

2017 Dry Bean Research Report

**Dry Bean Yield Constraints Associated with
High Performance Production Systems**



**Michigan Dry Edible Bean Production
Research Advisory Board**

The Michigan Bean Commission was awarded a grant from the MDARD Specialty Crop Block Grant Program-Farm Bill. The title of this project is “Dry Bean Yield Constraints Associated with High Performance Production Systems”. Main areas of study were White Mold and Root Rot Disease Control, Dry Bean Variety and Dry Bean Desiccants and Harvest Aids. Expected outcomes from this project are:

1. Assessment of impact of suitable strategies for dry beans that undergo acute losses from White Mold and Root Rots.
2. Development of tolerant cultivars and breeding lines for white mold and root rot disease conditions within diverse production regions in Michigan.
3. Assessments of dry bean disease control strategies aligned with IPM standards including varietal tolerance, biological and chemical pesticides.
4. Maximizing of yield through optimization of harvest aid applications.
5. Implementation of grower educational activities to communicate intervention strategies and economic options used for production of dry beans.

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Photos

Front Cover: Harvesting Dry Beans in Midland County.
 Top Back Cover: Close-up of Severe White Mold Infection.
 Bottom Back Cover: Navy Beans Planted in a Cover Crop.

2017 White Mold Fungicide Trial Giles Farms, Wheeler, Michigan

A field trial was conducted to determine the efficacy of various fungicide applications for controlling white mold in Midland County. The white mold trial had seven treatments and one untreated control with four replications of each treatment.

Treatment	Rate	Application Code	Visual Rating	Incidence % infection	YIELD
Untreated Check			5	84	1933
Edura	8 oz	AB	3	42	2765
Omega	8 oz	AB	2	26	2945
Propulse	10.3 oz	AB	2	40	2808
Approach	12 oz	AB	5	52	2502
Topsin M	24 oz	AB	3	52	2406
Proline	6 oz	AB	2	45	2308
Quadris	7 oz	AB	2	53	2547
Priaxor	6 oz	AB	4	70	2433
		LSD .05 =	1.82	14	543
		C. V. =	48.8%	22.6%	14.6%

Application Code:A=100% or first bloom, B=10 days after 100% bloom.

Visual Rating on August 27, 1 being 0-10% and 9 being 90-100%.

Rating Date: % infection "rating" on September 18. Percent of 100 plants.

Zenith Black Beans planted in 20" rows. Population of 130,680.

Planted: June 10. Harvested: October 4.

First Spray: July 29. Second Spray: August 8.

Sprayed with 4 row bicycle-wheel CO2 sprayer using 30 gpa at 65 psi.

Twin-Jet nozzle placed directly over the row. Plot size sprayed was 4 rows by 30 feet.

Harvest area was middle 2 rows by 15 feet.

7 irrigations of one half inch applied between July 20 and August 31 as rainfall dictated.

White mold apothecia were observed on August 11.

Field History: 2016-Navy Beans, Cover crop of Annual Ryegrass. Sprayed Roundup to burn down on May 2. Disc Tillage on May 13. Sprayed 1.3 pints Dual and 1.6 pints Prowl H2O on May 20.

Sprayed 16 oz. Basagran, 4 oz. Raptor, 12 oz. Reflex, 12 oz. Select Max herbicides and 9 oz.

Asana insecticide on July 5.

Fertilization consisted of 75 pounds of actual nitrogen from Urea. Applied on June 13. After heavy rains in late June, an additional 40 pounds of actual nitrogen from Urea was applied on July 3.

**2017 Anthracnose Fungicide Trial
Giles Farms, Wheeler, Michigan**

Treatment	Rate	Application Code	Visual Rating	YIELD
Untreated Check			8.8	793
Priaxor	8 oz	AB	0.0	2253
Headline	9 oz	AB	0.0	1677
Approach	12 oz	AB	3.3	1707
		LSD .05 =	1.8	395
		C. V. =	29.30%	18.20%

**2017 Anthracnose Fungicide Trial
Sherwood Farms, St. Louis, Michigan**

Treatment	Rate	Application Code	Visual Rating	YIELD
Untreated Check			5	1108
Priaxor	8 oz	AB	0.0	1372
Headline	9 oz	AB	0.0	1338
Approach	12 oz	AB	1	1402
		LSD .05 =	0.62	447
		C. V. =	30.80%	23.80%

Field trials were conducted to determine the efficacy of various fungicide applications on controlling Anthracnose. Zorro Black Beans planted in 20" rows. Population of 130,680.

Planted: June 10. Harvested: October 1-Sherwood, October 4 Giles.

First Spray: August 2. Second Spray: August 11. Inoculated with Race 73 Spores on evening of first spray.

Sprayed with 4 row bicycle-wheel CO2 sprayer using 30 gpa at 65 psi.

Twin-Jet nozzle placed directly over the row. Plot size sprayed was 4 rows by 25 feet.

2017 Quadris In-Furrow Fungicide Strip Trial

Quadris controls Rhizoctonia Root Rot in Sugar Beets. Trials were conducted for control in dry beans.

Ackerman Farms, Quadris at 10 oz. applied In-Furrow on June 6, planting Medalist navy beans.

Bernia Family Farms, Quadris at 10 oz. applied In-Furrow on June 8, planting Zorro black beans.

Ackerman Farms

Treatment	Stand Count	Dry Root Mass	Dry Shoot Mass	YIELD
No Quadris 6-28-17	45.6	1.106	4.442	2386
Quadris 6-28-17	39.2	0.93	3.496	2284
No Quadris 8-1-17		8.894	128.342	
Quadris 8-1-17		10.578	155.526	

Bernia Farms

Treatment	Stand Count	Dry Root Mass	Dry Shoot Mass	YIELD
No Quadris 6-28-17	49.6	1.236	8.88	2911
Quadris 6-28-17	48.8	1.484	8.34	2734
No Quadris 8-1-17		6.628	101.954	
Quadris 8-1-17		7.728	133.686	

In Ackerman Farms trial, the Quadris treated beans were slower in growth than the untreated beans. This could be noticed from the road as you observed the field in the first 8 weeks.

In Bernia Family Farms trial, there were no observed plant growth differences between the treated and untreated beans. Rhizoctonia was not observed in either location.

Dry Bean Disease Induced Yield Constraints Associated with High Performance Production Systems

Martin Chilvers, Plant Soil and Microbial Sciences

Pathogen surveillance, identification and characterization

An additional year of root rot survey was conducted in 2017. Isolates collected this year and in previous years are being identified to species level and characterized for their pathogenicity to dry beans. In particular attention is being given to the *Fusarium solani* species complex and the *Fusarium oxysporum* species complex, which appear to be the primary *Fusarium* root rot pathogens. A large collection of *Rhizoctonia* has also been assembled, and collection of *Pythium* species. Please see the summary report on last page of our report.

Characterization of soil health and impact of crop rotation

Soil samples were collected from 4 fields of Mr. Brian Jaquays farm. Mr. Jaquays has noted the impact of crop rotation on root health of his dry beans. We are attempting to develop and conduct greenhouse tests to quantify the degree of root rot risk, and potential management solutions, such as cultivar selection or seed treatment.

In-furrow fungicide trials

In collaboration with Mr. Greg Varner, on farm trials were conducted to assess the efficacy and yield benefit of Quadris fungicide in-furrow. Root rot assessments were made on the trials, yield data is being collected and data will be compiled for winter meetings. The trial was also conducted in combination with a seed treatment trial at the Montcalm research farm.

Root rot resistance screening

Root rot resistance screening was conducted on 51 dry bean lines. The trial consisted of a non-inoculated check treatment, *Rhizoctonia solani* and *Fusarium brasiliense* inoculated treatments. Stand counts were collected twice as a measure of pathogen impact on the dry bean lines.

Yield loss and seed treatment trial for *Fusarium* species

A yield loss trial was established with a kidney bean (Red Hawk) and black bean (Zorro) used in a factorial field study in which inoculum (no inoculum, *F. virguliforme* inoculum, and F.

brasiliense inoculum) and seed treatment (no treatment, commercial base seed treatment, and commercial base plus ILeVO seed treatment) were the factors. Each treatment was replicated four times in a randomized block design.

The presence of either seed treatment improved emergence and stand for the Red Hawk cultivar. While the commercial base significantly improved stand for plants inoculated with *F. brasiliense* as compared to the non-treated, inoculated control, the ILeVO seed treatment led to an increased stand for both *F. virguliforme* and *F. brasiliense* inoculated plots. In addition to leading to a better stand, the seed treatments led to a decreased, though not significant, root rot rating for both cultivars. For Red Hawk, there was a slight yield bump for treated plots. Treated Zorro plants also experienced a greater yield than the non-treated, non-inoculated control, though not significant. The overall trends of improved stand counts, root rot ratings, and yield for treated plants suggest that either seed treatment does offer some protection for dry beans against such pathogens, however there is not enough evidence to suggest ILeVO significantly reduces the risk posed by *F. virguliforme* and *F. brasiliense*.

There is, however, enough evidence to suggest that the pathogens, specifically *F. brasiliense*, lead to decreased plant health. While these particular pathogens don't always cause root mass reduction, they did lead to reduced shoot mass for Red Hawk, especially at the early reproductive stage. While later on in the season, the Red Hawk plants were able to recover, there was still less shoot mass for plants inoculated with either pathogen. Red Hawk plants inoculated with *F. brasiliense* also had a significantly higher root rot rating than the non-inoculated control.

Photosynthetic parameters also show decreased plant health. Leaf temperature differential (LTD) values for both Red Hawk and Zorro show plants inoculated with *F. brasiliense* were more water stressed at the later reproductive stage. Photosynthetic parameters such as relative chlorophyll and Phi2, or photosynthetic efficiency, showed the interaction between seed treatment and inoculum for Zorro led to decreased plant health, especially for the *F. brasiliense* inoculated plants treated with ILeVO. Shoot mass, root rot rating, and leaf temperature differential suggest that *F. brasiliense* is a cause for concern on dry beans and the use of photosynthetic parameters imply further work should be done on the interaction of the seed treatments and pathogens.

Impact of nitrogen on white mold development

A field trial was conducted to assess the impact of nitrogen rate on white mold development. Two cultivars were planted and 3 rates of nitrogen were applied.

Identification and Characterization of Root Rot Pathogens of Dry Bean in Michigan

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Introduction Root rot, caused by a complex of *Fusarium* spp., *Pythium* spp., and *Rhizoctonia solani* is a constant disease problem in dry bean production in Michigan. Root rot often leads to poor stand establishment, reduced plant vigor, and potential yield loss. It is not uncommon for growers to replant sections or whole fields due to poor stand establishment as a result of root rot pathogens.

Identification of the organisms responsible for stand loss and root rot would provide valuable information for plant breeding efforts and identifying the best seed treatments to manage disease.

The objectives of this research were to i) conduct a survey of Michigan commercial dry bean fields to determine which pathogens are associated with stand loss and root rot symptoms; ii) characterize the isolates for pathogenicity and virulence in a seedling assay.

Materials and methods

Symptomatic plants were collected from 30 fields in eight counties from 2014 – 2017. Oomycete and fungal isolations were made on CMA-PARPB and WA amended with metalaxyl and streptomycin, respectively. DNA was extracted from lyophilized mycelium, and ITS and TEF-1 α gene were utilized for identification of isolates. Pathogenicity screening was conducted with a representative panel of oomycete and *Fusarium* spp. on red kidney (cv. Red Hawk) and black bean (cv. Zorro) in a seedling assay (Rossman et al. 2017). *Rhizoctonia solani* isolates representing anastomosis groups (AG), AG2-2, AG2-3, AG4, AG5, and AG11 were tested for pathogenicity against dry bean, as well as soybean (cv. Sloan), and corn (cv. DK52-61).

Results and Discussion

A total of 859 isolates were recovered during the survey period. *Fusarium* spp. were isolated in the greatest abundance across years, with the exception of 2014. The majority of isolates were identified as belonging to the *Fusarium solani* species complex (FSSC), with the second most abundant being the *Fusarium oxysporum* species complex (FOSC). *Rhizoctonia solani* isolates representing anastomosis groups (AG), AG2-2, AG2-3, AG4, AG5, and AG11 were identified. A total of 28 different oomycete species were isolated representing *Pythium* and *Phytophthora* genera.

Conclusions

Fusarium spp. were the most commonly isolated dry bean pathogens in three of four survey years. Isolates within the FSSC and FOSC produced the highest disease severity index (DSI) on both bean seed types. *Rhizoctonia solani* isolates within AG2-2 and AG4 were the most aggressive on dry bean and soybean resulting in the greatest disease severity and decreased root dry weight. *Pythium ultimum*, *Pythium myriotylum*, and *Phytophthora* aff. *vexans* significantly reduced emergence of both seed types. *Pythium* aff. *diclinum*, *Pythium irregular*, *Pythium lutarium*, and *Pythium sylvaticum* significantly reduced dry root weight, root length, and root area in both Andean and Mesoamerican germplasm.

Variety x N Rate on Yield, Seed Size and White Mold incidence at MRF, 2016, 2017.

Variety		Yield cwt/acre						
	2016			2017				
N rate	20 lb	80 lb	Mean	20 lb	40 lb	80 lb	Mean	
Zenith	32.7	40.9	36.8	25.1	27.9	27.7	26.5	
Viper	27.2	35.1	31.1	29.6	32.1	31.7	31.0	
Mean	29.9	38.0	34.0	27.2	29.6	29.5	28.7	
LSD .05			2.3			4.4	3.6	
CV%			6.0				17.2	
Variety		100 seed wt. g						
	2016			2017				
N rate	20 lb	80 lb	Mean	20 lb	40 lb	80 lb	Mean	
Zenith	22.8	23.5	23.1	24.1	24.3	24.8	25.1	
Viper	29.9	32.2	31.1	30.6	30.8	30.8	31.0	
Mean	26.3	27.8	27.1	27.7	28.2	28.1	28.0	
LSD .05			0.88			0.96	0.79	
CV%			2.9				3.8	
Variety		White Mold Rating in 2017						
	Disease Incidence %				Disease Index DIX			
N rate	20 lb	40 lb	80 lb	Mean	20 lb	40 lb	80 lb	Mean
Zenith	9.0	19.0	5.8	11.3	7.1	14.1	1.4	7.5
Viper	35.0	45.7	40.0	40.2	24.7	39.1	26.4	30.1
Mean	22.0	32.4	22.9	25.7	15.9	26.6	14.9	18.8
LSD .05			22.2	12.9			17.9	10.4
CV%								

Observations:

In 2016, plots were planted on new land and no white mold developed. Yield gain from application of 60 lb N plus over 20 lb N base rate was 27%, equivalent in both varieties. Zenith outperformed Viper. No soil test was conducted.

In 2017, plots were planted on land where white mold had been present in previous years. An additional N treatment of 40 lb N was included as this reflects the recommended N-rate for bean production in Michigan. In 2017, white mold developed and appeared to more severely infect the Viper variety, incidence of 40% versus 11% for Zenith. However, Viper outperformed Zenith at all N treatments. This was due in part to a seed quality issue with Zenith. Viper germinated at 97%, while Zenith germinated at 64%. The trial was damaged earlier by flooding which contributed to the high CV. The yield increase due to an additional 40 lb N over the 20 lb N base was 9% similar across varieties, but significantly lower than in 2016. Interestingly there was no gain by applying 80 lb N compared with the 40 lb N recommended rate. In fact, a small but non-significant decrease was observed. Based on data, the increased rate of N does not appear to contribute to higher white mold ratings; in fact the highest white mold rating was observed at the recommended 40 lb rate. The work needs to be continued in 2018.



2017 MICHIGAN DRY BEAN TRIALS
 Compiled by Gregory V. Varner, Dry Bean Research Director

COUNTY & COOPERATOR: Bay: *Frank Farms* Montcalm: *Mark Alexander Farm*
 Gratiot: *Hoard Farms* Sanilac: *Stoutenburg Farms*
 Huron: *D & B Karg Farms* Tuscola: *Bernia Family Farms*

PLANTING DATES: 6/5/17 6/12/17 6/8/17 6/16/17 6/1/17 6/2/17

<u>NAVY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	2017 AVE 4-2 LOC	White Mold - Lodging Rating
HMS MEDALIST	100-108	COOP/ADM	1866	2733	2957	2940	2823	2088	2680-2523	2.4-2.0
MERLIN	100-108	COOP/ADM	2181	2756	2892	3119	2189	2449	2804-2671	2.4-2.5
HYLAND T9905	98-107	TVS	2340	2516	2737	2725	2864	2194	2543-2466	2.8-2.5
VIGILANT	98-103	PROVITA	1327	2921	2692	3375	2558	2584	2893-2638	3.2-1.5
ALPENA	98-106	MSU	1919	2557	2559	2277	2632	2236	2407-2398	3.2-2.0
DS105WO	100-106	TVS	2337	2555	3041	2884	2871	2641	2780-2841	2.0-3.0
VISTA	99-108	GTS	2104	3159	2686	3218	2462	2581	2914-2634	2.5-2.5
GTS OB-1723-03	101-108	GTS	2099		2597		2170	2130	2364	2.8-2.5
REXETER	102-106	OAC-HDC	1806		2806		2784	2790	2798	2.5-2.5
NAUTICA	102-105	OAC-HDC	2331		3184		2539	2562	2873	2.2-2.5
MIST	100-106	OAC-HDC	1967		3017		2041	2129	2573	1.7-2.5
ARGOSY	101-107	OAC-HDC	2909		3685		2592	2392	3039	2.5-2.5
BLIZZARD 08072	102-107	PROVITA	2220		2969		2125	1948	2459	2.7-2.5
PROVITA 06063	103-109	PROVITA	2220		3031		2098	2654	2843	3.2-2.5
PROVITA 12039	103-109	PROVITA	2461		3018		2871	2803	2911	3.0-3.0
PROVITA 12047	103-108	PROVITA	2376		3204		2138	2090	2647	2.4-2.0
PROVITA 12062	103-107	PROVITA	2610		3314		3686	2462	2888	2.5-2.0
PROVITA 12063	102-106	PROVITA	2435		3451		2954	2314	2883	2.8-2.5
PROVITA 12064	104-107	PROVITA	2204		3143		2995	2493	2818	2.0-2.0
PROVITA 13049	105-109	PROVITA	2089		3066		2514	2024	2545	2.5-2.5
PROVITA 13058	106-111	PROVITA	3006		2971		3332	2192	2582	3.0-2.5
PROVITA 13066	106-110	PROVITA	1967		3280		3305	1967	2624	2.0-1.5
PROVITA 13068	104-108	PROVITA	2299		3278		2648	2358	2818	2.5-2.0
PROVITA 14068	106-110	PROVITA	2697		3116		3029	3038	3077	3.0-2.0
PROVITA 14078	107-112	PROVITA	1948		3394		3292	2420	2907	3.0-2.0
PROVITA 14084	104-109	PROVITA	2594		3087		3463	2111	2599	2.0-2.0
MSU N14229	95-105	MSU	2792		3118		2722	3033	3076	2.5-3.0
MSU N15341	100-104	MSU	2642		2737		3128	2557	2647	3.0-2.5
MSU N16401	97-104	MSU	1525		2538		1961	2043	2291	2.0-2.5
MSU N16405	100-104	MSU	2309		2725		2818	2663	2694	2.0-2.5
			lsd=813	lsd=456	lsd=508	lsd=931	lsd=819	lsd=395		
			cv-25.7%	cv-11.2%	cv-12.0%	cv-21.4%	cv-21.4%	cv-11.7%		

<u>SMALL RED/PINK</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	2017 AVE 5-4 LOC	White Mold - Lodging Rating
MERLOT	95-108	USDAMSU	2526	2716	2842	1721	3386	2638-2619	3.0-3.0
VIPER SR 09303	94-108	PROVITA	3483	3488	3582	1415	4280	3250-3190	3.0-3.0
RUBY SR 09304	95-108	PROVITA	2838	3005	3068	1480	3660	2810-2761	3.5-3.5
SR 11511	108-112	PROVITA	3159		3785	1955	3983	3221	3.0-3.5
CAYENNE	96-108	MSU	2789	3274	3312	1975	3547	2979-2906	2.0-2.5
MSU R16503	105-108	MSU	2734		3538	1801	2894	2742	2.0-2.5
ROSETTA PINK	97-108	MSU	2388		2746	1662	3218	2504	2.0-3.0
S16808 PINK	100-108	MSU	2117		2786	1090	3258	2313	2.0-3.0
			lsd=624	lsd=419	lsd=518	lsd=716	lsd=486		
			cv-15.4%	cv-8.4%	cv-11.0%	cv-29.7%	cv-9.4%		

<u>BLACK</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>TUSCOLA</u>	<u>2017 AVE</u> <u>4-2 LOC</u>	<u>White Mold -</u> <u>Lodging Rating</u>
ZORRO	99-108	MSU	1462	2383	3153	2223	1712	2519	2570-2836	2.4-2.0
ZENITH	99-109	MSU	1401	2360	3125	2690	1574	2587	2691-2856	2.8-2.0
LORETO	99-108	COOP-PRO	1800		3075		2237	3079	3077	2.8-2.5
SHANIA	104-108	ADM	2198		2918		2048	2928	2923	2.8-2.5
ECLIPSE	93-100	NDSU	1933		3138		2239	2768	2953	3.0-1.5
BLACK CAT	99-108	PROVITA	1531		2855		2434	2887	2871	3.5-2.5
BLACK BEAR 12576	105-110	PROVITA	2054		3227		1685	3019	3123	3.0-2.5
BL 13489	100-108	PROVITA	1844		3275		2185	3059	3167	3.3-2.5
BL 13490	100-108	PROVITA	2745		3465		2675	2478	2972	2.5-2.0
BL 13496	101-107	PROVITA	1896		2797		1918	2645	2721	2.0-2.0
BL 13503	99-105	PROVITA	1235		2809		1521	1683	2246	2.0-2.0
BL 13505	100-107	PROVITA	2566		3669		1963	2922	3296	2.0-2.0
BL 14496	102-110	PROVITA	2255		3352		2611	3289	3321	2.0-2.0
BL 14497	104-110	PROVITA	2464		3687		1812	3251	3469	2.0-2.0
BL 14498	102-106	PROVITA	2533		3425		2349	3297	3361	1.5-2.0
BL 14500	102-107	PROVITA	2443		3895		2779	3500	3698	2.0-2.0
BL 14504	104-108	PROVITA	2303		3453		2661	2699	3076	2.2-2.5
BL 14506	104-108	PROVITA	2738		3423		2249	2926	3175	2.5-2.0
BL 14510	104-109	PROVITA	1652		3071		2591	2150	2611	2.5-2.5
BL 14522	103-109	PROVITA	2402		3438		2127	2878	3158	2.0-2.0
MSU B15430	100-106	MSU	2436		3120		2403	3331	3226	2.0-2.5
MSU B15442	98-105	MSU	2443		3485		2892	3023	3254	2.0-2.0
MSU B16504	98-106	MSU	2799		3918		2599	3643	3781	2.0-2.0
MSU B16506	98-105	MSU	2251		3457		1741	3070	3264	2.0-2.0
MSU B16507	96-106	MSU	2166		3343		2687	2902	3123	2.0-2.0
ADM B8006282	101-106	ADM	1792				2144	2579		3.0-2.5
ADM B0040613	100-105	ADM	2324				2085	2739		2.5-2.0
ADM B1048276	101-104	ADM	2086				2180	2520		2.0-2.5
ADM B1048280	102-106	ADM	2024				2360	2675		
			lsd=606 cv-20.2%		lsd=456 cv-9.8%	lsd=612 cv-17.2%	lsd=905 cv-29.0%	lsd=458 cv-11.4%		

<u>PINTO</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>2017 AVE</u> <u>4 LOC</u>	<u>White Mold -</u> <u>Lodging Rating</u>
ELDORADO	100-104	MSU	2773	2360	3305	2807	2811	2.5-3.0
LA PAZ	95-102	PROVITA	2195	2565	2269	2085	2279	3.5-2.5
MSU P14812	93-102	MSU	2119	2472	3063	1554	2302	3.0-3.0
MSU P14814	98-99	MSU	2114	2853	2257	2385	2402	4.0-3.0
MSU P16911	94-102	MSU	1877	3182	2269	2039	2342	4.0-3.0
WINDBREAKER	92-98	SEMINIS	1485	2050	2717	1406	1915	3.0-3.0
SV6139GR	95-98	SEMINIS	1310	1879	3123	1216	1882	2.5-2.5
RADIANT SD	92-102	PROVITA	1343	2990	3228	1534	2274	2.5-2.5
VIBRANT SD	93-99	PROVITA	1508			1573		0.0-2.5
			lsd=582 cv-21.5%	lsd=508 cv-13.8%	lsd=1059 cv-25.9%	lsd=930 cv-34.5%		

<u>GREAT NORTHERN</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>BAY</u>	<u>HURON</u>	<u>MONTCALM</u>	<u>White Mold -</u> <u>Lodging Rating</u>
POWDERHORN	95-100	MSU	1040	3327	2852	3.0-2.0
MSU G16301	96-100	MSU	1580	3345	2651	3.0-2.0
MSU G16346	98-104	MSU	2338	3166	1668	4.5-3.0
ARIES GN	100-102	PROVITA	1687	3230		2.0-2.0
DRACO	100-104	PROVITA	1934	3180		2.0-2.0
TAURUS	101-104	PROVITA	2239	3240		3.0-2.0
			lsd=474 cv-17.4%	lsd=554 cv-11.3%	lsd=949 cv-25.2%	

<u>CRANBERRY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
ETNA	88-92	SEMINIS	2254	2986
CHIANTI vine	95-97	SEMINIS	2991	2893
BELLAGIO vine	96-98	MSU	2800	2868
14L1203B	92-93	USDA/MSU	2004	2495
VERO	90-91	ADM		3558
CR 151084	97-98	PROVITA	2906	3052
CR 151085	97-98	PROVITA	3111	3538
CR 151093	97-98	PROVITA	2918	2877
CR 151106	92-93	PROVITA	2394	2722
CR 151118	90-91	PROVITA	1759	2690
CR 151126	95-97	PROVITA	2944	3838
			lsd=644	lsd=864
			cv-17.0%	cv-19.6%

<u>LIGHT RED KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
CALIF ELRK	88-90	CAL	2530	3547
CLOUSEAU	91-92	SEMINIS	2613	3942
INFERNO	99-104	OAC-HDC	3104	3566
MSU K15601	95-98	MSU	1996	2688
MSU K16640	95-97	MSU	2670	3220
MSU K16655	89-91	MSU	2706	3778
ROSIE	97-98	NDSU	2769	3100
BIG RED	93-95	PROVITA	2606	4067
LRK 06269	94-95	PROVITA	2546	3140
LRK 09360	97-102	PROVITA	3229	4013
LRK 09363	88-90	PROVITA	2575	3666
LRK 09378	93-96	PROVITA	2941	4053
LRK 15907	101-106	PROVITA	3112	3402
LRK 15926	101-105	PROVITA	2933	2982
			lsd=525	lsd=548
			cv-13.4%	cv-10.9%

<u>DARK RED KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
RED HAWK	98-99	MSU		3162
MONTCALM	100-104	MSU		3141
RED ROVER	91-94	SEMINIS		3104
DYNASTY	97-99	OAC-HDC		3259
RED CEDAR	94-96	MSU	1890	2955
MSU K16121	97-99	MSU	2209	2910
MSU K16136	98-99	MSU		3900
GTS 104	100-102	GTS		3117
TALON	99-101	NDSU	2438	3004
CHAPARRAL	96-97	PROVITA		2995
EPIC 09430	95-97	PROVITA	2985	3249
DRK 09431	93-95	PROVITA	3448	3166
DRK 11479	94-97	PROVITA	2724	2956
DRK 13774	98-101	PROVITA		3034
DRK 15978	94-95	PROVITA		3316
DRK 15979	96-98	PROVITA		2623
DRK 15981	97-98	PROVITA	2797	2922
DRK 151011	88-90	PROVITA		3502
DRK 151021	97-99	PROVITA	3410	3077
			lsd=272	lsd=712
			cv-6.8%	cv-16.1%

<u>WHITE KIDNEY</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>
BELUGA	100-105	MSU		3033
SNOWDON	89-90	MSU		2958
MSU K15901	88-90	MSU		3194
MSU K16924	94-96	MSU	2570	3484
MSU K16962	100-103	MSU	2954	3258
MSU K16981	99-101	MSU	1932	3152
COB-212-03	105-107	GTS		2190
COB-228-03	96-98	GTS	2515	3244
YETI	103-105	HDC		3161
			lsd=474	lsd=641
			cv=11.9%	cv=14.3%

<u>TEBO</u>	<u>DAYS</u>	<u>ORIGIN</u>	<u>GRATIOT</u>	<u>MONTCALM</u>	<u>SANILAC</u>	<u>White Mold - Lodging Rating</u>
FUJI	96-100	MSU	2168		1392	3.5-4.0
SAMURAI G12901	97-100	MSU	2680	2264	2591	3.5-2.5

ORIGIN KEY

MSU - Michigan State University
GTS - Gen-Tec Seeds LTD
SEMINIS - Seminis Seeds - Monsanto
ADM - Archer Daniels Midland-Seedwest
COOP - Cooperative Elevator Company
TVS - Treasure Valley Seed Company
CAL - University of California
USDA - US Department of Ag - ARS
NDSU - North Dakota State University
OAC-HDC - University of Guelph-Hensall District Coop
PROVITA - Provita Seeds

Maturity days = planting until harvest in 2017
Direct Cut Lodging Ratings = 1-erect, 5-laying flat on ground
White Mold Rating = 1-10% mold, 5-100% mold
White Mold Rating from Huron, Montcalm and Tuscola counties
Bay, Huron, Sanilac and Tuscola were direct harvested
Gratiot and Montcalm navies, blacks, pintos and sm. reds were direct harvested and large colored beans were hand pulled and harvested



DRY BEAN CHARACTERISTICS

Gregg Varner, Michigan Dry Edible Bean Production Research Advisory Board															
Variety	Class	Plant Type	Maturity	Origin	BCMV	Anthracnose	73	7	Canning Quality	White Mold	Halo Blight	Common Blight	Rust	Air Pollution	Direct Cut-Rating
Medalist	N	USV	F	COOP/ADM	R-1	S	S	R	3	2	R	S	T	T	2
Vigilant	N	USV	F	COOP/ADM	R-1	S	R	R	3	2	R	S	T	T	2
Hyland 19905	N	USV	M	HYLAND	R-1	S	R	R	2	2	R	S	T	T	2
Merlin	N	USV	M-F	COOP/ADM	R-1	S	R	R	3	2	R	S	T	T	2
Indi	N	USV	M-F	ADM	R-1	S	R	R	3	2	R	S	T	T	1
Alprena	N	USV	F	MSU	R-1	S	R	R	3	3	T	S	T	T	2
La Paz	P	USV	M	ADM	R	S	S	S	3	2	T	S	R	T	2
Lariat	P	USV	M	NDSU	R	S	S	S	3	3	T	S	R	T	3
Eldorado	P	USV	F	MSU	R	S	S	S	3	1	T	S	R	T	2
T-39	B	SV	F	UCD	R-1	S	S	S	3	3	R	S	T	T	4
Zenith	B	USV	F	MSU	R-1	R	R	R	5	3	R	S	T	T	2
Black Velvet	B	USV	F	SEMINIS	R-1	S	R	R	4	3	R	S	T	T	2
Zorro	B	USV	F	MSU	R-1	S	R	R	5	2	R	S	T	T	2
Eclipse	B	USV	M	NDSU	R-1	S	R	R	4	2	R	S	T	T	2
Black Bear	B	USV	F	COOP/ADM	R-1	S	R	R	3	4	R	S	T	T	2
Shania	B	USV	F	ADM	R-1	S	R	R	3	3	R	S	T	T	2
Loreto	B	USV	F	COOP/ADM	R-1	S	R	R	3	2	R	S	T	T	2
Calif. ELRK	LRK	B	E	UCD	R-1	R	S	S	3	2	S	S	T	T	6
Clouseau	LRK	B	M	SEMINIS	R-1	R	S	S	3	2	S	S	T	T	6
Pink Panther	LRK	B	M	SEMINIS	R-1	R	S	S	3	2	S	S	T	T	6
Montcalm	DRK	B	F	MSU	R-1	R	S	S	4	2	R	T	T	T	6
Red Hawk	DRK	B	F	MSU	R-1	R	R	R	4	2	T	S	T	T	6
Red Rover	DRK	B	F	SEMINIS	R-1	R	R	R	4	2	S	S	T	T	6
Elna	C	B	E	SEMINIS	R-1	R	S	S	2	2	S	S	T	T	6
Chianti	C	SV	M	SEMINIS	R-1	S	S	S	5	3	S	S	T	T	6
Belaggio	C	SV	F	MSU	R-1	R	S	S	5	3	S	S	T	T	6
Cayenne	SR	USV	M	MSU	R	S	S	S	4	2	R	S	T	T	2
Merlot	SR	USV	M	MSUSDA	R	S	S	S	4	3	R	S	T	T	3
Viper	SR	USV	M	COOP/ADM	R	S	S	S	3	4	R	S	T	T	3
Ruby	SR	USV	M	COOP/ADM	R	S	S	S	2	4	R	S	T	T	3
Rosetta	PK	USV	M	MSU	R-1	S	S	S	3	3	R	S	T	T	3
Samurai Tebo	W	USV	M	MSU	R-1	S	S	S	3	3	T	S	S	S	3
Fuji Tebo	W	B	M	MSU	R-1	S	S	S	3	3	T	S	S	S	4
Beluga	WK-AL	B	F	MSU	R-1	R	S	S	3	3	S	S	T	T	6
Showdon	WK-AL	B	E	MSU	R-1	R	S	S	3	3	S	S	T	T	6
Aurora	SW	SV	M	CUNY	R-1	S	S	S	3	3	R	S	R	S	4

Plant Type: B=Bush, SV=Short Vine, USV=Upright Short Vine, V=Vine
 Maturity: E=Early (less than 88 days), M=Mid-Season (89-95 days), F=Full Season (96-102 days), L=Late Full Season (greater than 102 days)
 Canning Quality: 1=Poor, 2=Fair, 3=Good, 4=Above Average, 5=Excellent
 Disease -R=Resistant, S=Susceptible, T=Tolerant, R-1= gene, VS=Very Susceptible
 White Mold: 1=Less than 10% Infection, 2=Less than 20% Infection, 3=20-40% Infection, 4=40-60% Infection, 5=Greater than 60% Infection
 Direct Cut Rating: 1=Very erect, 2=lodging, pods off ground, 3=lodging, pods close to ground, 4=high yield loss, 5=severe yield loss, 6=not recommended

EXPERIMENT 7101 STANDARD NAVY YIELD TRIAL

PLANTING DATE: 6/1/17

Dr. James D. Kelly and Evan Wright, Plant, Soil and Microbial Sciences, Michigan State University

NAME	PEDIGREE	YIELD CWT 100 SEED		DAYS TO FLOWER		DAYS TO LODGING HEIGHT		DES.	CBB
		/ACRE	WT. (g)	FLOWER MATURITY	(1-5)	(cm)	SCORE	RATING	
N14229	N11275/N11256	29.1	19.2	44.0	90.0	1.0	49.8	6.0	2.0
N14230	N11275/N11256	24.6	19.0	46.0	91.0	1.0	49.3	5.3	2.5
I11264	COOP 03019, MERLIN	24.4	19.9	44.0	93.0	1.3	49.3	4.8	2.5
N17506	N14230/N12447	24.2	20.6	45.0	90.0	1.0	47.5	5.3	2.0
N17504	N14206/N14229	24.1	20.0	45.0	90.0	1.0	46.3	4.8	1.5
N14218	N11256/N11298	24.0	19.6	46.0	91.0	1.0	48.3	5.3	1.5
N17508	Alpena/N14229	24.0	20.2	46.0	90.0	1.0	49.0	4.8	3.0
N15337	N12466/N11258	23.9	20.9	45.0	92.0	1.0	50.0	5.5	2.5
N15313	N11258/N11277	23.8	19.7	43.0	89.0	1.0	48.0	4.8	4.0
N17505	N14230/N12447	23.7	22.0	47.0	91.0	1.0	48.3	5.8	1.5
N14201	N11249/N11256	23.3	19.8	46.0	90.0	1.0	47.8	5.3	2.0
I10101	COOP 02084, VIGILANT	23.2	22.1	44.0	91.0	1.0	47.8	4.0	2.0
N17503	N14206/N14223	23.2	18.9	45.0	91.0	1.0	47.8	4.8	1.5
I17518	ACUG 14-1, AAC SHOCK	22.9	22.4	43.0	89.0	1.0	48.0	4.0	3.0
N17509	N12466/N14206	22.6	20.2	46.0	90.0	1.0	45.3	4.3	2.5
N15306	N11230/N11298	22.4	19.7	43.0	91.0	1.0	49.0	5.5	1.5
N14205	N11256/N11258	22.2	19.9	44.0	89.0	1.0	46.5	4.5	2.0
N15341	N12468/N12466	21.6	20.3	45.0	91.0	1.0	47.8	5.0	1.0
N17510	N13124/N14230	21.4	19.0	44.0	90.0	1.0	47.3	4.5	2.0
I08902	HYLAND T9905	20.6	23.0	44.0	94.0	1.3	48.8	4.3	1.5
N17501	N13124/N14206	20.3	18.8	45.0	92.0	1.0	48.5	5.0	2.0
N16405	N12466/N11264	20.0	21.0	45.0	88.0	1.0	47.8	5.8	1.0
N17502	N14206/N14223	20.0	18.8	44.0	89.0	1.0	45.0	4.0	2.0
N15331	N12438/N12468	19.7	20.8	45.0	92.0	1.0	48.3	5.3	1.5
N17507	N14235/N14243	19.4	18.4	44.0	90.0	1.0	47.0	4.5	2.0
N16401	N09175/Alpena	17.9	21.7	44.0	88.0	1.0	43.5	4.0	1.0
I08958	Mayflower/Avanti, MEDALIST	17.2	21.3	43.0	94.0	1.8	49.5	4.3	2.5
N11283	MEDALIST/N08003, ALPENA	15.7	19.1	43.0	91.0	1.0	46.0	4.0	2.5
I17527	PR1217-16	14.5	26.6	43.0	90.0	1.0	43.0	3.3	2.5
I17526	PR0801-81A	13.7	24.1	43.0	92.0	1.0	46.5	3.0	2.5
MEAN(30)		21.6	20.6	44.5	90.5	1.0	47.5	4.7	2.1
LSD(.05)		2.6	0.7	1.0	1.8	0.3	2.3	0.9	1.2
CV%		10.2	2.7	1.3	1.2	15.4	2.9	12.0	34.7

EXPERIMENT 7102 STANDARD BLACK YIELD TRIAL

PLANTING DATE: 6/1/17

Dr. James D. Kelly and Evan Wright, Plant, Soil and Microbial Sciences, Michigan State University

NAME	PEDIGREE	YIELD CWT	100 SEED	DAYS TO	DAYS TO	LODGING HEIGHT	DES.	CBB	
		/ACRE	WT. (g)	FLOWER	MATURITY	(1-5)	(cm)	SCORE	RATING
B17119	B14306/B13218	26.1	20.5	48.0	89.0	1.0	46.8	4.3	2.5
B16504	Zenith//Alpena*/B09197	25.7	21.6	47.0	92.0	1.0	48.5	5.3	1.0
B15430	Zenith/B12721	25.5	24.3	47.0	89.0	1.0	48.5	4.8	2.0
B15447	B11363/Zenith	24.5	23.1	47.0	92.0	1.0	47.0	4.3	2.5
B15411	B09175/B11363	24.2	22.0	47.0	90.0	1.0	45.0	4.5	3.0
B16501	Zenith/B10215	24.2	22.6	47.0	90.0	1.0	46.0	4.0	1.5
B17109	B14303/B13218	23.9	24.0	47.0	91.0	1.0	48.3	5.8	1.0
B17103	B11371/B13204	23.7	21.9	47.0	89.0	1.0	47.3	4.8	1.0
B17118	B14306/B13218	23.7	20.0	46.0	90.0	1.0	46.5	4.8	1.0
B17115	B14306/B14311	23.6	20.4	48.0	89.0	1.0	46.8	4.3	1.5
B15434	Zenith/B12721	23.6	22.6	48.0	92.0	1.0	48.0	5.3	1.0
B15443	B11363/B09175	23.5	25.5	46.0	91.0	1.0	47.5	4.3	1.5
B17108	B14303/B13204	23.3	20.6	47.0	91.0	1.0	48.0	5.3	1.0
B15417	B10208/B09175	23.0	23.3	47.0	92.0	1.0	48.8	5.0	1.0
B15453	B11371/B11363	22.8	22.6	49.0	91.0	1.0	46.8	4.3	1.0
B17104	B11371/B14305	22.8	22.4	48.0	91.0	1.0	47.0	4.5	2.0
B15451	B11371/B11363	22.7	22.6	48.0	92.0	1.0	48.0	5.0	1.5
B17107	B14303/B13204	22.4	20.9	47.0	92.0	1.0	47.3	5.3	1.0
B15427	Zenith/B11343	22.3	24.3	47.0	89.0	1.0	46.3	4.8	3.0
B16503	Zenith/B12720	22.3	24.9	49.0	90.0	1.0	47.5	4.3	2.0
B16505	B11363//Alpena*/B09197	22.2	21.3	47.0	90.0	1.0	44.5	4.0	1.5
I17501	BL12576, BLACK BEAR	22.2	21.4	47.0	93.0	1.0	49.8	5.0	1.0
B17112	B14304/B10244	22.0	20.4	48.0	89.0	1.0	47.5	4.3	3.0
B15464	B12709/B12721	21.9	24.2	47.0	90.0	1.0	47.5	5.0	1.0
B17106	B14302/B13218	21.9	19.5	46.0	88.0	1.0	47.3	5.0	1.0
B17117	B14306/B14305	21.8	20.4	49.0	89.0	1.0	45.8	4.3	2.5
B16511	B13204//Alpena*/B09197	21.7	22.5	46.0	91.0	1.0	47.0	4.3	3.0
B17101	Zorro/B14302	21.5	19.1	48.0	89.0	1.0	45.0	3.3	2.5
B17116	B14306/B14311	21.5	20.4	49.0	89.0	1.0	47.8	4.8	1.5
B17114	B14304/B14302	21.2	23.2	48.0	93.0	1.0	47.8	5.3	2.5
B17111	B14303/B14301	21.1	19.2	47.0	88.0	1.0	45.3	4.5	1.0
B15414	B09175/B11611	20.9	27.1	46.0	94.0	1.0	48.5	5.3	1.0
B16507	B12720/Zenith	20.9	25.5	48.0	92.0	1.0	48.3	5.0	1.5
B17113	B14304/B14302	20.8	23.3	49.0	93.0	1.0	48.8	5.5	1.5
B16506	B11363//Alpena*/B09197	20.5	23.0	47.0	91.0	1.0	46.0	4.0	2.5
B17105	B14302/B13218	20.3	21.5	47.0	91.0	1.0	46.8	4.8	1.5
I17517	ACUG 15-B4	20.0	21.9	47.0	90.0	1.0	47.8	4.0	2.0
B17110	B14303/B14301	20.0	21.7	47.0	90.0	1.0	45.8	4.3	1.5
B16502	Zenith/B12710	20.0	23.6	46.0	92.0	1.0	47.8	4.3	2.5
B15442	B11363/B09175	19.9	25.9	48.0	93.0	1.0	47.8	4.5	1.5
I17529	PR1483-105	19.2	22.1	47.0	89.0	1.0	47.3	4.0	1.0
I03390	ND9902621-2, ECLIPSE	19.1	21.7	47.0	89.0	1.0	47.3	4.0	3.0
B16510	B12720/B11363	18.7	21.3	47.0	90.0	1.0	46.8	4.3	3.5
B16508	B12720/Zenith	18.5	27.6	47.0	92.0	1.0	47.3	4.3	1.0
B10244	B04644/ZORRO, ZENITH	18.4	24.3	48.0	93.0	1.0	48.3	4.8	2.5
B04554	B00103*/X00822, ZORRO	16.5	22.7	48.0	92.0	1.0	46.3	4.0	2.0
B17102	Zorro/B14302	15.9	18.0	48.0	89.0	1.0	43.8	4.0	1.5
I17528	PR1147-3	13.1	23.6	47.0	91.0	1.0	46.8	3.8	1.0
MEAN(48		21.6	22.4	47.1	90.5	1.0	47.1	4.5	1.7
LSD(.05)		2.6	0.7	1.3	1.1	-	1.4	0.7	1.0
CV%		10.1	2.8	1.6	1.0	-	2.4	12.5	35.6

EXPERIMENT 7103 PRELIMINARY BLACK YIELD TRIAL (POP.05)

PLANTED: 6/1/17

Dr. James D. Kelly and Evan Wright, Plant, Soil and Microbial Sciences, Michigan State University

NAME	PEDIGREE	YIELD CWT	100 SEED	DAYS TO	DAYS TO	LODGING	HEIGHT	DES.	CBB
		/ACRE	WT. (g)	FLOWER	MATURITY	(1-5)	(cm)	SCORE	RATING
B17220	B10244/B12724	31.7	23.2	45.0	93.0	1.0	49.0	5.5	2.5
B17202	B10244/B12724	31.5	20.7	47.0	92.0	1.0	49.5	5.0	2.5
B17218	B10244/B12724	31.4	22.4	45.0	93.0	1.0	49.0	4.5	3.5
B10244	B04644/ZORRO, ZENITH	26.3	22.4	46.0	94.0	1.0	47.0	4.5	2.5
B04554	B00103*/X00822, ZORRO	23.4	22.6	47.0	92.0	1.0	47.5	4.5	3.0
I03390	ND9902621-2, ECLIPSE	22.9	23.2	47.0	90.0	1.0	45.0	4.0	2.0
MEAN(156)		26.3	22.2	46.1	92.0	1.0	47.2	4.6	2.3
LSD(.05)		3.0	1.1	1.1	1.8	-	2.1	1.0	1.4
CV%		8.3	3.7	1.4	1.2	-	2.7	13.1	35.3

EXPERIMENT 7104 PRELIMINARY BLACK YIELD TRIAL (POP.76)

PLANTED: 6/2/17

B17416	B14311/B10244	33.7	24.1	46.0	94.0	1.0	48.0	4.5	2.5
B17511	B14311/B10244	32.8	24.4	47.0	91.0	1.0	47.0	5.0	3.0
B17453	B14311/B10244	32.5	20.9	46.0	93.0	1.0	46.5	4.5	1.0
B10244	B04644/ZORRO, ZENITH	26.6	25.1	47.0	95.0	1.0	46.5	4.5	3.0
B04554	B00103*/X00822, ZORRO	25.2	23.3	46.0	95.0	1.0	45.0	4.0	2.5
I03390	ND9902621-2, ECLIPSE	24.5	23.4	47.0	93.0	1.0	44.5	4.0	2.5
MEAN(156)		27.3	21.9	46.5	93.0	1.0	46.0	4.4	2.2
LSD(.05)		3.2	1.3	1.4	1.7	-	1.9	1.0	1.1
CV%		7.2	3.6	1.8	1.1	-	2.4	13.5	30.3

EXPERIMENT 7105 PRELIMINARY BLACK YIELD TRIAL (POP.86)

PLANTED: 6/2/17

B16504	Zenith//Alpena*/B09197	36.0	23.8	47.0	95.0	1.0	47.5	5.0	
B17691	B14311/B12724	35.3	23.6	46.0	95.0	1.0	48.5	5.5	
B17699	B14311/B12724	35.0	22.4	46.0	94.0	1.0	48.0	5.0	
B10244	B04644/ZORRO, ZENITH	31.4	24.9	46.0	95.0	1.0	46.5	4.5	
B04554	B00103*/X00822, ZORRO	27.8	23.5	47.0	93.0	1.0	46.0	4.0	
I03390	ND9902621-2, ECLIPSE	26.5	23.2	46.0	92.0	1.0	45.0	4.0	
MEAN(156)		29.6	22.4	45.8	93.0	1.0	46.6	4.6	
LSD(.05)		3.0	1.4	1.6	1.5	0.1	1.6	0.9	
CV%		6.2	3.9	2.1	1.0	5.6	2.1	12.1	

EXPERIMENT 7106 PRELIMINARY BLACK YIELD TRIAL (POP. 11)

PLANTED: 6/2/17

B17875	B14302/B10244	38.5	19.6	47.0	91.0	1.0	51.5	5.5	1.5
B17922	B14302/B10244	36.8	21.1	49.0	93.0	1.0	51.0	5.0	2.0
B17879	B14302/B10244	36.4	19.7	47.0	90.0	1.0	47.0	5.0	2.0
B10244	B04644/ZORRO, ZENITH	27.8	22.9	47.0	93.0	1.0	49.5	5.0	1.5
B04554	B00103*/X00822, ZORRO	25.7	22.4	47.0	92.0	1.0	48.5	4.5	2.0
I03390	ND9902621-2, ECLIPSE	22.2	22.9	47.0	90.0	1.0	48.0	4.0	2.5
MEAN(108)		30.2	20.7	46.7	90.4	1.0	48.1	4.9	1.9
LSD(.05)		3.1	1.3	1.4	10.1	-	6.6	1.0	1.0
CV%		6.2	3.9	1.9	6.7	-	8.3	12.8	31.9

EXPERIMENT 7107 PRELIMINARY BLACK YIELD TRIAL (POP. 31 & 45)

PLANTED: 6/2/17

B17003	B14303/B10244	33.0	21.6	48.0	90.0	1.0	46.5	5.5	1.5
B17076	B14303/B10244	32.5	20.5	48.0	93.0	1.0	49.5	4.5	3.0
B17096	B14303/B10244	30.9	20.5	48.0	91.0	1.0	47.0	5.0	1.5
B10244	B04644/ZORRO, ZENITH	30.4	25.3	48.0	94.0	1.5	48.5	5.5	2.5
MEAN(72)		24.5	21.1	47.3	90.7	1.0	45.3	4.9	2.0
LSD(.05)		4.2	1.4	1.3	2.1	0.1	6.7	1.0	1.3
CV%		10.3	3.9	1.7	1.4	8.3	8.8	11.7	39.2

EXPERIMENT 7110 STANDARD RED AND PINK YIELD TRIAL

PLANTED: 6/5/17

Dr. James D. Kelly and Evan Wright, Plant, Soil and Microbial Sciences, Michigan State University

NAME	PEDIGREE	YIELD CWT	100 SEED	DAYS TO	DAYS TO	LODGING	HEIGHT	DES.
		/ACRE	WT. (g)	FLOWER	MATURITY	(1-5)	(cm)	SCORE
R17603	R12859/R12844	27.9	38.4	45.0	93.0	1.0	47.8	5.0
I13401	SR 09303, VIPER	26.8	34.6	45.0	96.0	1.0	49.3	4.3
R12844	SR9-5/R09508, CAYENNE	25.5	38.8	44.0	92.0	1.0	49.3	5.0
R17604	R12859/R12844	25.3	36.8	45.0	95.0	1.3	48.8	5.5
S17706	S14708/X14117	24.6	40.4	45.0	94.0	1.0	49.3	5.0
R11806	X07714/X07710, GYPSY ROSE	24.5	34.9	45.0	96.0	2.0	47.5	4.0
R17605	R12859/R12844	24.3	38.8	46.0	95.0	1.0	48.8	5.0
S16804	S08418/S12904	24.1	42.1	44.0	95.0	1.0	48.8	5.3
R16522	R98026/I11207	23.6	44.0	43.0	93.0	1.0	47.8	4.5
R17602	R12845/R12859	23.3	40.5	43.0	93.0	1.0	48.0	4.8
S08418	S02754/S04503, ROSETTA	23.1	41.3	40.0	95.0	1.0	48.8	5.0
S17703	S14705/R14605	22.0	45.2	41.0	93.0	1.0	47.5	4.5
S17705	S14708/X14117	21.9	43.7	46.0	95.0	1.0	48.8	5.3
S17707	S12909/R12859	21.8	42.4	42.0	93.0	1.0	47.5	5.0
R17601	R12844/S14707	21.7	41.0	46.0	95.0	1.0	48.3	4.3
S17704	S14705/R14605	21.3	43.4	43.0	94.0	1.0	46.8	4.5
S16809	S12906/R11614	21.1	40.2	43.0	94.0	1.0	47.8	4.5
R98026	R94037/R94161, MERLOT	20.9	43.1	41.0	95.0	1.0	48.5	4.0
R16521	R98026/I11207	20.9	46.3	42.0	94.0	1.3	48.3	4.3
S17701	R12843/S14705	20.7	38.9	45.0	96.0	1.5	48.8	5.5
S17702	R12843/S14705	20.0	37.9	45.0	95.0	2.0	48.5	5.0
R16503	R12859/R13506	19.9	38.6	44.0	95.0	1.0	49.0	5.0
R16519	S12909/I13423	19.6	37.0	42.0	94.0	1.0	48.0	4.8
R16514	R12859/S12904	19.5	41.3	42.0	95.0	1.0	48.0	4.5
R17610	S12909/R12859	19.4	45.5	42.0	91.0	1.0	45.8	4.0
S16807	S08418/S12909	19.2	39.3	42.0	95.0	1.0	48.0	4.8
R16518	S12909/I13423	18.3	39.4	42.0	94.0	1.3	47.5	4.8
S16808	S08418/S12906	18.0	39.9	42.0	94.0	1.0	47.8	4.5
R17609	S12909/R12859	18.0	44.7	41.0	92.0	1.0	46.5	4.3
R11801	X07712/X07721, DESERT SONG	17.6	39.4	40.0	91.0	2.3	44.0	3.8
S16801	R12859/S12904	17.1	42.3	41.0	92.0	1.0	47.0	4.0
I16711	ACUG 13-SR1, OAC ROSITO	16.6	24.6	45.0	93.0	1.0	46.5	4.0
R17608	R12832/R12859	16.3	37.1	40.0	92.0	1.0	46.8	4.3
I15605	SR10-2-1	15.8	42.3	40.0	92.0	1.0	46.5	4.0
R17607	R12832/R12859	14.6	34.0	40.0	92.0	1.0	44.5	4.0
R17606	R12832/R12859	13.5	34.4	40.0	92.0	1.0	46.0	4.0
MEAN(36)		20.8	39.8	42.6	93.6	1.1	47.7	4.6
LSD(.05)		2.8	1.4	1.4	1.0	0.3	1.1	0.6
CV%		11.3	3.0	2.0	1.0	20.8	2.0	11.1

Harvest aid effects on two classes of dry beans

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location:	Richville (SVREC)	Tillage:	Conventional
Planting Date:	June 8, 2017	Row width:	30-inch
Replicated:	4 times	Soil Type:	Clay loam, 2.7% OM, pH 7.0
Varieties:	‘Zenith’ black beans	Populations:	109,000 seeds/A
	‘Merlin’ navy beans		109,000 seeds/A

Table 1. Preharvest treatments on bean desiccation (%) 3, 7, 14 days after treatment (DAT) and yield.

Treatments	Zenith				Merlin			
	3 DAT	7 DAT	14 DAT	Yield ^a	3 DAT	7 DAT	14 DAT	Yield
Sharpen (1 fl oz) + MSO + AMS	64 ab ^b	96 a	98 ab	15.3 c	55 ab	96 a	98 ab	12.6 c
Gramoxone (2 pt) + NIS	65 a	87 c	95 b	17.1 a-c	55 ab	83 cd	91 c	16.1 ab
Valor (1.5 oz) + MSO	56 cd	92 bc	98 ab	18.9 ab	55 ab	88 bc	95 a-c	17.9 a
Roundup (22 fl oz) + AMS	49 ef	78 d	98 a	20.0 a	45 d	75 e	93 bc	17.5 ab
Aim (2 fl oz) + MSO	53 de	75 d	87 c	17.7 a-c	50 c	78 de	91 c	15.2 a-c
Sharpen (2 fl oz) + MSO + AMS	58 b-d	97a	99 a	17.8 a-c	54 ab	98 a	100 a	17.2 ab
Sharpen (1 fl oz) + Roundup + MSO + AMS	59 a-d	98 a	100 a	17.1 a-c	53 bc	98 a	100 a	15.9 a-c
Sharpen (1 fl oz) + Gramox.+ MSO + AMS	48 a-c	94 ab	98 ab	15.9 bc	56 a	94 ab	95 a-c	14.2 bc
Untreated	47 f	56 e	86 c	17.7 a-c	45 d	56 f	83 d	16.9 ab

^a Yield is in cwt/A obtained by direct harvest and adjusted to 18% moisture

^b Means within a column with different letters are significantly different from each other

Summary: This study was conducted to evaluate the effects of preharvest treatments on desiccation and yield of two dry bean classes with differing speeds of dry down, ‘Zenith’ black bean (uniform dry down) and ‘Merlin’ navy bean (green stem). Preharvest applications were made when 65 and 70% of the pods were yellow for ‘Zenith’ and ‘Merlin’ beans, respectively. This is the third year that we have conducted similar trials. Over the three years there are some general trends. Sharpen applied at 1 fl oz/A is similar 2 fl oz/A rate, regardless of variety. The speed of effectiveness on desiccation is dependent on the year, but over 24 observations for the three years, Sharpen or Sharpen tank-mixtures provide the most consistent bean desiccation 7 DAT, followed by Valor and Gramoxone. It takes 14 days for maximum desiccation with Roundup, and Aim alone is the least effective of the treatments. The biggest concern is with yield, when quick acting herbicides are applied prior to 80% of the pods being yellow, we do see reductions in yield. This label recommendation must always be followed. In addition, Roundup should only be used to desiccate weeds and dry beans must be in the hard dough stage (30% seed moisture or less), due to chances of glyphosate residues found in the marketed crop. Overall, many of the treatments provided good bean desiccation. This research was supported by the Michigan Dry Bean Commission through the Michigan Department of Agriculture Specialty Crops grant.

Harvest aid effects on common lambsquarters and dry bean desiccation

Christy Sprague, Gary Powell and Brian Stiles, Michigan State University

Location: Richville (SVREC)	Tillage: Conventional
Planting Date: June 8, 2017	Row width: 30-inch
Replicated: 4 times	Soil Type: Clay loam, 2.7% OM, pH 7.0
Varieties: ‘Merlin’ navy beans	Date Treated: August 25, 2017

Table 1. Effect of preharvest treatments on common lambsquarters and dry bean desiccation and yield.

Treatments	C. lambsquarters		‘Merlin’ navy bean		
	7 DAT	14 DAT	3 DAT	7 DAT	Yield ^a
Sharpen (1 fl oz) + MSO + AMS	23 d-g ^b	37 d	65 d-f	96 ab	17.5 a-c
Sharpen (2 fl oz) + MSO + AMS	30 c-g	50 cd	73 a	97 a	17.4 a-c
Gramoxone (2 pt) + NIS	30 c-g	37 d	68 a-d	88 d-f	18.6 a-c
Valor (1.5 oz) + MSO	0 g	0 f	60 e	82 g	20.0 a
Roundup (22 fl oz) + AMS	13 e-g	58 c	61 de	85 e-g	19.1 ab
Aim (2 fl oz) + MSO	12 fg	20 e	66 cd	84 fg	17.9 a-c
Sharpen (1 oz) + Roundup + MSO + AMS	45 b-e	88 a	67 bc	98 a	16.6 bc
Sharpen (1 oz) + Gramox. + MSO + AMS	86 a	93 a	73 a	98 a	15.3 c
Valor (1.5 oz) + Roundup + MSO + AMS	56 b-e	92 a	66 cd	95 a-c	16.1 bc
Valor (1.5 oz) + Gramox. + MSO + AMS	56 a-c	75 b	71 ab	91 b-d	18.6 ab
Aim (2 fl oz) + Roundup + MSO + AMS	47 b-d	93 a	68 a-e	95 a-c	18.3 a-c
Aim (2 fl oz) + Gramox. + MSO + AMS	70 ab	81 ab	70 a-c	91 c-e	17.0 a-c
Untreated	0 g	0 f	46 f	66 h	17.7 a-c

^a Yield is in cwt/A obtained by direct harvest and adjusted to 18% moisture

^b Means within a column with different letters are significantly different from each other

Summary: This study was conducted to evaluate the effects of preharvest herbicide treatments on weed and bean desiccation. This is the third year we have looked at common lambsquarters desiccation and have evaluated Powell amaranth desiccation previously. In the past, Gramoxone, Roundup (glyphosate) or combinations with these herbicides have provided the greatest desiccation of common lambsquarters (88% or greater) and Powell amaranth (90% or greater). However, this year combinations of Gramoxone + Sharpen or Roundup combinations were needed for effective common lambsquarters control 14 DAT. The reduced common lambsquarters desiccation from Gramoxone alone and Roundup alone was unexpected. Sharpen alone and all combinations with Gramoxone or Roundup provided greater than 90% bean desiccation 7 DAT. By 14 DAT, all treatment desiccated dry bean greater 90%. While we have several years data comparing preharvest treatments, our recommendation if a grower decides to use Sharpen is to use 1 fl oz/A rate, this also reduces the rotation restriction for following crops, such as sugarbeet. In many cases there were no detriments to applying tank-mixtures of the preharvest herbicides. However, Gramoxone or Roundup were in many cases needed to help with weed desiccation. Please refer to the 2018 MSU Weed Control Guide (E-434) for recommendations for the different preharvest herbicide treatments available in dry bean. This research was supported by the Michigan Dry Bean Commission through the Michigan Department of Agriculture Specialty Crops grant.

Sensitivity of Two Classes of Dry Edible Beans to Plant Growth Regulator Herbicides

Scott Bales and Christy Sprague, Michigan State University

Location:	Richville (SVREC)	Tillage:	Conventional
Planting Date:	June 8, 2017	Row width:	30-inch
Replicated:	4 times	Soil Type:	Clay loam, 2.7% OM, pH 7.0
Varieties:	‘Zenith’ black beans	Populations:	109,000 seeds/A
	‘Merlin’ navy beans		109,000 seeds/A

Table 1. Sub-lethal doses of plant growth regulator herbicides effects on dry bean injury 21 days after treatment (DAT), maturity and yield.

						Yield ^d		
		Injury ^b		Delayed maturity ^c		Zenith		Merlin
Herbicide	Rate ^a	V2	V8	V2	V8	V2	V8	V2 & V8
Dicamba	0.1	2 f ^e	8 e	0 a	3 b	21.0 a-d ^c	21.6 b	17.8 c ^d
	1.0	13 d	26 c	10 b	25 c	20.2 cd	22.8 ab	20.5 b
	10	36 b	45 a	29 b	45 c	25.3 a	15.7 c	20.0 b
2,4-D Choline	0.1	0 f	0 f	0 A	2 A	21.5 b-d	22.2 ab	20.9 b
	1.0	1 f	1 f	2 B	5 B	23.5 a-c	22.4 ab	20.4 b
	10	2 f	6 e	7 C	33 C	24.6 ab	23.4 ab	23.7 a
Untreated	-	-	-	-	-	23.1 a-d	22.9 ab	19.4 bc

^a Rate is a % of 0.5 lb ae/A of dicamba and 1.0 lb ae/A of 2,4-D.

^b Injury and maturity are combined over dry bean class.

^c Days past the untreated to 50% maturity. The larger numbers are greater delays in maturity.

^d Yield is in cwt/A obtained by direct harvest and adjusted to 18% moisture combined over application timing when possible

^e Means within each outlined area with different letters are significantly different from each other.

Summary: With the recent commercialization of soybean resistant to dicamba (Xtend soybean) and upcoming release of soybean resistant to 2,4-D (Enlist soybean) a study was conducted to investigate the effects of off-target exposure of dicamba and 2,4-D on two classes of dry edible beans. The objective of this research was to gain a better understanding of how dry edible bean respond to sub-lethal doses of these PGR herbicides. ‘Zenith’ black bean and ‘Merlin’ navy bean were exposed to the PGR herbicides at the V2 and preflower (V8) stages. Dry bean varieties responded similarly to exposure of dicamba and 2,4-D. Exposure to dicamba always caused more injury and caused greater delays in dry bean maturity. Even with delays in maturity dry bean yield was only lower compared with the untreated when Zenith black beans were exposed to the 10% rate of dicamba. However, the delays in harvest may greatly effect yield of other treatments in the future. We will be looking at the effects of this injury on seed quality and will be repeating this research in the future.

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 (<i>Eptam</i>)	2.25	1.25 qt 7EC	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • <i>Eptam</i> suppresses common ragweed and wild mustard. • <i>Prowl</i> (pendimethalin), trifluralin, or Sonalan should be tank mixed with <i>Eptam</i> for additional broadleaf control, including lambsquarters. • <i>Pursuit</i> (2 oz) can be added to tank mixes with <i>Prowl</i>, <i>trifluralin</i>, or <i>Sonalan</i> for nightshade control. • <i>Pursuit</i> (2 oz) may also be applied preemergence after preplant incorporated applications of <i>Eptam</i> tank mixed with <i>Prowl</i>, <i>trifluralin</i>, or <i>Sonalan</i>. See remarks for <i>Pursuit</i>. • A postemergence application of <i>Basagran</i>, <i>Pursuit</i> or <i>Raptor</i> 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 (<i>Prowl</i>) OR (<i>Prowl H₂O</i>)	0.75	1.8 pt 3.3EC OR 1.6 pt 3.8CS	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • <i>Prowl</i> provides better velvetleaf control than <i>trifluralin</i> or <i>Sonalan</i>. • <i>Prowl</i> should be tank mixed with <i>Eptam</i>. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	ethalfluralin (<i>Sonalan</i>)	0.75	2 pt 3EC	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • <i>Sonalan</i> should be tank mixed with <i>Eptam</i>. Other measures may need to be taken for additional broadleaf control. • Refer to label and Table 12 for crop rotation restrictions.
	trifluralin (<i>many</i>)	0.5	1 pt 4EC	<ul style="list-style-type: none"> • Apply preplant incorporated only. • Refer to Table 5A for weed control and crop tolerance ratings. • Incorporate immediately after application. • <i>Trifluralin</i> provides better pigweed control than <i>Prowl</i> or <i>Sonalan</i>. • <i>Trifluralin</i> should be tank mixed with <i>Eptam</i>. 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) OR (Dual II Magnum, Cinch)	1.27	1.33 pt 7.62EC OR 1.33 pt 7.64EC	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • Refer to Table 5A for weed control and crop tolerance ratings. • PREPLANT INCORPORATED <i>Dual Magnum</i> minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce <i>Dual Magnum</i> 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. • <i>Dual Magnum</i> provides better yellow nutsedge control than <i>Outlook</i>. • <i>Prowl</i>, <i>trifluralin</i> or <i>Sonalan</i> can be tank mixed preplant incorporated for lambsquarters control. • <i>Pursuit</i> (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of <i>Basagran</i>, <i>Pursuit</i> or <i>Raptor</i> may be necessary for additional broadleaf control. • DO NOT apply <i>Dual Magnum</i> 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	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • Refer to Table 5A for weed control and crop tolerance ratings. • PREPLANT INCORPORATED <i>Outlook</i> minimizes the danger of bean injury. • DO NOT apply if soil is cracking and beans are in the crook stage. • Reduce <i>Outlook</i> rate to 12 oz/A on coarse-textured soils with low organic matter. • Navy and black beans are more sensitive to <i>Outlook</i> applications than to <i>Dual Magnum</i>. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • <i>Outlook</i> provides better pigweed and nightshade control than <i>Dual Magnum</i>. • <i>Prowl</i>, <i>trifluralin</i>, or <i>Sonalan</i> can be tank mixed preplant incorporated for lambsquarters control. • <i>Pursuit</i> (2 oz) can be tank mixed for nightshade and additional broadleaf control. • A postemergence application of <i>Basagran</i>, <i>Pursuit</i>, or <i>Raptor</i> may be necessary for additional broadleaf control. • DO NOT apply <i>Outlook</i> 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
<i>(continued)</i>				
Annual grasses	metolachlor <i>(Parallel PCS)</i>	1.3	1.33 pt 8EC	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • <i>Parallel PCS</i> 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, <i>Parallel PCS</i> 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 <i>Dual Magnum/ Dual II Magnum/Cinch</i> (s-metolachlor). • Refer to Table 5A for weed control and crop tolerance ratings. • See remarks and limitations for <i>Dual Magnum</i>. • DO NOT use on adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	glyphosate + s-metolachlor <i>(Sequence)</i> + ammonium sulfate	1.64	3 pt 2.25L + 17 lb/100 gal	<ul style="list-style-type: none"> • May be applied preplant or preemergence. • Sequence contains 0.9 lb a.e./A of glyphosate and 1.2 pt/A of <i>Dual Magnum</i>. • <i>Sequence</i> is best used to control existing vegetation prior to planting no-till dry beans with the residual control of <i>Dual Magnum</i>. • 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 <i>(Permit/Sandea)</i>	0.023	0.67 oz 75DG	<ul style="list-style-type: none"> • May be applied preplant incorporated or preemergence. • Refer to Table 5A for weed control and crop tolerance ratings. • Reduce the rate of <i>Permit/Sandea</i> to 0.5 oz/A on lighter textured soils with low organic matter. • <i>Permit/Sandea</i> can cause injury under cool and wet growing conditions. • Delayed maturity may result from applications of <i>Permit/Sandea</i>. • Dry bean varieties and classes vary in their tolerance to <i>Permit/Sandea</i>. From MSU research, CAUTION should be taken when applying <i>Permit/Sandea</i> to kidney and black beans. • <i>Permit/Sandea</i> can be tank mixed with <i>Eptam</i> for grass and additional lambsquarters control. • <i>Permit/Sandea</i> can be tank mixed with metolachlor products or <i>Outlook</i> for annual grass control. • <i>Permit/Sandea</i> will not control ALS-resistant weed species. • DO NOT plant SUGAR BEETS within 21 months of a <i>Permit/Sandea</i> application. • Refer to label and Table 12 for crop rotation restrictions.

(Continued on next page)

Dry Edible Beans – Soil Applied (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual broadleaves	imazethapyr <i>(Pursuit)</i>	0.031	2 oz 2L	<ul style="list-style-type: none"> • 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 <i>Pursuit</i> if cold and/or wet conditions are present or predicted to occur within 1 week of application. • Delayed maturity may result from applications of <i>Pursuit</i>. 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 <i>Pursuit</i> may be applied. • <i>Pursuit</i> can be tank mixed and applied preplant incorporated with <i>Eptam</i> plus <i>trifluralin</i>; <i>Prowl</i> or <i>Sonalan</i>; or <i>Dual Magnum</i> or <i>Outlook</i>; or preemergence with <i>Dual Magnum</i> or <i>Outlook</i>. <i>Pursuit</i> in these mixes will control eastern black nightshade. • Preemergence applications require rainfall for incorporation. Rotary hoe if no rainfall occurs within 7 days. • <i>Pursuit</i> will NOT control common ragweed. • Dry bean varieties vary in their sensitivity to <i>Pursuit</i>. 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 <i>(Reflex)</i>	0.25	1 pt 2L	<ul style="list-style-type: none"> • May be applied preplant surface or preemergence. • Refer to Table 5C for weed control and crop tolerance ratings. • <i>Reflex</i> 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. • <i>Reflex</i> can be applied only in the Lower Peninsula of Michigan. • DO NOT apply <i>Reflex</i> or other fomesafen products to the same field in CONSECUTIVE years. • The maximum use rate of <i>Reflex</i> 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 (<i>Assure II/Targa</i>)	0.044	7 oz 0.88L	<ul style="list-style-type: none"> • 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 <i>Assure II/Targa</i> application and dry bean harvest. • <i>Assure II/Targa</i> can be tank mixed with <i>Basagran</i> for foxtails and barnyardgrass. Increase the <i>Assure II/Targa</i> rate by 2 oz. • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • <i>Assure II/Targa</i> (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.
	+		+	
	crop oil concentrate OR surfactant		1% OR 0.25%	
	fluzifop-P-butyl (<i>Fusilade DX</i>)	0.188	12 oz 2L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Apply 6 oz/A of <i>Fusilade DX</i> to control volunteer corn. • Allow 60 days between <i>Fusilade DX</i> application and dry bean harvest. • Two applications 7-14 days apart are usually needed for control of perennial grasses. • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • DO NOT apply more than 48 oz/A of <i>Fusilade DX</i> per season. • Refer to label and Table 12 for crop rotation restrictions.
+	+			
crop oil concentrate	1%			
	sethoxydim (<i>Poast</i>)	0.19	1 pt 1.5SC	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Reduced rates of <i>Poast</i> (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 <i>Poast</i> application and dry bean harvest. • <i>Poast</i> is generally less effective than other postemergence grass herbicides for perennial grass control. • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • Refer to label and Table 12 for crop rotation restrictions.
+	+			
crop oil concentrate + ammonium sulfate	1 qt + 2.5 lb			

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Dry Edible Beans — Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations	
<i>(continued)</i>					
Grasses	clethodim <i>(Select/Arrow)</i>	0.094	6 oz 2EC	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Reduced rates of <i>Select/Arrow</i> (4-5 oz/A) or <i>Select Max</i> (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. • <i>Select/Arrow</i> or <i>Select Max</i> can be tank mixed with <i>Basagran</i>. Increase the <i>Select/Arrow</i> rate to 8-10 oz/A and the <i>Select Max</i> rate to 12 oz/A and apply with crop oil concentrate (1% v/v). • Tank mixes with <i>Pursuit</i> and <i>Raptor</i> are not recommended — grass antagonism will occur. • <i>Select/Arrow</i> (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 <i>Select Max</i> (12 + 12 oz/A) are needed to control 4 to 12 inch quackgrass. • Refer to label and Table 12 for crop rotation restrictions. 	
	+ crop oil concentrate OR <i>(Select Max)</i>	0.068	9 oz 0.97EC		
+ surfactant		0.25%			
+ ammonium sulfate		2.5 lb			
Annual Broadleaves	bentazon <i>(Basagran/Broadloom)</i>	0.75	1.25 pt 4L		<ul style="list-style-type: none"> • 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 trifoliolate 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.
+ crop oil concentrate			1 qt		

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Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual Broadleaves	halosulfuron (<i>Permit</i>) + surfactant	0.023	0.67 oz 75WG + 0.25%	<ul style="list-style-type: none"> • 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 trifoliolate leaves. • DO NOT apply if dry beans have begun to flower. • <i>Permit</i> can be tank-mixed with other herbicides for additional broadleaf and grass control. • Dry bean varieties and classes vary in their tolerance to <i>Permit</i>. 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 <i>Permit</i> application. • Refer to Table 12 for crop rotation restrictions.
	imazethapyr (<i>Pursuit</i>) + surfactant	0.031	2 oz 2L + 0.25%	<ul style="list-style-type: none"> • 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 trifoliolate before application. • DO NOT apply if dry beans have begun to flower. • Apply <i>Pursuit</i> 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 <i>Basagran</i> is added to “safen” this application. • Increase the rate of <i>Basagran</i> (16 oz) when tank mixed with <i>Pursuit</i> to control common cocklebur and jimsonweed. • Delayed maturity may result from applications of <i>Pursuit</i>. 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 <i>Pursuit</i>. 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.

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Dry Edible Beans – Postemergence (continued)

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Annual Broadleaves	imazamox (<i>Raptor</i>)	0.032	4 oz 1L	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • Most effective on small weeds (less than 2 inches).
	+ bentazon (<i>Basagran</i>)	0.25	8 oz 4L	
	+ crop oil concentrate		+ 1%	<ul style="list-style-type: none"> • Beans MUST HAVE one fully expanded trifoliolate 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 <i>Raptor</i> with crop oil concentrate (1% v/v) or a non-ionic surfactant (0.25% v/v). • At least 8 fl oz of <i>Basagran</i> must be tank mixed with <i>Raptor</i>, if ammonium sulfate (12-15 lb/100 gal) or 28% liquid nitrogen (2.5% v/v) are added. <i>Basagran</i> “safens” this application. • Increase the rate of <i>Basagran</i> (16 oz) when tank mixed with <i>Raptor</i> 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 <i>Raptor</i> + <i>Basagran</i> on adzuki beans. <i>Basagran</i> causes significant injury to adzuki beans. • Refer to label and Table 12 for crop rotation restrictions.
	+ ammonium sulfate		+ 2.5 lb	
	fomesafen (<i>Reflex</i>)	0.25	1 pt 2L	
	+ surfactant		+ 0.25%	<ul style="list-style-type: none"> • 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 <i>Reflex</i>. • Beans MUST HAVE one fully expanded trifoliolate 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. • <i>Reflex</i> can be tank-mixed with <i>Basagran</i>, <i>Raptor</i>, or <i>Pursuit</i>. Include a COC when tank-mixing <i>Reflex</i> + <i>Basagran</i>. ONLY include a non-ionic surfactant when tank-mixing with <i>Raptor</i> or <i>Pursuit</i>. DO NOT add AMS or 28%N. • <i>Reflex</i> can be applied only in the Lower Peninsula of Michigan. • DO NOT apply <i>Reflex</i> 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 (<i>Varisto</i>)	0.68	21 oz 4.18L	
	+ crop oil concentrate		+ 1%	<ul style="list-style-type: none"> • Refer to Table 5A for weed control and crop tolerance ratings. • <i>Varisto</i> at 21 fl oz/A is equivalent to 21 fl oz/A of <i>Basagran</i> 4L and 4 fl oz/A of <i>Raptor</i>. • Most effective on small weeds (less than 2 inches). • Beans must have one fully expanded trifoliolate 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.
	+ ammonium sulfate		+ 2.5 lb	

Table 5C – Preharvest Treatments in Dry Edible Beans

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
Preharvest	glyphosate (<i>many</i>) + ammonium sulfate	0.75 lb a.e.	See Table 10 + 17 lb/100gal	<ul style="list-style-type: none"> • 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, <i>Duramax</i>, <i>Durango DMA</i>, <i>Touchdown Total</i> and <i>Traxion</i> 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 (<i>Gramoxone SL 2.0</i>) + surfactant	0.3-0.5	1.2–2 pt 2SL + 0.25%	<ul style="list-style-type: none"> • <i>Gramoxone SL 2.0</i> 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 <i>Gramoxone SL 2.0</i>; or split applications at the lower rates. Split applications may improve vine coverage. DO NOT exceed 2.0 pt/A of <i>Gramoxone SL 2.0</i>. • Do not harvest within 7 days of application.
	paraquat (<i>Parazone</i>) + surfactant	0.5	1.33 pt 3SL + 0.25%	<ul style="list-style-type: none"> • <i>Parazone</i> is a restricted-use pesticide. • <i>Parazone</i> contains the same active ingredient as <i>Gramoxone SL 2.0</i> (paraquat), but is at a different concentration. • See the Remarks and Limitation section for <i>Gramoxone SL 2.0</i>.
	saffluenacil (<i>Sharpen</i>) + methylated seed oil + ammonium sulfate	0.023	1 oz 2.85L + 1% + 17 lb/100 gal	<ul style="list-style-type: none"> • 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. • <i>Sharpen</i> 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. • <i>Sharpen</i> 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.

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Preharvest Treatments in Dry Edible Beans *(continued)*

Weed Controlled	Herbicide	Rate lb/A a.i.	Formulation/A	Remarks and Limitations
<i>(continued)</i>				
Preharvest	flumioxazin (<i>Valor</i>) + methylated seed oil	0.05	1.5 oz 51WG + 1 qt	<ul style="list-style-type: none"> • 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. • <i>Valor</i> can be applied at rates up to 2 oz/A. • Dry beans can be harvested 5 days after <i>Valor</i> application. However, it generally takes 7 to 14 days to reach maximum desiccation activity. • Dry bean desiccation is similar to that from <i>Gramoxone</i> and glyphosate; however, the spectrum of weed control is not as broad. • <i>Valor</i> provides residual activity that may reduce winter annual growth. • Follow sprayer clean-up instructions — residues of <i>Valor</i> can be trapped in poly-tanks and hoses if not adequately cleaned. • Crop rotation restrictions are dependent on rainfall, <i>Valor</i> use rate and tillage. • Rotation restrictions for 2 oz or less of <i>Valor</i> 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 <i>Valor</i> preharvest treatment resulted in major sugar beet stand reduction. Tillage reduced the effect of <i>Valor</i> on sugar beet; however, slight injury may occur on sandier soils. • Refer to label and Table 12 for crop rotation restrictions.
	carfentrazone (<i>Aim</i>) + methylated seed oil	0.03	2 oz 2EC + 1% v/v	<ul style="list-style-type: none"> • 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. • <i>Aim</i> alone is not as effective as <i>Sharpen</i>, glyphosate, <i>Gramoxone</i>, or <i>Valor</i> for dry bean desiccation. • Tank mixtures with <i>Gramoxone</i> 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 <i>Aim</i> alone.

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

	SITE OF ACTION	CROP TOLERANCE**	ANNUAL BROADLEAVES										ANNUAL GRASSES							PERENNIALS					
			COCKLEBUR	JIMSONWEED	LAMBSQUARTERS	NIGHTSHADE (E. BLACK)	PIGWEEED	RAGWEEED (COMMON)	SMARTWEEED	VELVETLEAF	WILD MUSTARD	BARNYARDGRASS	CRABGRASS	GIANT FOXTAIL	GREEN FOXTAIL	YELLOW FOXTAIL	FALL PANICUM	WITCHGRASS	SANDBUR	BINDWEEED (FIELD)	BINDWEEED (HEDGE)	CANADA THISTLE	QUACKGRASS	YELLOW NUTSEEDGE	
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 ₂ O/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.

