS	Fair

[a] 2,4-D ester at (1 qt/A) wait a minimum of 30 d before planting soybean; 2,4-D ester at (1 pt/A) wait a minimum of 7 d before planting soybean

[b] DO NOT apply *Canopy* at rates higher than 2.25 oz or *Canopy EX* at rates higher than 1.1 oz to soils with a composite pH exceeding 7.0. DO NOT apply *Canopy* or *Canopy EX* to soils with a composite pH exceeding 7.6.

[c] These treatments are most effective if plants have been treated previously in the fall or spring with effective dandelion treatments.

[d] Treatments containing Liberty can be applied only to LibertyLink corn or soybean.

[e] Treatments containing glyphosate can be applied only to Roundup Ready crops.

MSPC
Corn Marketing Program of Michigan
Project GREEEN

Controlling Wild Carrot

WILD CARROT, otherwise known as Queen Anne's lace, is a deep-rooted biennial. Wild carrot usually becomes a problem in continuous no-till production systems. Similar in appearance to cultivated carrots, leaves of wild carrot are finely divided and arranged in a rosette. Keeping with its name, when any part of the plant is crushed the characteristic odor of carrot is present. Seedlings of wild carrot may emerge as early as April and continue to emerge until mid-October if conditions are favorable. Since wild carrot is a biennial it overwinters as a rosette, starts to produce new leaves as early as March, and will bolt as early as June the following season. In order to survive the winter, wild carrot's root diameter must be at least 1/8 inch. After bolting, flowering may begin as early as late-June and continue through August. Flowering wild carrot plants may grow to 4 ft tall. The umbel or seedhead of wild carrot is made up of numerous individual white flowers. Cross-pollination by insects is the primary method of fertilizing wild carrot flowers, but some self-pollination can occur. One wild carrot umbel can produce as many as 1000 seeds. Seeds are light in weight and are primarily dispersed by wind. However, wild carrot seeds have hooked spines that easily attach to animal fur and clothing that lead to other methods of dispersal. Most seeds germinate within the first two years after dispersal, but they may persist in the soil for up to seven years.

CULTURAL CONTROL

- Including fall-planted cereals, like wheat, in the rotation will reduce wild carrot seed production because wheat harvest occurs when wild carrot plants are flowering but before seed is produced.

MECHANICAL CONTROL

- Tillage effectively and consistently controls wild carrot.
- Mowing wheat stubble, roadsides, and fence rows in late August will cut off wild carrot flowers and stop seed production.

CHEMICAL CONTROL*

Wild carrot may be controlled by herbicides at three stages of growth: seedling, over-wintered, and established plants. Over-wintered and established plants are generally more difficult to control. This coupled with the frequency of 2,4-D resistant wild carrot populations in Michigan limits the options for wild carrot control. Below are herbicides options for controlling wild carrot.

BURNDOWN *(Early Preplant)*[a]

Herbicide[b,c]	Rate	Effectiveness
glyphosate + AMS	1.13 lb a.e.	Fair-**Good**
SOYBEAN ONLY		
Canopy + 2,4-D + COC	3 oz + 1 pt	Fair

SOYBEANS

Herbicide[b,c]	Rate	Effectiveness
Classic + COC	0.67 oz	Fair-**Good**
Pursuit + NIS + N	4 oz	Poor-Fair
STS SOYBEAN ONLY		
Synchrony XP + COC + N	0.75 oz	Fair-**Good**

CORN

Herbicide[b,c]	Rate	Effectiveness
Atrazine + COC	2 lb a.i.	**Good-Excel.**
Beacon + COC + N	0.76 oz	**Good**
Northstar + NIS + N	5 oz	**Good**
Accent + COC +N	0.67 oz	Fair-**Good**
Permit + NIS	0.67 oz	Fair-**Good**

ROUNDUP READY CROPS

Herbicide[b,c]	Rate	Effectiveness
glyphosate + AMS	1.13 lb a.e.	Fair

TREATMENT BETWEEN CROPS *(FALL)*[d]

Herbicide[c]	Rate	Effectiveness
glyphosate + AMS	1.5 lb a.e.	**Good-Excel.**
glyphosate + AMS	1.13 lb a.e.	**Good**

* Research supported by the Michigan Soybean Promotion Committee.

[a] Control will be greater when application is made during the first warm period in the spring following green-up.

[b] Refer to herbicide label for maximum application heights and stages.

[c] NIS = non-ionic surfactant; COC = crop oil concentrate; N = 28% UAN or AMS (ammonium sulfate).

[d] Apply in late-September or early-October. Light frosts that do not injure wild carrot will not reduce the effectiveness of the herbicide treatments.

Project GREEEN

Controlling Canada Thistle

CANADA THISTLE is a perennial weed. Infestations can start from seed but plants primarily regrow and spread each year from Canada thistle's creeping root system. The roots have adventitious buds that form new shoots each spring and summer. This extensive root system can run 15 ft or more horizontally and may penetrate up to 20 ft deep. Canada thistle plants can grow 2 to 5 ft tall and branch only at the top. Leaves are slender, smooth, and have crinkled edges with spiny margins. Canada thistle has male and female flowers on separate plants (dioecious) and seed production requires the presence of both plants. Flowers are about ¾ inch in diameter, are rose to purple in color, and are produced between July and August. Individual flower heads have about 100 florets and vigorous stems can produce 50 to 100 flower heads, with each producing 80 to 90 seeds. Viable seeds are formed 8 to 10 days after flowering and single plants can release more than 5,000 seeds. Long distance dispersal by wind is unlikely since the seeds often remain in the flower head while the pappus detaches and floats away. However, seed that remains attached to the pappus may move several feet from the parent plant. Seeds may remain viable in the soil for up to 4 years.

CULTURAL CONTROL

Including a forage or small grain in the rotation can help manage Canada thistle.

- Repeated mowing suppresses Canada thistle in forages.
- Small grains are competitive with Canada thistle, and provide an opportunity for mechanical and chemical control after harvest.

MECHANICAL CONTROL

- Tillage of established patches may spread and chop up rootstock; breaking apical dominance that leads to emergence of more shoots.

CHEMICAL CONTROL

Canada thistle is most susceptible to certain herbicides between the bud and flower stages. However, most herbicides have maximum crop height or stage restrictions for application; refer to the herbicide label for these restrictions.

SOYBEANS

Herbicide[a,b]	Rate	Effectiveness
Basagran + COC	1 qt	**Good**
Classic + NIS[c]	0.5-0.75 oz	Fair-**Good**
Pursuit + NIS + N[c]	4 oz	Fair-**Good**
FirstRate + NIS or COC + N[c]	0.3 oz	Fair
Ultra Blazer + NIS + N	1.5 pt	Poor
Cobra + COC	12 oz	Poor

CORN[d]

Herbicide[a,b]	Rate	Effectiveness
Stinger	0.5 pt	**Good**
Hornet + Stinger + NIS + N	4 oz + 4 oz	**Good**
Basagran + COC	1 qt	Fair-**Good**
Clarity	0.5 pt	Fair-**Good**
Beacon + 2,4-D + NIS	0.38 oz + 1 pt	Fair-**Good**
Beacon + Clarity + NIS + N	0.38 oz + 0.5 pt	Fair-**Good**
Northstar + NIS + N	5 oz	Fair-**Good**
Status + NIS + N	5 oz	Fair-**Good**
Clarity + 2,4-D amine	0.25 pt + 0.5 pt	Fair
Beacon + COC or NIS + N	0.76 oz	Fair
2,4-D amine	1 pt	Poor

ROUNDUP READY CROPS

Herbicide[a,b]	Rate	Effectiveness
glyphosate + AMS	1.13 lb a.e.	**Good-Excel.**
fb.		
glyphosate + AMS *(if needed)*	1.13 lb a.e.	
SOYBEANS ONLY		
Extreme + NIS + AMS	3 pt	**Good**

TREATMENT BETWEEN CROPS (WHEAT STUBBLE)[e]

Herbicide[b]	Rate	Effectiveness
glyphosate + AMS	1.5-2.25 lb a.e.	**Good-Excel.**
Clarity	1-2 qt	**Good-Excel.**
2,4-D ester	1-2 qt	Fair-**Good**

[a] Refer to herbicide label for maximum application heights and stages.
[b] NIS = non-ionic surfactant; COC = crop oil concentrate; N = 28% UAN or AMS (ammonium sulfate).
[c] Apply when Canada thistle is between 2 and 4 inches tall.
[d] Applications should be made when Canada thistle is 8 inches tall.
[e] Apply when Canada thistle is in the bud stage for Clarity and 2,4-D; bud to bloom stage for glyphosate; **Fall applications** are most effective.

Project GREEEN

Controlling Common Pokeweed

COMMON POKEWEED is a deep-rooted perennial that reproduces from buds on the root or from seeds. Aboveground shoots of this plant arise from the taproot and consist of diffusely branched, fleshy stems (resembling a small tree) that can reach heights of 6 to 8 ft under fertile conditions. In older plants the taproot can be up to 6 inches in diameter and can grow to depths of more than 12 inches. The fruit produced in late summer are clusters of green berries that turn purple to black at maturity and contain a profuse amount of red juice. The green leaves, fleshy stem, and purple berries of common pokeweed can inhibit the harvesting process and lead to discounts at the elevator for high moisture and stained seed. In addition, areas with heavy infestations of common pokeweed have been known to compete and reduce yield in both corn and soybeans. Numerous bird species are known to feed on the berries and are capable of randomly dispersing pokeweed seeds over sizeable areas. Seedlings can emerge from mid-spring through early summer. Within 5 to 9 weeks after emergence, seedlings of common pokeweed develop the taproot that is capable of regrowth (becomes perennial). New plants from seed dispersed over undisturbed sites, such as no-till crop fields, are capable of becoming more entrenched as their taproots develop.

CULTURAL CONTROL

- Common pokeweed establishment often begins in fence rows or under power lines (dispersal by birds), monitor and control pokeweed in these areas to prevent spread.

MECHANICAL CONTROL

- Common pokeweed does not become a problem in fields with intensive tillage.
- Tillage will control true seedlings within 5-6 weeks after emergence.
- After pokeweed establishment reduced tillage will only suppress common pokeweed.

CHEMICAL CONTROL

Several herbicides with residual activity are effective at controlling seedling common pokeweed. However, common pokeweed is more difficult to control once it has developed its taproot and becomes perennial. Because of the variable size of common pokeweed populations in a field, application timing is critical. For in-crop applications time herbicide applications when common pokeweed is at least 8 inches tall and preferably less than 12 inches tall. Below are effectiveness ratings for several herbicides for common pokeweed control. Refer to the herbicide labels for maximum crop height and stage application restrictions for individual herbicides.

SOYBEANS

Herbicide[a,b]	Rate	Effectiveness
Raptor + NIS + N	5 oz	Fair
Classic[c] + NIS	0.67 oz	Poor-Fair
FirstRate + NIS or COC + N	0.3 oz	Poor
STS SOYBEAN ONLY		
Synchrony XP + COC + N	0.75 oz	Fair

CORN

Herbicide[a,b]	Rate	Effectiveness
Callisto + COC + N	3 oz	**Good**
Status + NIS + N	5 oz	Fair-**Good**
Clarity	0.5 pt	Fair-**Good**
Northstar + NIS + N	5 oz	Fair-**Good**
Beacon + COC or NIS + N	0.76 oz	Fair
2,4-D amine	1 pt	Poor

ROUNDUP READY CROPS

Herbicide[a,b]	Rate	Effectiveness
glyphosate + AMS	1.13 lb a.e.	**Good**
fb.		
glyphosate + AMS *(if needed)*	1.13 lb a.e.	

NONCROP/FALLOW (FALL)[c]

Herbicide[b]	Rate	Effectiveness
glyphosate + AMS	1.5 lb a.e.	**Good-Excel.**

[a] Refer to herbicide label for maximum application heights and stages.
[b] NIS = non-ionic surfactant; COC = crop oil concentrate; N = 28% UAN or AMS (ammonium sulfate).
[c] Apply in late-September or early-October when common pokeweed is 8 to 24 inches tall, but before a frost.

Project GREEEN

Controlling Hemp Dogbane

HEMP DOGBANE is a perennial weed that reproduces by seed, by crown buds, or by over-wintering rootstocks. Similar in appearance to common milkweed, hemp dogbane plants grow to be 3 to 5 ft tall, and all plant parts when broken exude a white milky sap. However, hemp dogbane leaves are smaller, lighter-green in color, and generally are more pointed than common milkweed. Additionally, the stem branches near the top of the plant, giving hemp dogbane a 'bushy' appearance. Flowers of hemp dogbane each produce two seed pods that are slender, sickle-shaped, and produce 80 to 200 seeds per pod.

Seeds of hemp dogbane are dispersed by wind and are not persistent (less than 6 months survival in the soil). Seeds have very little dormancy and more than 75% of the seeds germinate the year they are produced. True seedlings are susceptible to soil disturbance from cultivation before becoming perennial, which happens within 5 to 6 weeks after emergence. Plants do not flower the year they start from seed.

Rootstock of hemp dogbane is persistent and can grow to a depth of 6 ft in the soil and spread up to 10 ft in length in one season. Because of this reproductive characteristic, hemp dogbane is often found in patches. In two seasons one hemp dogbane plant can invade an area nearly 40 ft in diameter if not adequately controlled.

CULTURAL CONTROL

Including a forage or small grain in the rotation can help manage hemp dogbane.

- Repeated mowing suppresses hemp dogbane in forages.
- Small grains are competitive with hemp dogbane, and provide an opportunity for mechanical and chemical control after harvest.

MECHANICAL CONTROL

- Tillage will control true seedlings within 6 weeks after emergence.
- Tillage of established patches may spread and chop up rootstock; breaking apical dominance that leads to emergence of more shoots.
- Herbicide treatments are generally more effective if the soil is undisturbed.

CHEMICAL CONTROL

Herbicides are more effective for control of hemp dogbane on larger plants. Hemp dogbane is most susceptible to herbicides between the late bud and flower stages. However, most herbicides have maximum crop height or stage restrictions for application; refer to the herbicide label for these restrictions.

SOYBEANS

- There are no effective herbicides for control of hemp dogbane in conventional soybeans.

CORN*

Herbicide[a,b]	Rate	Effectiveness
Starane	2/3 pt	**Good-Excel.**
Beacon + 2,4-D + NIS	0.38 oz + 1 pt	**Good**
Accent + Clarity + NIS	0.67 oz + 0.5 pt	Fair-**Good**
Beacon + Clarity + NIS + N	0.38 oz + 0.5 pt	Fair-**Good**
Northstar + NIS + N	5 oz	Fair-**Good**
Status + NIS + N	5 oz	Fair-**Good**
Clarity + 2,4-D amine	0.25 pt + 0.5 pt	Poor-Fair
2,4-D amine	1 pt	Poor-Fair
Clarity	0.5 pt	Poor

ROUNDUP READY CROPS

Herbicide[a,b]	Rate	Effectiveness
glyphosate + AMS fb.	1.13 lb a.e.	**Good-Excel.**
glyphosate + AMS *(if needed)*	1.13 lb a.e.	

TREATMENT BETWEEN CROPS (WHEAT STUBBLE)[c]

Herbicide[b]	Rate	Effectiveness
glyphosate + AMS	3 lb a.e.	**Excellent**
Clarity	1 qt	**Good**
Clarity + 2,4-D	0.5 pt + 1 pt	Fair-**Good**

* Research supported by the Corn Marketing Program of Michigan.
[a] Refer to herbicide label for maximum application heights and stages.
[b] NIS = non-ionic surfactant; N = 28% UAN or AMS (ammonium sulfate).
[c] Apply when hemp dogbane is late bud to flower stage.

Project GREEEN

PESTICIDE EMERGENCY INFORMATION

For any type of an emergency involving a pesticide, immediately contact the following emergency information centers for assistance.

Current as of October 2017

Human Pesticide Poisoning

POISON CONTROL

From anywhere in the United States, call

1-800-222-1222

Special Pesticide Emergencies

Animal Poisoning

Your veterinarian:

Phone No.

or

Animal Poison Control Center ($65 consultation fee per case, fee is subject to change)

****1-888-426-4435***

or

Pet Poison Helpline ($49.00 credit card fee)

1-800-213-6680

Pesticide Fire

Local fire department:

Phone No.

and

****911***

Traffic Accident

Local police department or sheriff's department:

Phone No.

and

****911***

Pesticide Spill

Spills, releases or environmental emergencies:

DEQ Pollution Emergency Alerting System (PEAS):

****1-800-292-4706***

Agricultural pesticide, fertilizer or manure spills:

MDARD Agriculture Pollution/Spills Hot Line:

****1-800-405-0101***

Pesticide Disposal and Pesticide Container Recycling

Environmental Stewardship Division
Michigan Department of Agriculture and Rural Development

Pesticide Disposal:

www.michigan.gov/cleansweep

Michigan Clean Sweep Program
Abigail S. Eaton
Phone: 517-284-5612
Email: eatona@michigan.gov
Monday– Friday: 8 a.m.–5 p.m.

Pesticide Container Recycling:

www.michigan.gov/pesticidecontainerrecycling

National Pesticide Information Center

Provides advice on recognizing and managing pesticide poisoning, toxicology, general pesticide information and emergency response assistance. Funded by EPA, based at Oregon State University.

Monday-Friday; excluding holidays

8:00 a.m. – 12:00 p.m. Pacific Time, Monday–Friday.

1-800-858-7378 ***FAX: 1-541-737-0761***

npic.orst.edu

* ***Telephone Number Operated 24 Hours***

Revised by Sue Risley, MSU Pesticide Safety Education Program

NOTES:

This publication contains pesticide recommendations based on research and pesticide regulations. However, changes in pesticide regulations occur constantly. Some pesticides mentioned may no longer be available, and some uses may no longer be legal. If you have questions about the legality and/or registration status for using pesticides, contact your county MSU Extension office.

To protect yourself and others and the environment, always read the label before applying any pesticide.

MICHIGAN STATE UNIVERSITY | Extension

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