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

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

Integrated Pest Management (IPM) is a sustainable approach to pest control. IPM suppression systems include biological, cultural, mechanical, and the judicious use of chemical control measures.

IPM strategies (Prevention, Avoidance, Monitoring and Suppression or "PAMS") shall be employed to prevent or mitigate pest management risks for identified natural resource concerns. Detailed IPM strategies are contained in **Appendix 1**.

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 Oklahoma State University (OSU).

The following general IPM strategies (PAMS) will be used to reduce pest populations below economic injury levels and to minimize pest resistance and adverse effects of pesticides on human health and the environment.

Prevention – is the practice of keeping pest populations from infesting a crop or field and is the first line of defense for pest control.

Avoidance – is practiced when pest populations exist but the impact of the pest on the crop can be avoided.

Monitoring – tracking and identifying pests through surveys or scouting programs.

Suppression – managing pest populations using cultural, biological, mechanical, and/or the judicious use of chemical practices.

Appendix 2 contains biological, cultural, and mechanical practices which can be used in the development of the overall IPM plan. IPM strategies will include Field Scouting and Economic Thresholds when insects are the pest of concern and when available for crops and pests.

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.

Chemical pesticide applications will be made according to the Oklahoma NRCS Brush Management (314) and Herbaceous Weed

Control (315) standards.

The **Oklahoma Mesonet** website is available for weather information, drift risk advisement and a pest database. It can be accessed at the following website:

http://agweather.mesonet.org

The following websites are available for managing pests:

OSU PEET:

http://soilphysics.okstate.edu/software/index.html

OSU IPM:

http://www.ento.okstate.edu/IPM/index.html

USDA Plants ID Database:

http://plants.usda.gov

OSU Plant Pathology and Entomology:

http://www.entoplp.okstate.edu

Noble Foundation Plant ID Database:

http://www.noble.org/WebApps/PlantImageGallery/Index.aspx

OSU Pesticide Safety Program:

http://pested.okstate.edu

OSU Plant and Soil Sciences:

http://pss.okstate.edu

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 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

Use Agronomy Technical Note 5, 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 5 - Table I to 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 Agronomy Technical Note 5, 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 5 - 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 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 of Agronomy Technical Note 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

For identified natural resource concerns related to cultural, mechanical and biological pest suppression, (e.g. air quality concerns with burning for weed control or soil erosion concerns with tillage for weed control), natural resource concerns shall be addressed to FOTG 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 avoid 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 Oklahoma State University 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

A more intensive level of IPM focused primarily on prevention and avoidance strategies can further minimize pest management risks to natural resources and humans.

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 5 - 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 comprehensive 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:

Monitoring or scouting results including the date, pest population/degree of infestation, and the crop or plant community condition.

When and where each pest suppression technique was implemented.

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

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APPENDIX 1
Integrated Pest Management Strategies and Pest Targets

Monitoring	Insects	Weeds	Diseases	Brush
1. *Use economic threshold to determine when suppression methods are needed (when available).	X	X		
2. *Scout field and keep records - Identify pests, monitor crop development and weather. Keep records of pesticide applications.	X	X	X	X
3. Use traps, sticky cards and/or soil sampling to monitor pests	X			

Prevention	Insects	Weeds	Diseases	Brush
1. Clean tillage and harvesting equipment between fields and crops.	X	X	X	
2. Use tillage to bury residues and disrupt wintering environments.	X		X	
3. Promote plant vigor using proper seedbed preparation, irrigation scheduling, nutrient management and clean, tested, pest free seed.	X	X	X	
4. Eliminate alternate hosts.	X		X	
5. Use a tillage system that leaves adequate residues on the surface after planting.	X	X		
6. Use a prescribed grazing or forage harvest management plan.		X		X

Avoidance	Insects	Weeds	Diseases	Brush
1. Use pest resistant or pest tolerant varieties or seed with biological insect resistance.	X		X	
2. Use crop rotations to break pest life cycles.	X	X	X	
3. Adjust planting and/or harvesting dates to reduce pest injury or select cultivars that have earlier or later planting or harvesting dates.	X	X	X	
4. Increase seeding rate and/or decrease row spacings for better canopy cover.		X		
5. Avoid planting in parts of field where pest populations will cause crop failure.	X	X	X	

Suppression	Insects	Weeds	Diseases	Brush
1. Use biological treatments (parasitoids, predators, goats, pathogens, GMOs, etc).	X	X		X
2. Mechanically cultivate, hand hoe, hand pick, or spot treat to suppress pests.	X	X	X	X
3. Provide alternative crops or habitats adjacent to the primary crop for natural enemies.	X			
4. Use burning or mowing for suppression.		X		X
5. Use trap crops to attract pests where they can be easily suppressed.	X			

***Essential components when insects are the pest of concern.**

APPENDIX 2

INTEGRATED PEST MANAGEMENT

(This appendix was adapted from Module 3 of Nutrient and Pest Management Considerations in a Conservation Management System Plan, NRCS National Employee Development Center self-paced study course, 1999.)

Integrated pest management is an approach to pest control that combines biological, cultural, mechanical, and other alternatives to chemical control with the judicious use of pesticides. The objective of IPM is to maintain pest levels below an economic injury level (Economic Threshold) while minimizing harmful effects of pest control on human health and environmental resources. Economic thresholds for some crops and/or pests are not currently known. Attempts to control one pest species without regard for the entire ecosystem can disrupt checks and balances between crop plants, pests, beneficials, and the physical environment.

Integrated pest management (IPM) depends on a detailed understanding of pests' natural enemies and crop growth and development, and in particular, what causes outbreaks and determines survival.

IPM strives for maximum use of naturally occurring control forces in the pest's environment including weather, pest diseases, predators, and parasites.

With IPM, the role for chemical pesticides is one of last resort if other alternatives fail to correct the problem. Foliar applied pesticides are rarely applied according to a pre-set schedule or spray calendar in an IPM program. Instead, they only are used if scouting shows they really are needed to prevent severe damage.

Prescriptive IPM depends largely on judicious use of pesticides based on field scouting that shows pest infestation has exceeded economic thresholds.

IPM Principles

Principle #1. There is no silver bullet, use several complimentary control practices to increase the long term stability of the production system.

Over reliance on any single control measure can have undesirable effects. This especially has been documented for pesticides where over-reliance can lead to the "3-R's": resistance, resurgence, and replacement. IPM considers all possible control actions, including taking no action at all, and fits tactics together into mutually complementary strategies. The idea is to combine different control tactics into an overall strategy that balances the strengths of each against any individual weaknesses.

Principle #2. Tolerate low numbers of pests.

IPM recognizes that keeping fields entirely pest-free is generally neither necessary nor desirable; it is usually not necessary to totally eliminate pests and, in fact, low levels of pest help maintain a predator population. Because most crops can tolerate low pest infestation levels without any loss in harvestable produce or quality, the presence of a pest does not necessarily mean that you have a pest problem. IPM seeks to reduce pest populations below levels that are economically damaging rather than to totally eliminate infestations.

Principle #3. Treat the causes of pest outbreaks, not the symptoms.

IPM requires detailed understanding of pest biology and ecology so that the cropping system can be manipulated to the pest's disadvantage. The idea is to make the crop less favorable for pest survival and reproduction with as little disturbance to the rest of the ecosystem as possible.

Principle #4. If you kill the natural enemies, you inherit their job.

Naturally occurring predators, parasites, pathogens, antagonists, and competitors (collectively known as biological control agents) help keep many pest populations in check. IPM strives to enhance the impact of beneficials and other natural controls by conserving or augmenting those agents already present.

Principle #5. Pesticides are not a substitute for good farming.

A vigorously growing plant can better defend itself against pests than a weak, stressed plant. IPM takes maximum advantage of farming practices that promote plant health and allow crops to escape or tolerate pest injury. IPM begins from the premise that killing pests is not the objective; protecting the commodity is. Pest

status can be reduced by repelling the pest, avoiding the pest, or reducing its rate of colonization or invasion, as well as by directly killing the pest.

Dependence on Pesticides

When a pest control program is based wholly on the use of pesticides, adverse consequences of Resistance, Resurgence, and Replacement (pesticide treadmill) can become more common.

Resistance is the genetically inherited ability of organisms to survive exposure to pesticides that were formerly lethal to earlier generations. Resistance can develop when pesticides kill susceptible individuals while allowing naturally resistant individuals to survive. These survivors pass to their offspring the genetically determined resistance trait. With repeated pesticide application, the pest population increasingly is comprised of resistant individuals.

In theory, pests can develop resistance to any type of IPM tactic: biological, cultural, or chemical.

In the Midwest, farmers routinely rotate corn with soybeans to break the infestation cycle of the corn rootworm, an insect that only feeds on grassy plants and so has become the key insect pest of field corn. Yet the rootworm has developed strains that overcome crop rotation by extending their overwintering resting stage in the soil from one winter to several winters. This allows them to be ready to attack corn the next time it is planted in the field.

Still other rootworm populations have developed strains that feed on both corn and soybeans.

In practice, resistance occurs most frequently in response to pesticide use. Insects were the first group of pests to develop pesticide resistant strains. Worldwide, over 600 species are resistant to at least one insecticide; some are resistant to all the major classes of insecticides. Herbicide resistant weeds now number more than 100 worldwide and fungicide resistant plant pathogens have also been observed.

Resurgence of pests occurs when insecticide applications initially reduces an infestation, but soon after, the pest rebounds (resurges) to higher population levels than before treatment.

Replacement or secondary pest outbreak is resurgence of nontarget pests. It occurs when a pesticide is used to control the target pest, but afterwards a formerly insignificant pest replaces the target pest as an economic problem.

Components of the IPM Strategy

Field Scouting (Monitoring)

One principle of IPM is that pesticides should be used only when field examination or scouting shows infestations exceed economic thresholds, guidelines that differentiate economically insignificant infestations from intolerable populations. Pest scouting should be conducted in each individual field and generally should be random and representative.

The field examination or scouting must provide quantifiable pest/damage counts that can be used in making the management decisions for each individual field.

The only time to take control action and apply pesticides is when pest density reaches levels near the economic threshold (ET) value.

Pesticide application at the ET keeps infestations from increasing beyond the breakeven economic injury level (EIL) value.

Cultural Methods

Cultural methods are those farming practices that control pests by breaking their infestation cycle by making the living and non-living environment less suitable for pest survival.

Cultural methods achieve these goals in 4 basic ways by:

- Reducing the overall favorableness of the habitat (by destroying pest over-wintering sites and other infestation sources both in the crop field and alternate hosts or habitats)
- Altering planting patterns to disrupt or interrupt in time and space the food or other habitat resources required by the pest
- Diverting mobile pests from the crop
- Enhancing the vigor of the crop so that it can better tolerate pest injury

Examples of cultural methods used in the IPM programs include:

Crop Rotation – alternate unrelated crops in the same field each season to break pest life cycles.

Adjust Planting or Harvesting Dates - alter planting and harvest dates to avoid or reduce pest infestations.

Adjust Seeding Rates - increase seeding rates and/or decrease crop row spacing to compete with potential weed problems.

Promote Plant Vigor – provide proper seedbed preparation, fertilizer application, and irrigation water scheduling to maintain plant vigor and help plants outgrow pests. Use seed that has been germination tested and free of pathogens to insure correct plant population (certified seed when available).

Avoid Problem Areas – avoid planting in parts of the field where pest populations will cause crop failure.

Eliminate Alternate Hosts – eliminate hosts or potential hosts that may harbor pests.

Sanitation Practices - clean tillage and harvesting equipment between fields and/or crops.

Plant Trap or Host Crops – use crops that attract and concentrate pest populations in a small portion of the field where they can be easily killed with minimal or even no pesticide or plant crops that provide habitats adjacent to the field for natural enemies.

Grazing and Burning Management – use grazing and forage management plans that promote grass vigor.

Mechanical Methods

The following are examples of mechanical methods used in IPM:

Mechanical Treatments – use cultivation, mowing, hand hoeing, hand picking, or spot treating to suppress pests.

Tillage System – use operations that turn the soil and bury crop residues to disrupt pathogens that winter in the soil or below crop residues. This can also apply to maintaining adequate cover on the soil surface to disrupt the habitat or life cycle of pests.

Biological Methods

Biological controls use living organisms (natural enemies) to suppress populations of other pests. Conserving naturally occurring parasites and predators are usually the most effective method of biological control.

Examples of biological methods in the IPM programs include:

Pest Resistant Varieties - tolerate pest injury, are less attractive to pests, or control pests by producing chemicals that are toxic to them.

Predators - are free-living animals (most often other insects or arthropods, but also birds, reptiles, and mammals) that eat other animals.

Parasitoids - are insect (or related arthropods) parasites of other insects (or other arthropods). Most parasitoids are tiny wasps and flies. They differ zoologically from true parasites (fleas, lice, or intestinal tapeworms) primarily in that parasitoids kill their host whereas parasites weaken, but seldom kill the host.

Pathogens - are disease causing micro-organisms including viruses, bacteria, fungi, and nematodes. They provide natural control of insects, plants, and even other micro-organisms.

Chemical Methods

The final component of IPM is selection of pesticides that are cost effective, least disruptive to the ecosystem and pose the least risk of leaching through soil or being transported from fields in runoff water and sediment or drifting as spray particles on the wind.

Pesticides are defined as "any substance used for controlling, preventing, destroying, repelling, or mitigating any pest." The three most common pesticide classes are herbicides, insecticides, and fungicides.

Herbicides, insecticides, and fungicides represent more than 93 percent of the pesticide active ingredient used worldwide. Herbicides typically represent more than 50 percent of pesticide use, followed by insecticides (23 to 35 percent), and fungicides (11 to 14 percent).

Putting IPM to Practice

The IPM philosophy can be put into practice by following these three steps:

Step 1. Use cultural methods, biological methods, mechanical methods, and other alternatives to conventional chemical pesticides as the basis of the IPM program.

Step 2. Use quantifiable field scouting, pest forecasting, and economic thresholds to ensure that pesticides are used only when there are real pest problems.

Step 3. Select pesticides that are efficacious, cost effective and least likely to disrupt natural and biological controls. Match pesticides with

field site features so that the risk of contaminating water is minimized.