NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

INTEGRATED PEST MANAGEMENT (IPM)

(Acre)

CODE 595

DEFINITION

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

PURPOSE

- Prevent or mitigate off-site pesticide risks to water quality from leaching, solution runoff and adsorbed runoff losses.
- Prevent or mitigate off-site pesticide risks to soil, water, air, plants, animals and humans from drift and volatilization losses.
- Prevent or mitigate on-site pesticide risks to pollinators and other beneficial species through direct contact.
- Prevent or mitigate cultural, mechanical and biological 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.

A comprehensive IPM plan utilizing PAM's 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 University of Missouri Extension.

If a comprehensive IPM system is not feasible, utilize appropriate IPM techniques to adequately prevent or mitigate pest management risks for identified natural resource concerns. All IPM techniques will treat natural resource concerns to FOTG quality criteria levels (soil loss to "T", ephemeral gully erosion controlled, Soil Conditioning Index is positive value, etc.).

Additional Criteria to Prevent or Mitigate Off-site Pesticide Risks to Water Quality from Leaching, Solution Runoff and Adsorbed Runoff Losses

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 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

Use attached Appendix Table 1 to determine if planned conservation practices provide adequate mitigation. If additional mitigation is necessary beyond planned conservation practices, use Appendix Table 2 to select and

apply appropriate IPM techniques with this practice.

Additional Criteria to Prevent or Mitigate Off-site Pesticide Risks to Soil, Water, Air, Plants, Animals and Humans from Drift and Volatilization Losses

For identified natural resource concerns related to pesticide drift, use Appendix Table 1 to determine if planned conservation practices provide adequate mitigation. If additional mitigation is necessary beyond planned conservation practices, use Appendix Table 2 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 on page 6 of Agronomy Technical Note No. 5 – "Pest Management in the Conservation Planning Process".

Additional Criteria to Prevent or Mitigate On-site Pesticide Risks to Pollinators and Other Beneficial Species through Direct Contact

For direct contact pesticide risks to pollinators and other beneficial species in the application area, apply at least two IPM mitigation techniques from the Pesticide Direct Contact section on page 6 of Agronomy Technical Note No. 5 – "Pest Management in the Conservation Planning Process".

Additional Criteria to Prevent or Mitigate Cultural, Mechanical and Biological Pest Suppression Risks to Soil, Water, Air, Plants and Animals

Refer to Appendix Table 3 for guidance in selecting cultural, mechanical, and biological IPM strategies for land treatment and the protection of natural resources. Use NRCS resource evaluation tools such as RUSLE2, WEPS, SCI and STIR to determine if FOTG quality criteria levels have been achieved.

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, mechanical, 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 University of Missouri 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 all environmental risk analyses such as WIN-PST, RUSLE2, WEPS, etc. 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 Appendix Tables 1 and 2 for pesticide risk mitigation conservation practices and management techniques.
5. A list of pest prevention and avoidance strategies that will be implemented.
6. A scouting plan for each applicable pest. Refer to: http://extension.missouri.edu/explorepdf/agguides/pests/IPM1006.pdf for guidance.
7. Other monitoring plans 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.

Note: Items 5, 6, 7 and 8 are required to document a comprehensive IPM system, but they may not be applicable when any two conservation practices, two mitigation techniques, or one conservation practice and one mitigation technique properly applied and maintained 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 including rate of products applied, dates of application, and methods of application.
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. Refer to: http://extension.missouri.edu/publications/DisplayPub.aspx?P=G1270.
- Maintain records of pest management for at least two years. Pesticide application records shall be in accordance with USDA Agricultural Marketing Service's Pesticide Recordkeeping Program (http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateQ&navID=PesticideRecordkeepingProgram&rightNav1=PesticideRecordkeepingProgram&topNav=&leftNav=ScienceandLaboratories&page=PesticideRecordkeepingProgram&resultType) 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

APPENDIX -

Table 1 – Conservation Practices for Reducing Pesticide Environmental Risk

Pesticide Mitigation Conservation Practice [1, 2]	Mitigation Index Value [4]				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)	10	10	10		Increases infiltration; reduces soil erosion; and builds soil organic matter in perennial cropping systems such as orchards, vineyards, berries, and nursery stock
Conservation Crop Rotation (328)	10	10	10		Reduces the need for pesticides by breaking pest life cycles Rotation shall consist of at least two 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
Cover Crop (340) incorporated into the soil	5	5	5		Increases infiltration; reduces soil erosion; builds soil organic matter Assumes at least 4,000 pounds per acre of live biomass at the time of tillage
Cover Crop (340) for weed suppression that is mulch tilled or no tilled for next crop	10	10	10	10	Increases infiltration; reduces soil erosion; builds soil organic matter Requires at least 4,000 pounds per acre of live biomass at the time of tillage and at least 30 percent ground cover at the time of the pesticide application

Pesticide Mitigation Conservation Practice [1, 2]	Mitigation Index Value [4]				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Cross Wind Ridges (588)			5 [3]		Reduces wind erosion and adsorbed pesticide deposition in surface water Assumes the pesticide is applied while the field is in the ridged state
Cross Wind Trap Strips (589C)			10 [3]		Reduces wind erosion and adsorbed pesticide deposition in surface water; traps adsorbed pesticides
Dike (356)		10	10		Reduces exposure potential—excludes outside water or captures pesticide residues and facilitates their degradation Not applicable if pesticide leaching to groundwater is an identified natural resource concern
Drainage Water Management (554)		10	10		Drainage during the growing season increases infiltration and aerobic pesticide degradation in the root zone and reduces storm water runoff Managed drainage mode when the field is not being cropped reduces discharge of pesticide residues from the previous growing season Seasonal saturation may reduce the need for pesticides Not applicable if pesticide leaching to groundwater is an identified natural resource concern
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
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
Forage and Biomass Harvest Management (511)	10	10	10	10	Reduces exposure potential—timely harvesting reduces the need for pesticides
Hedgerow Planting (422)			10 [3]	10	Reduces adsorbed pesticide deposition in surface water; also can reduce inadvertent pesticide application and drift to surface water
Herbaceous Wind Barriers (603)			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
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)		15	15		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) with natural materials	10	10	10		Increases infiltration, reduces soil erosion, reduces the need for pesticides
Mulching (484) with plastic	10	5	5		Reduces the need for pesticides. Not applicable if erosion and pesticide runoff from non-mulched areas is not adequately managed
Residue and Tillage Management, No Till/Strip Till/Direct Seed (329)	5	10	15		Increases infiltration, reduces soil erosion, builds soil organic matter Assumes at least 60 percent ground cover at the time of application
Residue and Tillage Management, Mulch Till (345)	5	5	10		Increases infiltration, reduces soil erosion, builds soil organic matter Assumes at least 30 percent ground cover at the time of application
Residue and Tillage 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 Practice [1, 2]	Mitigation Index Value [4]				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. Assumes 30-foot minimum width
Sediment Basin (350)			10		Captures pesticide residues and facilitates their degradation Not applicable if less than 50 percent of the treatment area drains into the sediment basin
Stripcropping (585)		15	15	5	Increases infiltration; reduces soil erosion and generally will only be treating half the area of concern
Subsurface Drainage (606)	5	10	10		Increases infiltration and aerobic pesticide degradation in the root zone Note: avoid direct outlets to surface water
Surface Roughening (609)			5 [3]		Reduces wind erosion and adsorbed pesticide deposition in surface water
Terrace (600)		10	15		Increases infiltration and deep percolation; reduces soil erosion Not applicable if pesticide leaching to groundwater is an identified natural resource concern
Vegetative Barriers (601)			10		Reduces soil erosion; traps sediment; increases infiltration
Water and Sediment Control Basin (638)		10	15		Captures pesticide residues and facilitates their degradation; increases infiltration and deep percolation Not applicable if pesticide leaching to groundwater is an identified natural resource concern
Windbreak/Shelterbelt Establishment (380)			10 [3]	10	Reduces wind erosion; reduces adsorbed pesticide deposition in surface water; traps adsorbed pesticides; reduces pesticide drift

1/ Additional information on pest management mitigation techniques can be obtained from Extension pest management publications including IPM Guidelines and Crop Profiles, 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 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.

Table 2 - IPM Techniques for Reducing Pesticide Environmental Risk

IPM Techniques [1]	Mitigation Index Value [4]				Function and Performance Criteria
	Leaching	Solution Runoff	Absorbed Runoff	Drift	
Application Timing – ambient temperature				5	Reduces exposure – spraying during cooler temperatures (early morning, evening or night) can help reduce drift losses Avoid spraying in temperatures above 90^0F
Application Timing – rain	15	15	15		Reduces exposure – delaying application when significant rainfall events are forecast that could produce substantial leaching or runoff can reduce pesticide transport to ground and surface water
Application Timing – relative humidity				5	Reduces exposure – spraying when there is a higher relative humidity reduces evaporation of water from spray droplets thus reducing drift losses
Application Timing – wind				10	Reduces exposure – delaying application when wind speed is not optimal 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 9 miles per hour
Formulations and Adjuvants [2, 3]	5	5	5		Reduces exposure – specific pesticide formulations and/or adjuvants can increase efficacy and allow lower application rates; drift retardant adjuvants can reduce pesticide spray drift
Monitoring plus Economic 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
Partial Treatment	15	15	15	15	Reduces exposure – spot treatment, banding and directed spraying reduces amount of pesticide applied Assumes less than 50 percent of the area is treated
Precision Application Using Smart Sprayers	10	10	10	10	Reduces exposure – using smart sprayer technology (green sensors, sonar-based sensors, GPS-based variable rate application, computer controlled spray nozzles, etc.) can substantially reduce the amount of pesticide applied

IPM Techniques [1]	Mitigation Index Value [4]				Function and Performance Criteria
	Leaching	Solution Runoff	Adsorbed Runoff	Drift	
Setbacks	5	5	5	10	Reduces exposure – reduces overall amount of pesticide applied; reduces offsite pesticide drift Assumes that the setbacks with no application are at least 30 feet wide
Soil Incorporation [2, 3]		15	15		Reduces exposure – reduces solution and adsorbed runoff losses, but potentially increases leaching losses, especially for low K_{oc} pesticides Applicable to shallow mechanical or irrigation incorporation Not applicable if pesticide leaching to groundwater is an identified natural resource concern Not applicable if soil erosion is not adequately managed
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
Selection of Cultural, Mechanical, or Biological Controls	15	15		10	Reduces risk—partial substitution of alternative cultural, mechanical, or biological pest suppression techniques reduces the application of a pesticide that poses a hazard to an identified natural resource concern Not applicable if hazards from alternative suppression techniques are not adequately managed
Substitution—lower risk pesticides [2, 3]	15	15	15	15	Reduces risk—partial substitution of an alternative lower risk pesticide reduces the application of a pesticide that poses a hazard to an identified natural resource concern Not applicable if the alternative pesticide is not explicitly recommended by Extension or an appropriately certified crop consultant because the NRCS cannot make pesticide recommendations
Substitution—semiochemicals	15	15	15	15	Reduces risk – using semiochemicals (e.g., mating disruption pheromones) to decrease reproductive success or control population density/location reduces, the application of a pesticide that poses a hazard to an identified natural resource concern

1/ Additional information on pest management mitigation techniques can be obtained from Extension pest management publications including IPM Guidelines and Crop Profiles, 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 needed to meet NRCS pest management requirements for identified resource concerns.
3/ The 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.
4/ 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 3 – IPM Alternatives to Chemical Fertilizer or Chemical Pest Suppression

PREVENTION	Diverse Crop Rotations Cover Crops - Mixes or Monocultures Designed Cover Crops for a Particular Purpose or Benefit Cover Crops with Weed Suppression Benefits Mustards for Soil Fumigation Buckwheat for Phosphorus Availability Scavenging Nutrients Biotillage (Reducing Compaction) Nitrogen Source Materials Roller/Crimper Technology to Terminate Cover Crops No Till Planting into Cover Crops Year-round Cover (Growing Roots for Soil Quality) Pest Resistant Varieties Pest-free Seeds and Transplants Weed-tolerant Varieties (Strong Emergence and Growth Characteristics) Allelopathic Crop/Cover Crop (Rye, Sorghum-sudangrass, Oats, Barley, Alfalfa, etc.) Appropriate Planting Dates Delayed Planting for Weed Control

	PREVENTION (continues…) Staggered Planting Dates Appropriate Harvest Dates Long Rotations (Multiple Years between Same or Similar Crops) Polyculture (Multiple Crops Alternated in Rows or between Rows) Relay Intercropping Perennial Forage Crops Mowing/Flailing Bacillius thuringiensis (Bt) and Other Organisms Mulching Compost Tea Sanitation Plastic Film or Mulch Weed Barrier Material Row Covers Mesh Covers
AVOIDANCE	Companion Crops Trap Crops Refuge Management Plant and Row Spacing Buffers and Barriers Crop and Field Isolation Cleaning Equipment between Fields and Uses Healthy Productive Soils (Soil Quality) Manure Applied Compost Applied Residue Removal or Residue Additions Nitrogen Fixation by Legumes with Proper Inoculation Adequate Drainage Maintain Adequate Rooting Depth Maintain Porosity and Soil Tilth Grazing (integrates livestock and crop production) Rotational Grazing (includes strip grazing) Selecting Animal Class for Desired Grazing Benefit Multi Species Grazing Irrigation Scheduling Conserving, Augmenting, or Introducing Beneficial Organisms Providing Beneficial Organism Habitat Bee Hives near Fields Bat Houses at Field Edge Optimize Growing Conditions (row layout, direction of rows, spacing, etc.)
MONITORING	Manure Testing Soil Testing Compost Testing Crop Tissue Analysis Monitoring Pest Populations Economic Thresholds Pest Scouting Weather Forecasting Lures, Traps, and Repellents
SUPPRESSION	Tillage with a Purpose Proper Timing of Tillage Proper Depth of Tillage Cultivations for Weed Control or Sanitation Mechanical Weed Control (rotary hoe, coiled tine finger harrow, etc.)

	SUPPRESSION (continues…) Row Cultivations Flaming Weeds Proper Timing of Tillage, Cultivation, or Flaming Hoeing Hand Weeding Woody Brush Control with Goats Weeding with Ducks or Geese Insect Reduction with Poultry Soil Solarization Pruning Vacuuming Pests Approved Pesticide Products (NOP Reg. 205.601 and 205.603)