NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

INTEGRATED PEST MANAGEMENT (IPM)

(Ac.)

CODE 595

DEFINITION

A site-specific combination of pest prevention, pest avoidance, pest monitoring, and pest suppression strategies.

PURPOSE

1. Prevent or mitigate pesticide risks to water quality through leaching, solution runoff and adsorbed runoff.
2. Prevent or mitigate pesticide risks to soil, water, air, plants, animals and humans through drift and volatilization.
3. Prevent or mitigate pesticide risks to pollinators and other beneficial species through direct contact.
4. Prevent or mitigate cultural pest suppression risks to soil, water, air, plants, animals and humans.

CONDITIONS WHERE PRACTICE APPLIES

On all lands where pests will be managed.

CRITERIA

General Criteria Applicable to All Purposes

IPM strategies (Prevention, Avoidance, Monitoring and Suppression or "PAMS") shall be employed to prevent or mitigate pest management risks for identified natural resource concerns.

An IPM plan utilizing PAMS strategies will be developed in accordance with this standard to document how specific pest management risks will be prevented or mitigated. The IPM plan must be crop and/or land use specific and adhere to applicable elements and guidelines accepted by the local Land Grant University or Extension.

If a full IPM system is not feasible, appropriate IPM techniques must still be utilized to adequately prevent or mitigate pest management risks for identified natural resource concerns.

Additional criteria to prevent or mitigate pesticide risks to water quality through leaching, solution runoff and adsorbed runoff

For identified water quality concerns related to pesticide leaching, solution runoff and adsorbed runoff, the current version of the USDA-NRCS WIN-PST program will be used to evaluate potential risks to humans and/or fish, as appropriate, for each pesticide to be used.

The minimum level of mitigation required for each resource concern is based on the final risk ratings in the "WIN-PST Soil/Pesticide Interaction Hazard Ratings" Table below:

WIN-PST Identified Hazard Rating	Minimum Mitigation Index Score Level Needed
Low or Very Low	None Needed
Intermediate	20
High	40
Extra High	60 or more

Use *Agronomy Technical Note 3, Pest Management in the Conservation Planning Process - Table II* to determine if planned conservation practices provide adequate mitigation. If they do not, use *Agronomy Technical Note 3 - Table I* to apply appropriate IPM techniques with this practice.

Additional criteria to prevent or mitigate pesticide risks to soil, water, air, plants, animals and humans through drift and volatilization

For identified natural resource concerns related to pesticide drift, use Agronomy Technical Note 3, Pest Management in the Conservation Planning Process – Table II to determine if planned conservation practices provide adequate mitigation. If they do not, use Agronomy Technical Note 3 - Table I to apply appropriate IPM techniques with this practice. The minimum level of mitigation required for drift is an index score of 20.

For Volatile Organic Compound (VOC) emission concerns, apply at least one IPM mitigation technique from the Pesticide Volatilization section of Agronomy Technical Note 3 - Pest Management in the Conservation Planning Process.

Additional criteria to prevent or mitigate pesticide risks to pollinators and other beneficial species through direct contact

For direct contact pesticide risks to pollinators and other beneficial species, apply at least two IPM mitigation techniques from the Pesticide Direct Contact section of Agronomy Technical Note 3 - Pest Management in the Conservation Planning Process.

Additional criteria to prevent or mitigate cultural pest suppression risks to soil, water, air, plants and animals

For identified natural resource concerns related to cultural pest suppression, (e.g. soil erosion concerns with tillage for weed control or air quality concerns with burning for weed control), natural resource concerns shall be addressed to eFOTG quality criteria levels.

CONSIDERATIONS

IPM strategies that keep pest populations below economically damaging levels and minimize pest resistance should be utilized because they also help prevent unnecessary pest management risks to natural resources and humans.

For noxious weed and invasive species control, the minimum level of pest suppression necessary to meet natural resource objectives should be used, however, for the eradication of invasive species, the acceptable pest threshold may be zero.

IPM Prevention, Avoidance, Monitoring, and Suppression (PAMS) techniques include:

- Prevention – Activities such as cleaning equipment and gear when leaving an infested area, using pest-free seeds and transplants, and irrigation scheduling to limit situations that are conducive to disease development.
- Avoidance – Activities such as maintaining healthy and diverse plant communities, using pest resistant varieties, crop rotation, and refuge management.
- Monitoring – Activities such as pest scouting, degree-day modeling, and weather forecasting to help target suppression strategies and avoid routine preventative treatments.
- Suppression – Activities such as the judicious use of cultural, biological and chemical control methods that reduce or eliminate a pest population or its impacts while minimizing risks to non-target organisms.

IPM guidelines from the local Land Grant University or Extension may be supplemented with information from appropriately certified professionals.

When providing technical assistance to organic producers, the IPM approach to managing pests should be consistent with the USDA-Agricultural Marketing Service National Organic Program standard which includes:

- A diverse crop rotation that reduces habitat for major pests and increases habitat for natural enemies
- Use of “farmscaping” principles to create borders of beneficial species habitat
- Farming techniques to improve soil quality
- Planting of locally adapted, pest resistant crop cultivars.

Adequate plant nutrients and soil moisture, including favorable pH and soil quality, can reduce plant stress, improve plant vigor and increase the plant's overall ability to tolerate pests.

On irrigated land, irrigation water management should be designed to avoid conditions conducive to disease development and minimize offsite contaminant movement.

Producers should be reminded that they are responsible for following all pesticide label instructions and complying with all applicable Federal, state and local regulations, including those that protect Threatened and Endangered Species.

Enhancement Considerations

1. A more intensive level of IPM focused primarily on prevention and avoidance strategies can further minimize pest management risks to natural resources and humans.
2. Precision pesticide application techniques in an IPM system can further minimize pesticide risks to natural resources and humans.

PLANS AND SPECIFICATIONS

The IPM plan shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

The IPM plan shall include at a minimum:

1. Plan map and soil map of site/affected area, if applicable (use conservation plan maps if available).
2. Location of sensitive resources and setbacks, if applicable (use conservation plan maps if available).
3. Interpretation of the environmental risk analysis. Note: all pesticide label requirements and federal, state, and local regulations must be followed for all pesticide applications.
4. Identification of appropriate mitigation techniques. See Agronomy Technical Note 3 - Table I for pesticide risk mitigation management techniques.
5. A list of pest prevention and avoidance strategies that will be implemented, if applicable.
6. A scouting plan and threshold levels for each pest, if applicable.
7. Other monitoring plans, if applicable, such as weather monitoring to indicate when pesticide application for prevention is warranted.
8. A list of accepted pest thresholds or methods to determine thresholds that warrant treatment, if applicable.

Note: Items 5, 6, 7 and 8 are required to document a full IPM system, but they may not be applicable when only a limited number of mitigation techniques are sufficient to address identified natural resource concerns.

Record Keeping. The following records, where applicable, shall be maintained by the producer:

1. Monitoring or scouting results including the date, pest population/degree of infestation, and the crop or plant community condition.
2. When and where each pest suppression technique was implemented.
3. When and where special IPM techniques were implemented to mitigate site-specific risks (e.g. soil incorporation of a pesticide to reduce its surface runoff to a nearby stream).

Note: Applicability will depend on the level of IPM adoption and mitigation requirements.

OPERATION AND MAINTENANCE

The IPM plan shall include appropriate operation and maintenance items for the client. These may include:

- Review and update the plan periodically in order to incorporate new IPM strategies, respond to cropping system and pest complex changes, and avoid the development of pest resistance.
- Maintain mitigation techniques identified in the plan in order to ensure continued effectiveness.
- Calibrate application equipment according to Extension and/or manufacturer recommendations before each season of use and with each major chemical change.

- Maintain records of pest management for at least two years. Pesticide application records shall be in accordance with USDA Agricultural Marketing Service's Pesticide Recording Keeping Program and site specific requirements.

REFERENCES

National Information System for the Regional IPM Centers – IPM Elements and Guidelines:

http://www.ipmcenters.org/ipmelements/index.cfm

USDA-AMS National Organic Program, National List of Allowed and Prohibited Substances.

http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateN&navID=NationalListLinkNOPNationalOrganicProgramHome&rightNav1=NationalListLinkNOPNationalOrganicProgramHome&topNav=&leftNav=NationalOrganicProgram&page=NOPNationalList&resultType=&acct=nopgeninfo

USDA-NRCS GM-190-404 Pest Management Policy:

http://directives.sc.egov.usda.gov/RollupViewer.aspx?hid=17015

Using Farming Bill Programs for Pollinator Conservation:

http://plants.usda.gov/pollinators/Using_Farm_Bill_Programs_for_Pollinator_Conservation.pdf

Note: The Attached NRCS Technical Note will be filed in the NRCS eDirectives system after the public review is completed and final comments incorporated. It is attached here for the reviewer's convenience

Agronomy Technical Note 3:

Pest Management in the Conservation Planning Process

Introduction

This technical note is designed to help conservation planners address pest management concerns in the conservation planning process.

NRCS Pest Management Policy is contained in GM_190_404_A-D, Amendment 12, dated March 2009. http://directives.sc.egov.usda.gov/RollupViewer.aspx?hid=17015

NRCS Pest Management Policy states that we have four roles in pest management:

(1) Evaluate environmental risks associated with a client's probable pest suppression strategies.

(2) Provide technical assistance to clients to mitigate identified environmental risks.

(3) Assist clients to adopt IPM techniques that protect natural resources.

(4) Assist clients to:

(i) Inventory, assess, and suppress noxious and invasive weeds on non-cropland.

(ii) Suppress weeds to ensure successful implementation and/or maintenance of permanent vegetative conservation practices (e.g., buffer type practices).

Roles 1, 2 and 3 are addressed in the conservation planning process with the application of **Integrated Pest Management (IPM) (Code 595)** and other conservation practices. Even though NRCS does not provide technical assistance for managing pests on cropland, NRCS can work with Extension, producers and their crop consultants to integrate IPM into the conservation planning process to prevent and/or mitigate pest management environmental risks.

Integrated Pest Management (IPM) (Code 595) is designed to support the adoption of a full IPM system: a site-specific combination of pest Prevention, Avoidance, Monitoring, and Suppression strategies, or IPM 'PAMS' strategies.

The two primary goals of the 595 standard are to prevent environmental risks if possible and then to mitigate environmental risks that cannot be prevented.

A full IPM system prevents and avoids *pests* as much as possible to reduce the need for *pest suppression*, including the use of hazardous pesticides.

A full IPM system also includes carefully monitoring pest populations and only utilizing suppression techniques when the economic benefit is greater than the cost. These economic pest thresholds must be developed for each pest in each cropping system based on the biology of the crop, the pest, and the pest's natural enemies. The economic threshold is then dynamically adjusted based on the cost of the pest suppression technique and the projected value of the crop.

And finally, a full IPM system must also mitigate environmental risks that cannot be prevented by utilizing application techniques that minimize risks to non-target species in the field and reduce off-site movement of hazardous pesticides.

In some cropping systems a full IPM system will not be feasible because appropriate IPM technology has not been developed. **The 595 standard can be used to support the application of individual IPM techniques <u>if they appropriately mitigate site-specific pest suppression risks to natural resources and/or humans</u>.**

NOTE: Identified risks associated with planned pest suppression can also be addressed through other conservation practices or a system of conservation practices that includes 595.

Role 4 in our Pest Management Policy is addressed in the conservation planning process with the application of **Brush/Shrub Control (Code 314)** and **Herbaceous Weed Control (Code 315)** on non-cropland to address natural resource concerns related to plant pests, including invasive, noxious and prohibited plants. **Integrated Pest Management (IPM) (Code 595) should be used to prevent and/or mitigate pest management environmental risks associated with the application of 314 and 315.**

NRCS Pesticide Risk Analysis in the Conservation Planning Process

The United States Environmental Protection Agency (EPA) regulates pesticides under two major federal statutes: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA), both amended by the Food Quality Protection Act (FQPA) of 1996.

Under FIFRA, pesticides intended for use in the United States must be registered (licensed) by EPA before they may be sold or distributed in commerce. EPA will register a pesticide if scientific data provided by the applicant show that, when used according to labeling directions, it will not cause "unreasonable adverse effects on the environment". FIFRA defines "unreasonable adverse effects on the environment" as "…any unreasonable risk to man or the environment, taking into account the economic, social and environmental costs and benefits of the use of any pesticide…".

Under FFDCA, EPA is responsible for setting tolerances (maximum permissible residue levels) for any pesticide used on human food or animal feed.

With the passage of the Food Quality Protection Act (FQPA) in 1996, both major pesticide statutes were amended. FQPA mandated a single, health-based standard for setting tolerances for pesticides in foods; provided special protections for infants and children; expedited approval of safer pesticides; and required periodic re-evaluation of pesticide registrations. FQPA also limited the consideration of benefits when setting tolerances. FQPA did not address the consideration of ecological risk.

The EPA pesticide registration process, including any pesticide label use restrictions, is based on a comprehensive *pesticide risk assessment* for typical conditions under which the pesticide will be used. This risk assessment is designed to address many different risks to many different species that might be impacted by a particular pesticide use, but it does not include how these risks can vary substantially across the landscape. **Even when a pesticide is applied according to pesticide label instructions, site-specific conditions may cause that pesticide to pose significant risks to nearby water resources.**

NRCS utilizes the Windows Pesticide Screening Tool (WIN-PST) for water quality pesticide risk analysis. The *risk analysis* done with WIN-PST for drinking water and aquatic habitat is not as comprehensive as the *risk assessment* that supports the EPA pesticide registration process, but it is sufficient to guide the site-specific application of mitigation techniques to address identified natural resource concerns. **NRCS uses WIN-PST to identify sensitive soil/pesticide combinations and what type of mitigation will help protect site-specific natural resources.**

Utilizing WIN-PST in the Conservation Planning Process

WIN-PST is the NRCS supported technical tool that is used to assess relative pesticide leaching, solution runoff, and adsorbed runoff risk to water quality. WIN-PST analysis is based on:

- Soil properties
- Pesticide physical properties
- Pesticide toxicity data

The major components of the NRCS non-point source water quality pesticide risk analysis are:

1. The potential for pesticide loss in
   - water that leaches below the rootzone;
   - water that runs off the edge of the field;
   - sediment that leaves the field in run off;
2. Chronic (long term) pesticide toxicity to human drinking water and aquatic habitat;
3. And finally, the combination of pesticide loss potential with pesticide toxicity to provide site-specific ratings for pesticide hazards in leaching, solution runoff, and sediment adsorbed runoff.

The final ratings are called **WIN-PST Soil/Pesticide Interaction Hazard Ratings**. The term "hazard" is used even though these ratings include both pesticide toxicity and a partial exposure analysis based on field conditions. It is the responsibility of the planner to put these hazard ratings into proper context by using their professional judgment to assess the potential for pesticide movement below the bottom of the rootzone and beyond the edge of the field to identified ground or surface water resources, as well as the potential for that pesticide contamination to impact the water resources based on watershed and waterbody characteristics. This entire process is considered a “risk” analysis, so the term “hazard” is used in the final WIN-PST ratings to remind users that they must put these “partial” ratings into the proper context to fully analyze risk to human drinking water and aquatic habitat.

WIN-PST provides ratings for 5 different categories of resource concerns:

- **‘Human Hazard Leaching**’ for leaching risk to drinking water
- **‘Fish Hazard Leaching**’ for leaching risk to aquatic habitat (lateral flow to streams)
- **‘Human Hazard Solution**’ for solution runoff risk to drinking water
- **‘Fish Hazard Solution**’ for solution runoff risk to aquatic habitat
- ‘**Fish Hazard Adsorbed**’ for adsorbed runoff risk to aquatic habitat including benthic organisms.

  Note: there is no WIN-PST rating for ‘Human Hazard Adsorbed’ since human exposure to sediment is minimal.

The final “WIN-PST Soil/Pesticide Interaction Hazard Ratings” are ‘**Very Low**’, ‘**Low**’, ‘**Intermediate**’, ‘**High**’ or ‘**Extra High**’.

To fully analyze the risk of a pesticide to a human drinking water supply or aquatic habitat, the user must consider the impact of: flow path characteristics between the field and the waterbody of concern (through the vadose zone to groundwater or overland flow to surface water); watershed characteristics; and waterbody characteristics.

On the higher end of the overall risk spectrum, the flow path from the field to the waterbody will be short and direct with little opportunity for pesticide degradation or assimilation. The watershed will have significant pesticide loading potential from numerous fields that are managed in a similar fashion as the field being analyzed. And finally, the waterbody will be sensitive to pesticide contamination due to limited flushing and dilution.

On the lower end of the overall risk spectrum, the flow path to the waterbody will be long and arduous with lots of opportunity for pesticide degradation and assimilation. The watershed will have only a few fields that are managed in a similar fashion so there will be limited loading potential for the pesticide in question. And finally, the waterbody will not be very sensitive to pesticide contamination due to lots of flushing and dilution.

If the overall risk is low, the conservation planner will not identify a water quality concern related to the use of pesticides, so no mitigation will be needed. If the overall risk is high, a suite of conservation practices may be required to provide enough mitigation to meet eFOTG quality criteria. Appropriate mitigation should be chosen based on final WIN-PST hazard ratings for applicable pesticide loss pathways to identified water resource concerns.

To conduct a WIN-PST analysis:

1. Choose all the major soil types that cover 10% or more of the field or planning area
2. Choose all the pesticides that the client is planning to use
   (Note that each pesticide can be chosen by product name, EPA registration number, or active ingredient name, but the final ratings are specific to each active ingredient)
3. Analyze the results for each soil/pesticide interaction
4. **Select the highest hazard soil/pesticide combination for the identified natural resource concern(s) to plan appropriate mitigation**

In the example below, there is a solution runoff concern to aquatic habitat. Pesticides X and Y are planned for a field that contains Soils A, B and C.

Soil/Pesticide Combination	WIN-PST Fish Hazard Solution Rating
Soil A - Pesticide X (20% of the area)	Very Low
Soil B - Pesticide X (50% of the area)	Low
Soil C - Pesticide X (25% of the area)	Intermediate
Soil A - Pesticide Y (20% of the area)	Low
Soil B - Pesticide Y (50% of the area)	Intermediate
Soil C - Pesticide Y (25% of the area)	**High**

In this example, the "High" rating for the combination of Soil C with Pesticide Y would be selected to plan an appropriate level of mitigation to protect the aquatic habitat.

<u>Applying the Integrated Pest Management (IPM) (Code 595) Standard</u>

If a conservation planner identifies natural resource concerns related to pest management activities, 595 may be applied to address those concerns.

If a *pesticide* related water resource concern is identified, the 595 standard requires a specific level of mitigation based on WIN-PST results.

For identified water quality concerns related to pesticide leaching, solution runoff and adsorbed runoff, WIN-PST must be used to evaluate potential hazards to humans and/or fish as appropriate, for each pesticide to be used. The minimum level of mitigation required for each resource concern is based on the final "WIN-PST Soil/Pesticide Interaction Hazard Ratings" Table below:

WIN-PST Identified Final Hazard Rating	Minimum Mitigation Index Score Level Needed
Low or Very Low	None Needed
Intermediate	20
High	40
Extra High	60 or more

Mitigation requirements can be met with IPM techniques and/or conservation practices. See Table I at the end of this technical note for mitigation index values for IPM techniques and Table II for mitigation index values for conservation practices. The index values from Table I can be added to the index values from Table II to calculate the total index score for the planned conservation system.

For example, if "Fish Hazard Solution" is identified as a pathway of concern for an identified water resource and WIN-PST reports an 'Intermediate' rating, IPM techniques from Table I or conservation practices from Table II that address solution runoff must be applied so that the sum of the index values from either table in the 'Solution Runoff' column for the selected IPM mitigation techniques and conservation practices will be 20 or more. Similarly, a 'High' rating would require a sum of 40 or more, and an 'Extra High' rating would require a sum of 60 or more. This will be the case for all natural resource concerns and all applicable pesticide loss pathways identified by the conservation planner with the aid of WIN-PST.

As an alternative to mitigation, the conservation planner can work with Extension personnel, published Extension recommendations, the producer or their crop consultant to see if there are lower risk alternatives that still meet the producer's objectives. *A producer can choose to use a pesticide that has risk if they also apply appropriate mitigation, or they can substitute a low risk pesticide that needs no mitigation –* ***pesticide choice is the producer's decision****.*

Pesticide drift has also been identified as a major pesticide loss pathway. ***Note that drift***

can be a major pesticide loss pathway to surface water in some cases. *Appropriate mitigation for drift may be required in addition to mitigation for leaching, solution and adsorbed pesticide loss pathways in order to adequately protect a surface water resource.*

Predicting spray drift is very difficult because it is influenced by many rapidly changing site-specific factors including wind speed, relative humidity, temperature and the presence of temperature inversions. Spray droplet size as determined by nozzle configuration and pressure also plays an important role in spray drift.

If the conservation planner identifies a natural resource concern related to pesticide spray drift, the minimum level of mitigation required is an index score of 20. The index values from Table I can be added to the index values from Table II to calculate the total index score for the planned conservation system.

Pesticide Volatilization has been identified as a contributor to air quality concerns through Volatile Organic Compound (VOC) emissions that are a key precursor to ground-level ozone. The state of California has local air shed rules and regulations in place for non-attainment areas, and other states may follow.

Pesticide related VOC emissions are influenced by the vapor pressure the active ingredient and the way the pesticide product is formulated. Emulisifiable concentrates have higher VOC emissions than other formulations. If the conservation planner identifies a VOC related natural resource concern, one or more of the following VOC mitigation techniques must be applied:

1. Use lower VOC emitting pesticide formulations - specifically eliminating the use of emulsifiable concentrates when other formulations are available;
2. Use precision pesticide application or “Smart Sprayer” technology including:

   - Near-infrared-based weed sensing systems

   - Map/GPS-based variable rate application

   - Sonar-based vegetation sensors

   - Computer controlled spray nozzles

   - Hoods and shields to direct applications

   - Wicks

   - Backpacks

   - Remote sensing, GIS, or other spatial information system

   - Steam desiccation systems

   - Fumigant delivery with precision application

   - Fumigant delivery with drip irrigation

   - Fumigant soil retention using precision water application;
3. Use impermeable tarps to cover fumigated areas;
4. Shift dates of fumigant application to outside the May - October timeframe to move VOC emissions out of the non-attainment period;
5. Use solarization (e.g. irrigate and tarp during summer fallow to kill pests without fumigation;
6. Use biofumigants or other soil treatments (e.g. thiosulfate) instead of pesticides.
7. Fallow fields for several years before replanting an orchard crop or inoculate young trees (e.g. with yeast) to reduce fumigant use;

Pesticide Direct Contact can affect pollinators and other beneficial species while pesticides are being applied and later when pollinators and other beneficial species reenter the treated area. This direct exposure to pesticides can occur even when spray drift is minimized.

For more information, see *How to Reduce Bee Poisoning from Pesticides* available at: http://extension.oregonstate.edu/catalog/pdf/pnw/pnw591.pdf

If the conservation planner identifies a pesticide direct contact concern to pollinators and other beneficial species, choose two or more of the following mitigation techniques:

1. Time pesticide applications when pollinators are least active (e.g. at night or when temperatures are low.) Note that dewy nights may cause an insecticide to remain wet on the foliage and be more toxic to bees the following morning, so exercise caution;
2. Time pesticide applications when crops are not in bloom and keep fields weed free to

discourage pollinators from venturing into the crop;

3. Use pesticides that are less toxic to pollinators and beneficial species. Note: all pesticide recommendations must come from Extension or an appropriately certified crop consultant.
4. Use selective insecticides that target a narrow range of insects (e.g. *Bacillus thuringiensis (Bt)* for moth caterpillars) to reduce harm to beneficial insects like bees;
5. Use liquid formulations instead of dusts and fine powders that may become trapped in the pollen collecting hairs of bees and consequently fed to developing larvae;
6. Use alternatives to insecticides such as pheromones for mating disruption and kaolin clay barriers for fruit crops;

Cultural pest management techniques can cause natural resource degradation. For example, tillage for weed control can cause soil erosion and burning for weed control can cause air pollution. All natural resource concerns from all forms of pest management should be evaluated, and significant natural resource concerns should be addressed to eFOTG quality criteria levels.

Developing the IPM Plan

IPM elements and guidelines from Extension or the Land Grant University should be utilized where available. A national listing is available at: http://www.ipmcenters.org/ipmelements/index.cfm. The goal is to develop an efficient IPM system that uses prevention, avoidance, monitoring, and then finally judicious suppression when a pest population exceeds an economic threshold. **IPM helps assure that unnecessary environmental risks are avoided.**

The best way to develop a good IPM system is to consider economics, efficacy, and environmental risk all at the same time.

Traditionally, IPM plans used to focus on economics and efficacy (including resistance management). Environmental risk reduction was an indirect benefit of an efficient IPM system.

With the advent of the National IPM Roadmap in 2004, environmental risk reduction became a core principle of IPM and is now just as important as economics and efficacy. The National IPM Roadmap can be viewed at: http://www.ipmcenters.org/Docs/IPMRoadMap.pdf.

Developing an IPM plan for a producer as part of the conservation planning process will allow the IPM Plan to directly address identified natural resource concerns as well as provide a broader context to area-wide pest management considerations and habitat management for beneficial species.

It may take several passes through the IPM planning process to achieve all of the producer's goals. An efficient IPM system may still have risks to site-specific natural resource concerns. Some of the risky suppression alternatives may be critical to the function of the overall system. A second pass through the IPM planning process may reveal some additional or alternative IPM techniques that can help mitigate those site-specific risks to natural resources.

It is important to note that other conservation practices like Crop Rotation, Cover Crop, and Field Borders can also be used to develop an efficient IPM system. And additional conservation practices like Filter Strips, Residue Management and Irrigation Water Management can be used in the conservation system along with the 595 conservation practice to provide adequate mitigation.

The IPM mitigation techniques in Table I below are included in most Land Grant University IPM Programs, but we have to be careful because NRCS cannot make pesticide recommendations ourselves.

*We must be certain that Extension or an appropriately certified farm advisor supports and recommends the use of these techniques, because changing the way a pesticide is applied or substituting a different pesticide **is** making a pesticide recommendation, and that is not supported by NRCS Pest Management Policy. However, **NRCS can and should fully support the conservation benefits of these IPM mitigation techniques.***

Using Table I - *IPM Techniques for Reducing Pesticide Environmental Risk* and Table II - *Conservation Practices for Reducing Pesticide Environmental Risk*

Table I identifies IPM techniques and Table II identifies conservation practices that have the potential to prevent or mitigate pesticide impacts on water and air quality. Water quality is addressed through four separate pesticide loss pathways: leaching, solution runoff, adsorbed runoff, and drift. The pesticide drift pathway also applies to air quality.

Not all IPM techniques and conservation practices will be applicable to a given situation. Relative effectiveness ratings by pesticide loss pathway are indicated with an index value of 5, 10, or 15. The tables also identify how the IPM techniques and conservation practices function and the performance level that the index value is based on. Effectiveness of any IPM technique or conservation practice can be highly variable based on site conditions and how it is designed and maintained. The professional judgment of the planner will ultimately determine the effectiveness of a particular IPM technique or conservation practice for a particular field or planning area.

Tables I and II are based on available research specific to IPM technique or conservation practice, related research, and the best professional judgment of NRCS technical specialists. The ratings are relative index values as opposed to absolute values, much like the Conservation Practice Physical Effects (CPPE) matrix ratings. The index values are intended to help planners choose the best combination IPM techniques and conservation practices for their identified resource concerns. The ratings are based on the relative *potential* for IPM techniques or conservation practices to provide mitigation. The IPM techniques or conservation practices need to be specifically designed, implemented and maintained for the mitigation potential to be realized. Varying site conditions can influence mitigation effectiveness, but the relative index values indicate which conservation practices or IPM mitigation techniques will generally provide more or less mitigation under a given set of conditions.

A general rule of thumb for IPM techniques or conservation practices having an index value of 5 is that they generally have the potential to reduce losses by 10 -15%. IPM techniques or conservation practices having an index value of 10 generally have the potential to reduce losses by about 25%, and IPM techniques or conservation practices having an index value 15 generally have the potential to reduce losses by 50% or more.

The original reference for many of the ratings in Tables I & II is: *Aquatic Dialogue Group: Pesticide Risk Assessment and Mitigation, Baker JL, Barefoot AC, Beasley LE, Burns LA, Caulkins PP, Clark JE, Feulner RL, Giesy JP, Graney RL, Griggs RH, Jacoby HM, Laskowski DA, Maciorowski AF, Mihaich EM, Nelson Jr HP, Parrish PR, Siefert RE, Solomon KR, van der Schalie WH, editors. 1994. Society of Environmental Toxicology and Chemistry, Pensacola, FL., pages 99-111 and Table 4-2*. This reference provides ranges of effectiveness for various mitigation techniques.

If you have any questions about the material in this publication, please contact the National Pest Management Specialist or your respective State or Regional Agronomist.

Table I – IPM Techniques for Reducing Pesticide Environmental Risk

IPM Techniques[1, 2, 5]	Mitigation Index Value[6] (by Pesticide Loss Pathway)				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Application Timing – Ambient Temperature				5	Reduces exposure - spraying during cooler temperatures (e.g. early morning, evening or at night) can help reduce drift losses. Avoid spraying in temperatures above 90º F.
Application Timing – Rain	10	10	10		Reduces exposure - delaying application when significant rainfall events are forecast that could produce substantial runoff or leaching can reduce pesticide transport to ground and surface water.
Application Timing – Relative Humidity				5	Reduces exposure - spraying when there is higher relative humidity reduces evaporation of water from spray droplets thus reducing drift losses.
Application Timing – Wind				5	Reduces exposure - delaying application when wind speed is not in accordance with label requirements can reduce pesticide drift. Optimal spray conditions for reducing drift occur when the air is slightly unstable with a very mild steady wind between 2 and 9mph.
Formulations/Adjuvants	5	5	5	5	Reduces exposure – formulations and/or adjuvants that increase efficacy allow lower application rates **or** formulations that have lower volatilization potential decrease atmospheric losses **or** use of appropriate adjuvants (drift retardants) reduce drift when conditions are less than ideal.
IPM applications based on monitoring and economic pest thresholds.	15	15	15	15	Reduces exposure - reduces the amount of pesticide applied with preventative treatments because applications are based on monitoring that determines when a pest population exceeds a previously determined economic threshold.

IPM Techniques[1, 2, 5]	Mitigation Index Value[6] (by Pesticide Loss Pathway)				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Partial Treatment	15	15	15	5	Reduces exposure - spot treatment, banding and directed spraying reduces amount of pesticide applied. (Assumes no more than 50% of the area is treated).
Precision Application – Using "Smart Sprayers"	10	10	10	10	Reduces exposure - using "Smart Sprayer" technology (i.e. green sensors, sonar-based sensors, GPS-based variable rate application, computer controlled spray nozzles, etc.) can substantially reduce the amount of active ingredient applied.
Set-backs – 30 feet or more with no application		5	5	5	Reduces exposure – reduces inadvertent pesticide application and drift to surface water and reduces the overall amount of pesticide applied.
Soil Incorporation – mechanical or irrigation		10	10		Reduces exposure – reduces solution and adsorbed losses, but potentially increases leaching losses, especially for low K_{OC} pesticides.
Spray Nozzle Selection, Maintenance and Operation.				10	Reduces exposure – selecting appropriate nozzle and pressure for the application, with an emphasis on higher volume spray nozzles run at lower pressures, will produce larger droplets and a narrower droplet size distribution, which reduces spray drift. Proper nozzle spacing, boom height, and boom suspension, along with frequent calibration and replacement of worn nozzles and leaking tubing, can increase efficacy and reduce drift potential.
Use of alternative cultural or biological suppression techniques[4]	15	15	15	15	Reduces risk - substituting cultural (including burning and mechanical controls) and biological controls can reduce or replace pesticide applications.

IPM Techniques[1, 2, 5]	Mitigation Index Value[6] (by Pesticide Loss Pathway)				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Use of alternative, lower risk pesticides[3]	15	15	15	15	Reduces risk - using alternative pesticides with lower risk is as effective as mitigating higher risk pesticides. Note: alternative pesticides must be recommended by Extension or an appropriately certified crop consultant.
Use of Semiochemicals to manage a pest population[4]	15	15	15	15	Reduces risk – using semiochemicals (e.g., mating disrupting pheromones) to decrease reproductive success or control population density/location can reduce or replace pesticide applications.

[1]Additional information on pest management mitigation techniques can be obtained from Extension pest management publications, pest management consultants and pesticide labels.

[2] The pesticide label is the law - all pesticide label specifications must be carefully followed, including required mitigation. Additional mitigation may be required for NRCS identified natural resource concerns.

[3] A specific pesticide risk is not actually reduced, but it is avoided by using an alternative pesticide that has less risk.

[4] Similar to note 3 above, a specific pesticide risk is not actually reduced, but it is avoided by using a different technique to help manage the pest population.

[5] NRCS does not make pesticide recommendations. All pesticide application techniques must be recommended by Extension or an appropriately certified crop consultant and selected by the producer.

[6] Numbers in these columns represent index values that indicate relative effectiveness of IPM mitigation techniques to reduce hazardous pesticide losses through the identified pathways.

Table II – Conservation Practices for Reducing Pesticide Environmental Risk

Pesticide Mitigation Conservation Practices[1, 2]	Mitigation Index Value[4] (by Pesticide Loss Pathway)				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Alley Cropping (311)	5	5	10	10	Increases infiltration and uptake of subsurface water, reduces soil erosion, can provide habitat for beneficial insects which can reduce the need for pesticides, also can reduce pesticide drift to surface water.
Anionic Polyacrylamide (PAM) Erosion Control (450)		5	15		Increases infiltration and deep percolation, reduces soil erosion.
Conservation Cover (327)	15	15	15		Retiring land from annual crop production into perennial vegetation reduces the need for pesticides, builds soil organic matter, and reduces runoff.
Conservation Crop Rotation (328)	10	10	10		Reduces the need for pesticides by breaking pest lifecycles. The rotation shall consist of at least 2 crops in the rotation and no crop grown more than once before growing a different crop.
Contour Buffer Strips (332)		10	10		Increases infiltration, reduces soil erosion.
Contour Farming (330)		5	5		Increases infiltration and deep percolation, reduces soil erosion.
Contour Orchard and Other Fruit Area (Ac.) (331)		5	5		Increases infiltration and deep percolation, reduces soil erosion.
Contour Stripcropping (585)		15	15	5	Increases infiltration, reduces soil erosion and generally will only be treating half the area of concern.
Cover Crop (340) that is incorporated into the soil	5	5	5		Increases infiltration, reduces soil erosion, builds soil organic matter. Assumes at least 4000 lbs/ac of live biomass at the time of tillage.
Cover Crop (340) for weed suppression that is mulch tilled or no-tilled into for the next crop.	10	10	10	10	Increases infiltration, reduces soil erosion, builds soil organic matter. Assumes at least 4000 lbs/ac of live biomass at the time of tillage and at least 30-100% ground cover at the time of the pesticide application.

Pesticide Mitigation Conservation Practices[1, 2]	Mitigation Index Value[4] (by Pesticide Loss Pathway)				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Cross Wind Ridges (589A)			5[3/]		Reduces wind erosion and adsorbed pesticide deposition in surface water. Assumes the pesticide was applied while the field is in the ridged state.
Cross Wind Stripcropping (589B)	5	5	10[3/]	5	Reduces wind erosion and adsorbed pesticide deposition in surface water, traps adsorbed pesticides. Different pesticides may be applied on one half of the field.
Cross Wind Trap Strips (589C)			10[3/]		Reduces wind erosion and adsorbed pesticide deposition in surface water, traps adsorbed pesticides.
Deep Tillage (324)		5	5		Increases infiltration and deep percolation.
Field Border (386)		5	10	5	Increases infiltration and traps adsorbed pesticides, often reduces application area resulting in less pesticide applied, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, also can reduce inadvertent pesticide application and drift to surface water. Assumes 20 foot minimum width.
Filter Strip (393)		10	15	10	Increases infiltration and traps adsorbed pesticides, often reduces application area resulting in less pesticide applied, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, also can reduce inadvertent pesticide application and drift to surface water. Assumes 30 foot minimum width.
Forage Harvest Management (511)	10	10	10	10	Reduces exposure potential - timely harvesting reduces the need for pesticides.
Herbaceous Wind Barriers (1003)			5[3/]	5	Reduces wind erosion, traps adsorbed pesticides, can provide habitat for beneficial insects which reduces the need for pesticides, can provide habitat to congregate pests which can result in reduced pesticide application, and can reduce pesticide drift to surface water.

Pesticide Mitigation Conservation Practices[1, 2]	Mitigation Index Value[4] (by Pesticide Loss Pathway)				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Irrigation System, Microirrigation (441)	10	15	15		Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water.
Irrigation System, Sprinkler (442)	10	10	10		Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water.
Irrigation System, Surface and Subsurface (443)	5	5	5		Reduces exposure potential - efficient and uniform irrigation reduces pesticide transport to ground and surface water.
Irrigation System Tail Water Recovery (447)		10	10		Captures pesticide residues and facilitates their degradation.
Irrigation Water Management (449)	15	15	15		Reduces exposure potential - water is applied at rates that minimize pesticide transport to ground and surface water, promotes healthy plants which can better tolerate pests.
Mulching (484)	5	5	5		Often reduces the need for pesticides, natural mulches increase infiltration and reduce soil erosion. Assumes plastic mulch is not used or the site is managed to prevent excess pesticide runoff from plastic mulch
Residue Management, No-till and Strip-Till (329)	5	10	15		Increases infiltration, reduces soil erosion, builds soil organic matter. Assumes at least 60% ground cover at the time of application.
Residue Management, Mulch-Till (345)	5	5	10		Increases infiltration, reduces soil erosion, builds soil organic matter. Assumes at least 30% ground cover at the time of application.
Residue Management, Ridge Till (346)	5	5	10		Increases infiltration, reduces soil erosion, builds soil organic matter.
Riparian Forest Buffer (391)	5	15	15	10	Increases infiltration and uptake of subsurface water, traps sediment, builds soil organic matter, and reduces pesticide drift. This assumes 30 foot minimum width.

Pesticide Mitigation Conservation Practices[1, 2]	Mitigation Index Value[4] (by Pesticide Loss Pathway)				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Riparian Herbaceous Cover (390)	5	10	10	5	Increases infiltration, traps sediment, builds soil organic matter, and reduces pesticide drift. This assumes 30 foot minimum width.
Sediment Basin (350)			10		Captures pesticide residues and facilitates their degradation. This assumes at least 50% of the treatment area drains into the sediment basin.
Stripcropping, Field (586)		10	10		Increases infiltration, reduces soil erosion **and generally will only be treating half the area of concern.**
Subsurface Drainage (10010)	5	10	10		Increases infiltration and aerobic pesticide degradation in the root zone *Note – avoid direct outlets to surface water
Terrace (600)		10	15		Increases infiltration and deep percolation, reduces soil erosion.
Vegetative Barriers (601)			10		Reduces soil erosion, traps sediment, increases infiltration.
Windbreak/Shelterbelt Establishment (380)			10[3/]	10	Reduces wind erosion, reduces adsorbed pesticide deposition in surface water, traps adsorbed pesticides, and reduces pesticide drift.

[1/] Additional information on pest management mitigation techniques can be obtained from Extension pest management publications, pest management consultants and pesticide labels.

[2/] Thee pesticide label is the law - all pesticide label specifications must be carefully followed, including required mitigation. Additional mitigation may be needed to meet NRCS pest management requirements for identified resource concerns.

[3/] Mitigation applies to adsorbed pesticide losses being carried to surface water by wind.

[4]/ Numbers in these columns represent index values that indicate relative effectiveness of pesticide mitigation techniques to reduce hazardous pesticide losses through the identified pathways.