

Pest management is a critical component of conservation planning. It should be used in conjunction with crop residue management, nutrient management, conservation buffers, and other practices to address natural resource concerns and to maximize economic returns by enhancing the quantity and quality of agricultural commodities. Pesticides used in pest management can negatively impact nontarget plants, animals, and humans. Unintentional exposure may occur in transport and handling, in the field, and after transport from the field in soil, water, and air. Ground and surface water quality impairment resulting from nonpoint source pesticide contamination is a major concern in many agricultural areas. Other forms of pest management also have environmental risks. Cultivation for weed control, burying or burning crop residue for disease and insect control, and biological methods of weed, insect, and disease control can negatively impact soil, water, air, plants, animals, and humans. To adequately address these environmental risks, conservation planning must include a pest management component that minimizes negative impacts to all identified resource concerns.

Many pest management principles are detailed and complex. Formal academic training is often required to master these principles. The Natural Resources Conservation Service's (NRCS) National Employee Development Center (NEDC) is developing a course to help conservationists gain the technical background they need to develop conservation plans with an effective pest management component. The name of the course is *Nutrient and Pest Management Considerations in a Conservation Management System Plan*. This self-paced study course will take about 60 hours to complete. A prerequisite course entitled Introduction to Water Quality is currently available from the NEDC.

Core4 Pest Management training is designed to complement NEDC technical courses by focusing on the pest management conservation planning process. This includes implementation of the pest management standard and filling out job sheets and specification sheets. Core4 Pest Management training briefly introduces many of the topics covered in detail in the NEDC courses. Although these courses cannot take the place of formal academic training, they can complement local Cooperative Extension and Land Grant University training to provide conservationists with the information they need to work effectively

with Extension agents, certified crop advisors (CCA's), agrichemical dealers, and others who make pest management recommendations. Cooperative development of the pest management component of a conservation plan will support pest management decisions that produce an abundant supply of food and fiber while simultaneously conserving our Nation's natural resources.

Conservation planning involves more than just considering individual resources. It focuses on the natural systems and ecological processes that sustain the resources. The planner must strive to balance natural resource issues with economic and social needs through the development of a Resource Management System (RMS). A CMS combines management and conservation practices that, when installed, will achieve a specified level of treatment for all resources (soil, water, air, plants, animals, and humans). Progressive planning at incrementally higher levels of treatment eventually results in an RMS that prevents degradation and permits sustained use of all natural resources.

Pest management policy

NRCS's primary role in pest management is to help producers understand the environmental risks associated with different pest control options so that they can incorporate them into their pest management decisionmaking process. Currently, the major emphasis is on quantifying how pesticide choice and management factors can affect the potential for pesticide movement below the root zone and beyond the edge of the field.

Our policy does not support NRCS originating site-specific pesticide recommendations. We do, however, have responsibility for supplementing recommendations made by Cooperative Extension, CCA's, and others with environmental risk information. The goal is to help producers understand how pest management (including the use of specific pesticides) interrelates with climate, water management, crop management, and soil management so they can implement strategies to minimize environmental hazards related to offsite contaminant movement and its potential impacts on nontarget plants, animals, and humans.

NRCS Policy on Pesticides

(This policy is excerpted from: GM-190 Ecological Sciences, Part 404, Pesticides, May 1981.)

404.2 Policy

(a) Secretary's Memorandum No. 1929 dated December 12, 1977; (404.4) provides the USDA policy statement on management of pest problems.

(b) It is the policy of USDA and NRCS to encourage the use of Integrated Pest Management (IPM) methods, systems, and strategies that are practical, effective, and energy efficient. Further, the policy advocates adequate protection against significant pests with pesticides that minimize hazards to man and the natural environment, including soil, water, and related plant and animal resources.

404.3

(a) NRCS does not originate specific instructions, specifications, formulations, or recommendations regarding pesticides. If such information is required, it is to be derived from official publications and documents of the USDA or its cooperating agencies.

(b) If pesticide use is an essential part of a conservation practice, specific information regarding kind of pesticide, amounts, and the proper use may be included in technical guide specifications, resource conservation plans, technical notes, job sheets, and contracts. When needed pesticide information is not included in NRCS documents, it is to be referenced in the practice standard(s) and specifications, and the reference material is to be available in the field office. Such technical information and use of pesticides must be consistent with label instructions. It may be necessary to include more detail, such as timing of application, equipment, and climatic conditions, than is included on the label. All technical notes, "how to do it" sheets, publications, and other information for general distribution that include specific information on pesticides will be dated and will include appropriate precautionary statement(s).

(This policy is excerpted from proposed policy in GM 450, part 401, subpart A. It is not yet final, but it is included to show what is being proposed to clarify and enhance NRCS's role in pest management.)

General Manual — Title 450, Part 401

(Proposed policy revisions — changes to existing policy are bolded.)

401.03(b)(3)(iv)(B)[2] Water quality

When nutrients and pest management negatively impact surface or ground water or potential problems exist, nutrient and/or pest management practices, including timing, forms, and rate and method application, shall be recommended to reduce adverse effects. The use of pesticides and nutrients with high potential for polluting water are avoided where site limitations, such as slope, **proximity to a surface waterbody**, depth to ground water, soil, and materials in the vadose zone or aquifer could **cause contamination. the soil pesticide screening tool, leaching index (LI), the phosphorus index (PI), and or other approved assessment procedures are used according to FOTG guidelines** to identify potential problem situations from surface runoff and/or leaching. Alternative practices for **pest management (i.e., chemical, mechanical, cultural, or biological) or nutrient management (i.e., phosphorus based manure management, legume cover crops, split nitrogen applications)** or integrated methods are recommended where site limitations exist that increase the probability of degrading water supplies.

401.03(b)(3)(iv)(D) Plants

Pest management methods for any land use are based on target pests, environmental considerations, production requirements, soil, climate and other planned practices. The timing, method and rate of application, and forms of management are considered in the planning process. Other considerations of pest management such as economics, health and availability of products and management skills are considered in planning process using the conservation practice standard "Pest Management" (code 595) in the FOTG. Recommended procedures for developing and documenting the pest management component are found in the National Agronomy Manual, section 503, Part C.

(This policy is excerpted from a new draft of GM 190, Ecological Sciences, Part 404 Pest Management. It is not yet final, but it is included to show what is being proposed to clarify and enhance NRCS's role in pest management.)

Part 404 - Pest Management

404.1(g) 404.1 Overall Policy

a. Guidance and procedures in this section are applicable to all technical assistance that involves pest management. NRCS employees will follow these procedures when providing such technical assistance. Third party vendors and other non-NRCS employees will use these pest management procedures when assisting with the implementation of federal conservation programs for which NRCS has technical responsibility.

b. NRCS promotes the protection of natural resource functions and values in all NRCS planning and application assistance. NRCS recognizes the need to protect soil, water, air, and related plant and animal resources while producing abundant high quality food, fiber and forage and promoting viable agricultural enterprises.

c. NRCS's role in pest management is to:

1. evaluate environmental risks associated with pest management;
2. develop appropriate mitigation alternatives for decision-maker consideration;
3. encourage widespread adoption of Integrated Pest Management (IPM) programs that help protect natural resources;
4. assist landowners with development and implementation of an acceptable pest management component of the overall conservation plan.

d. When providing technical assistance, NRCS will conduct an environmental evaluation and consider the objectives of the client in the context of environmental, economic and other pertinent factors.

e. The pest management component of a conservation plan shall be developed in compliance with all applicable federal, state and/or local regulations. Federal, State and/or local regulations take precedence over NRCS policy when more restrictive.

(Chapter 2, Integrated Pest Management, 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.)

Definition

A pest is any organism (plant or animal) that causes trouble, annoyance, or discomfort or becomes a nuisance by destroying food and fiber products, causing structural damage, or creating a poor environment for other organisms. Ecologically speaking, no organism is born a pest; it all depends on human perspective. Pest problems do not arise as independent or isolated events.

Crops and pests are part of an agroecosystem, and they are governed by the same biological processes as those in natural ecosystems. 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. Failure to appreciate ecological interactions may increase the severity of pest infestations. Action taken against one pest may exacerbate problems with another or may be incompatible with other control tactics.

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

Major pests of agricultural and horticultural crops

Insects and related arthropods—Invertebrate animals, such as caterpillars, bugs, beetles, and mites that cause injury by feeding on plants and animals and by transmitting pathogens that cause diseases.

Nematodes—Microscopic, multicellular, unsegmented roundworms that parasitize animals and plants. Most nematodes that attack agricultural crops feed on the roots, but a few feed aboveground on inside stems and leaves.

Pathogens—Disease-causing bacteria, fungi, viruses, and related organisms. Note that a pathogen is the agent whose injury causes a disease, whereas a disease is the process of injury that the pathogen causes. Most pathogens are too small to be seen with the naked eye, while diseases manifest themselves visually as symptoms and signs.

Vertebrates—Any native or introduced, wild or feral, nonhuman species of vertebrate animal that is detrimental to one or more persons as a health hazard or general nuisance, or by destroying food, fiber, or natural resources. Vertebrate feeding in agricultural crops causes the majority of direct damage including animals, such as mice, rats, and birds. Vertebrates may also cause damage indirectly by transmitting human diseases.

Weeds—Undesirable plants that reduce crop yield and quality by competing for space, water, and nutrients; weeds also may harbor crop-attacking insects and pathogens. Weeds also include plants that interfere with other human activities, such as by prolifically growing in waterways, or those that cause discomfort, such as skin irritation or hay fever.

Integrated pest management defined

Integrated pest management is an approach to pest control that combines biological, cultural, and other alternatives to chemical control with the judicious use of pesticides. The objective of IPM is to maintain pest levels below economically damaging levels while minimizing harmful effects of pest control on human health and environmental resources. Figure 2-1 shows a model for IPM.

Integrated means that a broad interdisciplinary approach is taken using scientific principles of plant protection to bring together a variety of management tactics into an overall strategy.

- IPM strives for maximum use of naturally occurring control forces in the pest's environment including weather, pest diseases, predators, and parasites (fig. 2-2). Biointensive IPM attempts to reduce the use of conventional pesticides by looking first to biological and cultural alternatives as well as use of least-toxic bio-rational products that only affect the target pest.
- Rather than focusing on one-shot chemicals to kill pests after problems occur, IPM looks first to nonchemical measures that help prevent problems from developing.
- With IPM, the role for chemical pesticides is one of last resort if alternatives fail to correct the problem. Pesticides never are applied according to a preset schedule or spray calendar in an IPM program. Instead, they only are used if close inspection shows they really are needed to prevent severe damage (fig 2-3). Prescriptive IPM depends largely on judicious use of pesticides as determined by regular field scouting to determine if pest infestations exceed critical threshold levels that justify pesticide application.

Management is the decisionmaking process to reduce pest status in a planned, systematic way by keeping their numbers below economically acceptable levels. The essence of integrated pest management is decisionmaking: determining if, when, where, and what mix of control methods are needed.

IPM attempts to satisfy economic, environmental, and social objectives (which sometimes are in conflict with each other) to provide cost-effective pest control that minimizes adverse impacts on human health or the quality of environmental resources.

Figure 2-1 Conceptual model for integrated pest management showing how control tactics are integrated into a complementary system

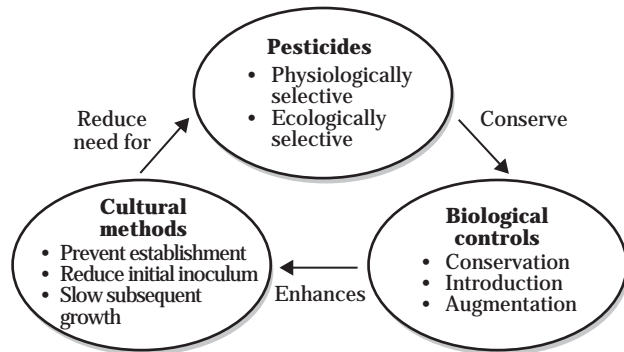


Figure 2-2 Biointensive IPM

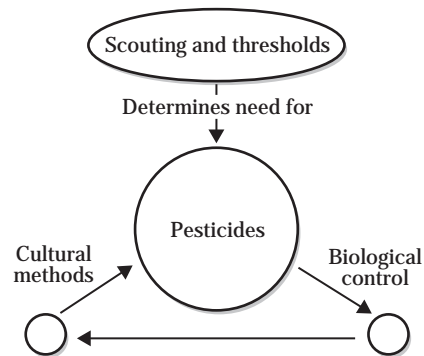
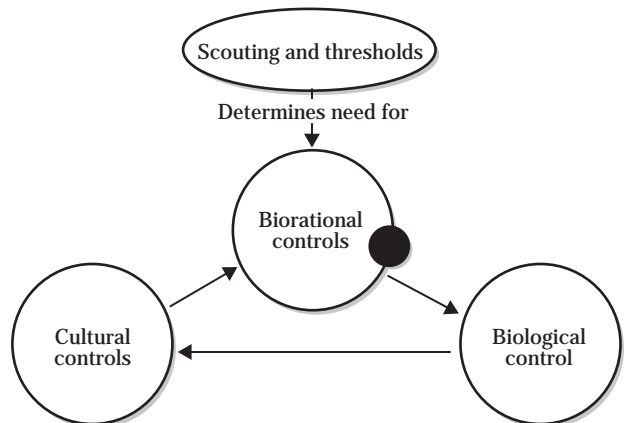


Figure 2-3 Prescriptive IPM



Resistance is the innate (genetically inherited) ability of organisms to evolve strains that can survive exposure to pesticides formerly lethal to earlier generations (fig 2-4). Resistance can develop when pesticide application kills 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 is the situation where insecticide application initially reduces an infestation, but soon afterwards the pest rebounds (resurges) to higher 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. Figure 2-5 illustrates the treadmill effect of over-reliance on pesticides.

Figure 2-5 Pesticide treadmill where over-reliance on pesticides creates an ever-increasing need to use pesticides

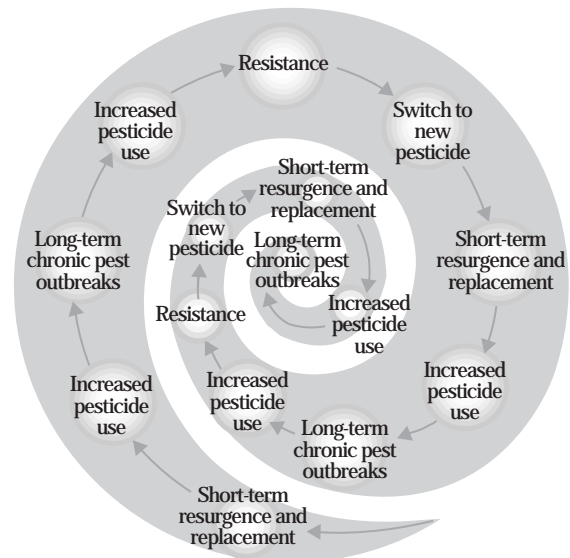
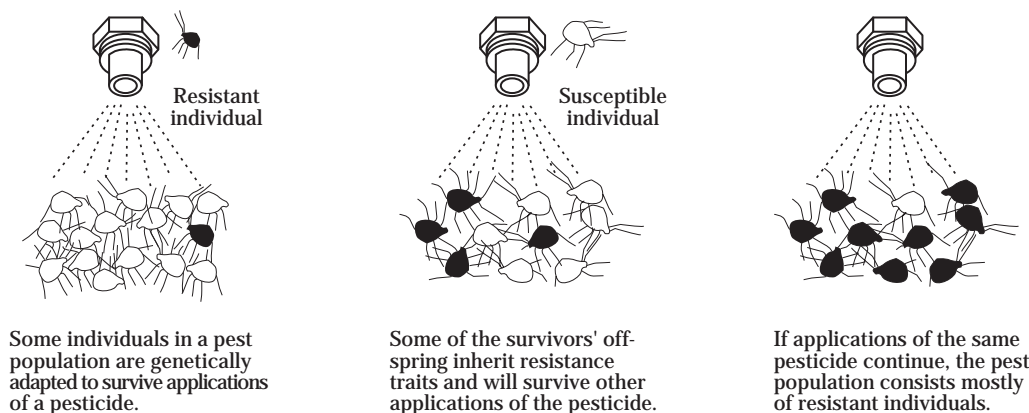


Figure 2-4 Resistance by organisms to pesticides (modified from The Safe and Effective Use of Pesticides, University of California)



IPM principles

Principle #1. There is no silver bullet.

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, do not eradicate.

IPM recognizes that keeping fields entirely pest-free is neither necessary nor desirable — it is not necessary to totally eliminate pests. 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 selectively 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 better can 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.

Overview of pest management practices

Farmers put IPM philosophy into practice by following these three steps:

Step 1. Use cultural methods, biological controls, and other alternatives to conventional chemical pesticides when practical.

Step 2. Use field scouting, pest forecasting, and economic thresholds to ensure that pesticides are used for real (not perceived) pest problems.

Step 3. Match pesticides with field site features so that the risk of contaminating water is minimized.

Alternatives to pesticides

Cultural methods

Cultural methods are those good farming (or good horticultural) practices that either control pests mechanically or break their infestation cycle by making the living and nonliving environment less suitable for pest survival by:

- Tillage operations that disrupt weeds
- Mowing
- Vacuuming
- Burning
- 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 controls used in IPM programs include:

- Crop rotation
- Tillage operations that turn the soil and bury crop debris
- Altering planting and harvest dates
- Altering seeding rates and crop spacing
- Seedbed preparation, fertilizer application, and irrigation schedules that help plants outgrow pests

- Sanitation practices, such as cleaning tillage and harvesting equipment
- Certified seed that is free of pathogens and weed seed
- Cover crops
- Trap crops
- Pest-resistant varieties that can tolerate pest injury, be less attractive to pests, or control pests by producing chemicals that are toxic to them

Biological controls

Biological controls use living organisms (natural enemies) to suppress populations of other pests.

Examples are:

- Predators are free-living animals (most often other insects or arthropods, but also birds, reptiles, and mammals) that eat other animals (the prey).
- 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 may weaken, but seldom kill the host.
- Pathogens are disease-causing micro-organisms, including viruses, bacteria, fungi, and nematodes.

Field scouting, pest forecasts, and thresholds

A principle of IPM is that pesticides should be used only when field examination or scouting shows that infestations exceed economic thresholds, guidelines that differentiate economically insignificant infestations from intolerable populations (fig 2-6). Pest scouting generally should be random and representative. In figure 2-6, the IPM scout used an understanding of pest biology to divide a large and variable wheat field into three subsections.

The only time to take control action and apply pesticides is when pest density reaches the economic threshold (ET) value. Pesticide application here keeps infestations from increasing to the breakeven economic injury level (EIL) value. The shaded part of the pest population curve in figure 2-7 shows actual pest density while the dotted curve shows a pest population increase in the absence of control.

Figure 2-6 Pest scouting

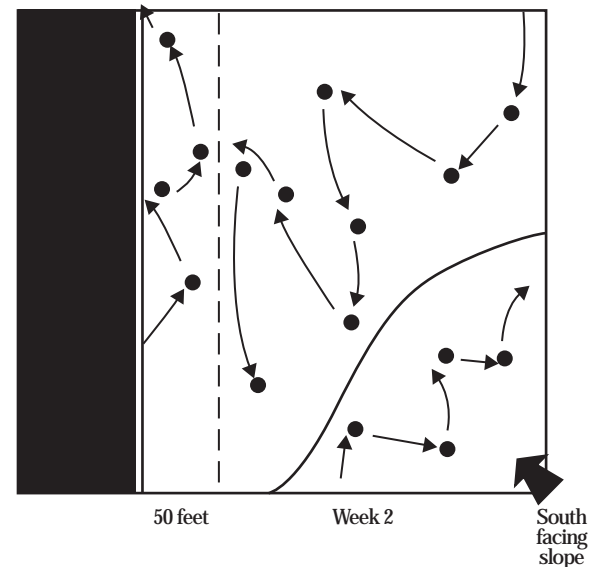
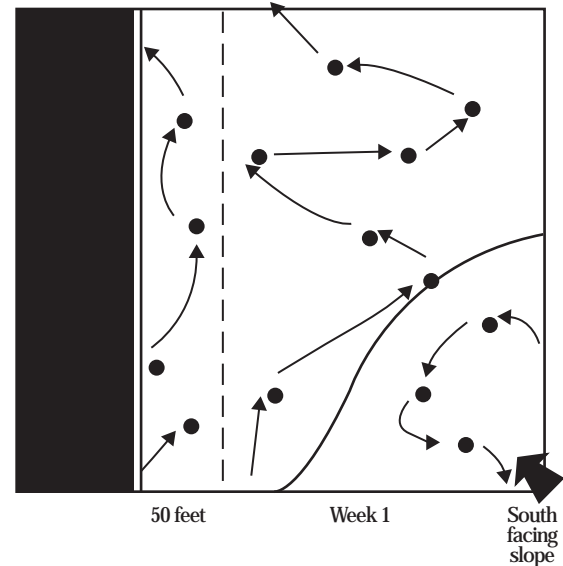
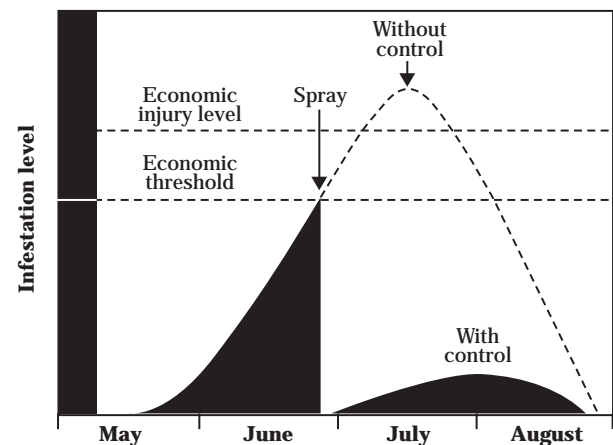


Figure 2-7 Relationship of economic injury level, economic threshold, and seasonal pest population growth



Site-specific pesticide selection

The final component of IPM is selection of pesticides that 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.

USDA National IPM Initiative

The United States Department of Agriculture, U.S. Environmental Protection Agency, and Food and Drug Administration responded to the President's proposal for reduced pesticide risk by jointly calling for the voluntary goal of implementing IPM methods on 75 percent of U.S. cropland by the year 2000. This voluntary approach to reducing pesticide risks contrasts with mandatory pesticide reduction strategies adopted by several European governments in the early 1990s.

To achieve the 75 percent adoption goal, the USDA announced on December 14, 1994, its National IPM Initiative. The Initiative is based on two premises:

- Involving farmers and other pest control advisors from the beginning in the development of IPM programs will increase the adoption of IPM methods.
- IPM benefits both consumers and farmers. It can reduce environmental and food safety risks from pesticides and increase farmer profitability by ensuring pest controls are used in the most judicious way.

In essence, the National IPM Initiative seeks to develop new IPM tools and then move them to the farm where they can be applied to solving priority pest control problems identified by farmers.

Pesticides

Pesticides are defined as *"any substance used for controlling, preventing, destroying, repelling, or mitigating any pest."* Tables 2-1 and 2-2 show the common pesticide classes and their target pests and functions.

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).

Formulations

Most end-use pesticide products are not 100 percent active ingredients. Typically, they are diluted with water, oil, air, or chemically inactive (inert) solids so they can be handled by application equipment and spread evenly over the area to be treated. Because the basic chemical generally cannot be added directly to water or mixed in the field with solids, manufacturers must further modify their products by combining them with other material, such as solvents, wetting agents, stickers, powders, or granules. The final product is called a pesticide formulation and is ready either for use as packaged or after being diluted with water or other carriers. Formulation types are:

| | |
|----|--------------------------|
| WP | wettable powder |
| S | solutions |
| F | flowable |
| G | granules or granular |
| D | dusts |
| SP | soluble powder |
| EC | emulsifiable concentrate |

Adjuvants are chemicals that are added to a pesticide formulation or spray mixture to improve performance and/or safety. Most pesticide formulations contain at least a small percentage of one or more adjuvants.

- Wetting agents allow wettable powders to mix with water.
- Emulsifiers allow petroleum-based pesticides (ECs) to mix with water.
- Invert emulsifiers allow water-based pesticides to mix with petroleum carrier.
- Spreaders allow pesticide to form a uniform coating layer over the treated surface.
- Stickers allow pesticide to stay on the treated surface for a longer time without being dislodged.
- Penetrants allow the pesticide to get through the outer surface to the inside of the treated target.
- Foaming agents reduce drift.
- Thickeners reduce drift by increasing droplet size.
- Safeners reduce the toxicity of a pesticide formulation to the pesticide handler or to the treated surface.
- Compatibility agents aid in combining pesticides effectively.
- Buffers allow pesticides to be mixed with diluents or other pesticides of different acidity or alkalinity.
- Antifoaming agents reduce foaming or spray mixtures that require vigorous agitation.

Table 2-1 Common pesticide classes and target pests

| Pesticide class | Target pest |
|-----------------|---------------------------|
| Acaricide | Mites |
| Avicide | Birds (kills or repels) |
| Bactericide | Bacteria |
| Fungicide | Fungi |
| Herbicide | Weeds |
| Insecticide | Insects |
| Larvicide | Larvae (usually mosquito) |
| Miticide | Mites |
| Nematicide | Nematodes |
| Ovicide | Eggs |
| Rodenticide | Rodents |

Table 2-2 Pesticide classes and functions

| Pesticide class | Function |
|-------------------|---|
| Attractants | Attract insects |
| Chemosterilants | Sterilize insect or pest vertebrates |
| Defoliants | Remove leaves |
| Desiccants | Speed drying of plants |
| Growth regulators | Stimulate or retard growth of plants or insects |
| Pheromones | Attract insects or vertebrates |
| Repellents | Repel insects, mites and ticks, or pest vertebrates |

Chemical control

The environmental risks of pest management using chemical control are:

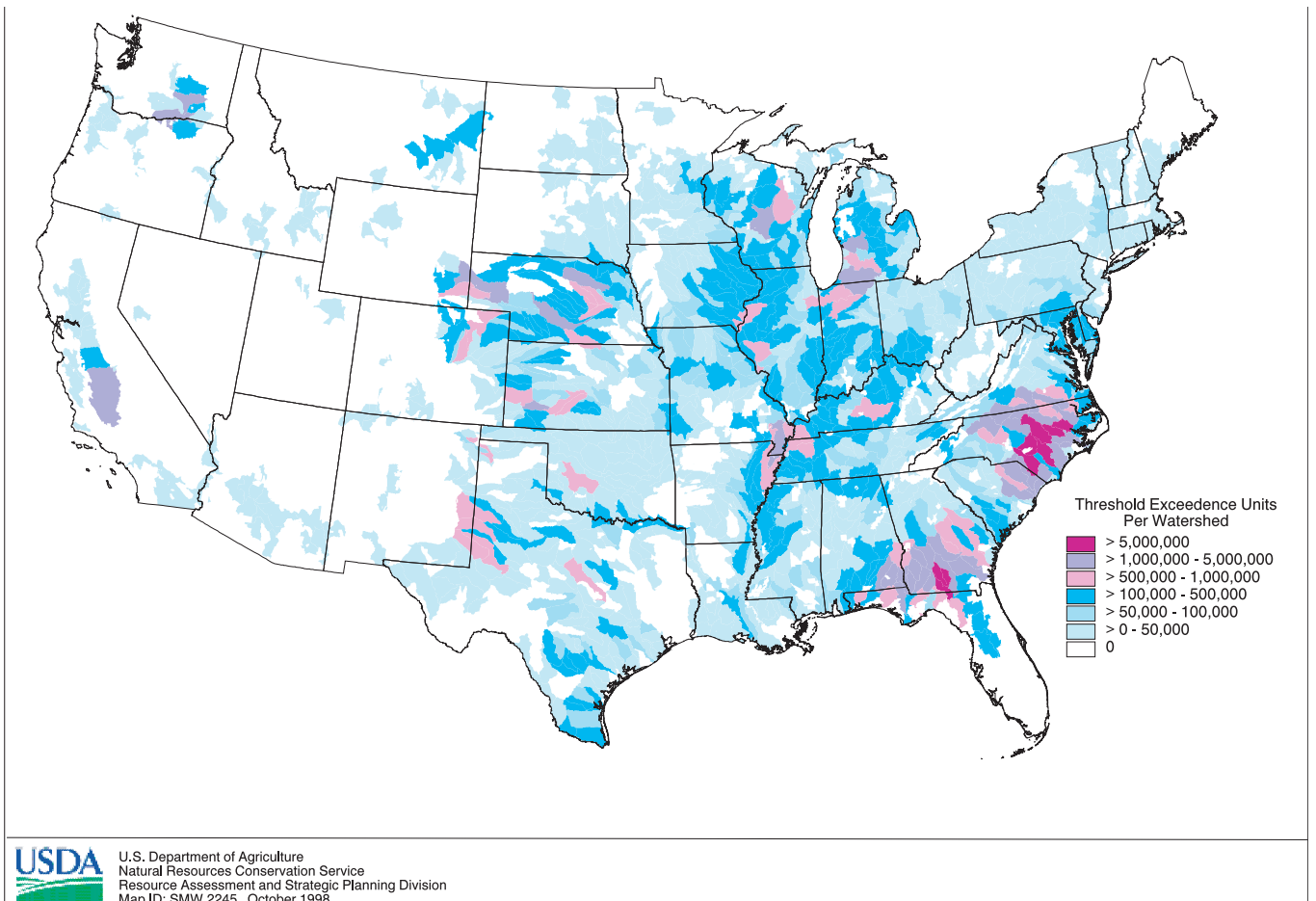
- Risk of pesticides leaving the agricultural management zone (AMZ) in soil, water and air, and negatively impacting nontarget plants, animals, and humans. (The boundaries of the AMZ are the edge of the field, the bottom of the root zone, and the top of the crop canopy.)
- Risk of harming beneficial organisms with pesticide application.
- Risk to personal safety during pesticide application.

Tools are available to help evaluate the potential for pesticides to leave the AMZ and impact nontarget plants, animals, and humans. National assessments can be used for strategic planning purposes. Figures 3-1 and 3-2 show national pesticide leaching and runoff indexes. The full text describing these maps can be viewed at <http://www.nhq.nrcs.usda.gov/land/pubs/gosstext.html>. The following is an excerpt from that text:

National Modeling

The National Pesticide Loss Database was used with the National Resources Inventory (NRI) to simulate pesticide loss by watershed for use in identifying potential priority watersheds for implementation of conservation programs.

Figure 3-1 Potential for concentration of pesticide leaching below the root zone to exceed water quality thresholds for humans (map can be viewed at <http://www.nhq.nrcs.usda.gov/land/pus/gosstext.html> as Map 6)



The NRI was used as a modeling framework and as a source of land use data and soil data. Each NRI sample point was treated as a representative field in the simulation model. The simulation was conducted using 13 crops-barley, corn, cotton, oats, peanuts, potatoes, rice, sorghum, soybeans, sugar beets, sunflowers, tobacco, and wheat-which comprise about 170,000 NRI sample points. The statistical weights associated with the NRI sample points are used as a measure of how many acres each representative field represents. Land use for the most recent inventory-1992-was used.

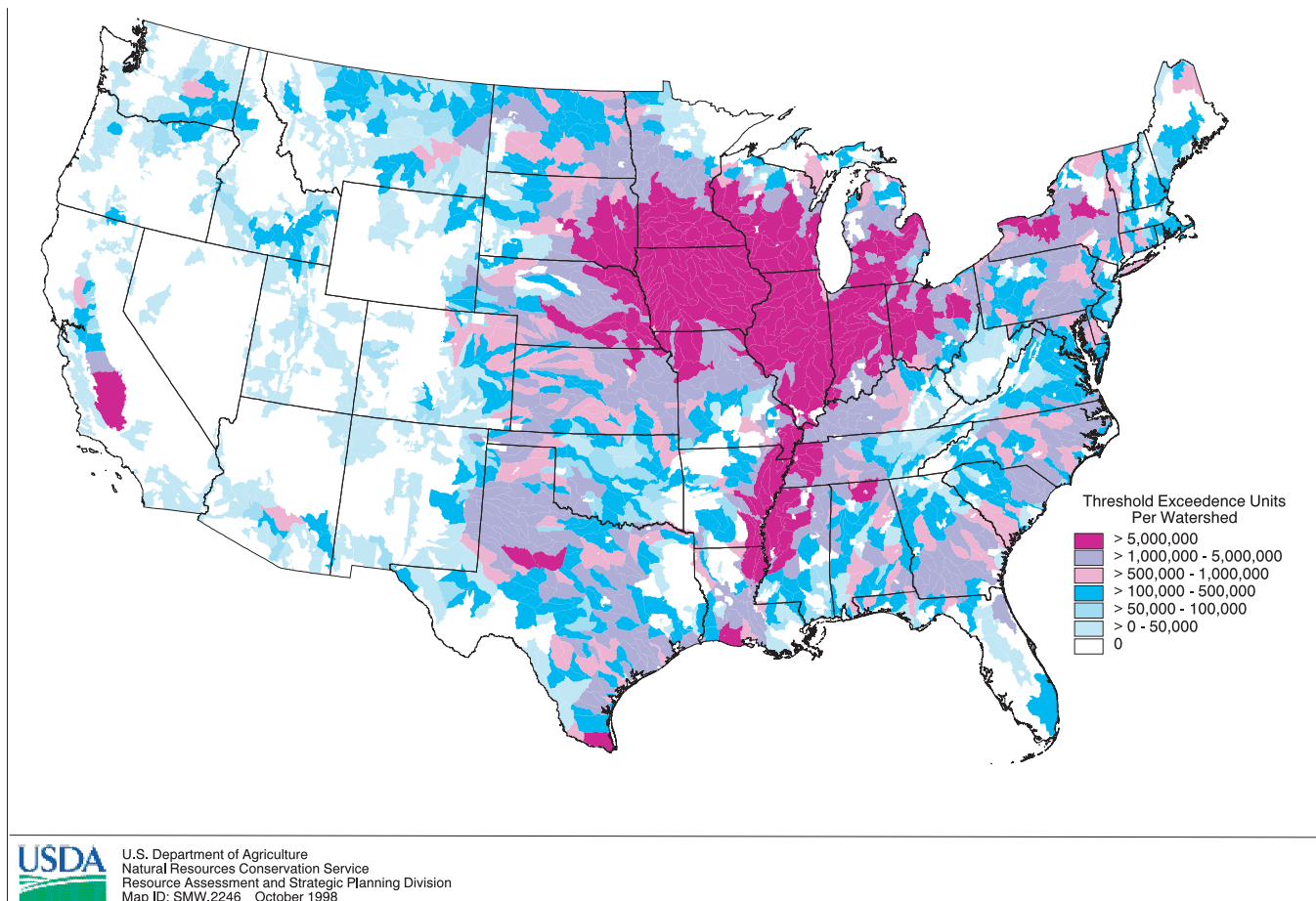
Pesticide use data were taken from Gianessi and Anderson, who estimated the average application rate and the percentage of acres treated by state for over 200 pesticides and for 84 crops for the time period 1990-93. Estimates of percent acres treated and application rate were imputed onto NRI sample points by state and crop. Map 2 was created by multiplying the percent acres treated times the acres represented by

each point to obtain the acres treated for each pesticide, and then multiplying by the application rate and summing over the pesticides at each NRI sample point to obtain the total pounds of pesticides applied. These results were aggregated over NRI sample points in each 8-digit hydrologic unit in the 48 states.

Estimates of pesticide loss from the National Pesticide Loss Database were imputed onto the 170,000 sample points according to soil type, geographic location, and pesticide. Mass loss and annual concentration were calculated for each pesticide at each sample point. Mass loss estimates were then aggregated over acres treated in each watershed to produce national maps.

Concentrations were compared to water quality thresholds to derive a measure of environmental risk at each NRI sample point. Health Advisories (HAs) and Maximum Contaminant Levels (MCLs) were used for humans for pesticides that have been assigned drinking water standards by EPA. For other pesticides,

Figure 3-2 Potential for concentration of pesticide runoff at the edge of the field to exceed water quality thresholds for humans (map can be viewed at <http://www.nhq.nrcs.usda.gov/land/pus/gosstext.html> as Map 14)



"safe" thresholds were estimated from EPA Reference Dose values and cancer slope data. Maximum Acceptable Toxicant Concentrations (MATCs) were used as "safe" thresholds for fish, which were calculated using toxicity data published by EPA.

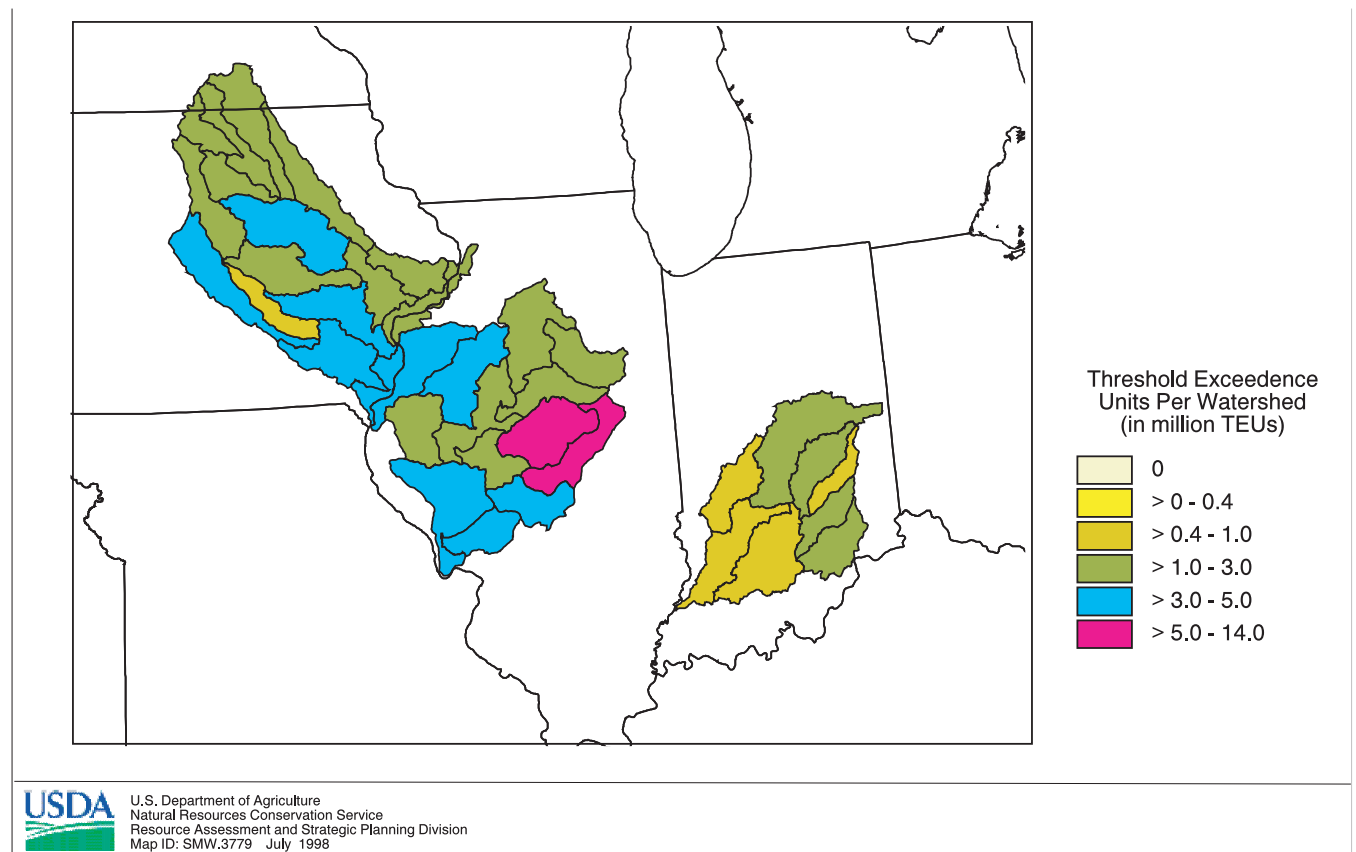
The extent to which the concentration exceeded the threshold was used as a measure of risk for each pesticide. This risk measure was aggregated over the pesticides at each point and then multiplied by the number of acres treated and summed over the points in each watershed to obtain an aggregate risk measure for each watershed—Threshold Exceedence Units (TEUs) per watershed. TEUs are similar in concept to the acre-feet volumetric measure, since they are a multiple of acres times a measure of magnitude at a point. They are used here only to measure relative risk from one watershed to another; the higher the TEU score, the higher the risk.]

Watershed level analysis (fig. 3-3) can be used to address specific water quality concerns and show the potential for management solutions to protect natural resources.

Field scale tools can be used to address identified resource concerns in targeted areas. The Windows Pesticide Screening Tool (WIN-PST) can help field office personnel evaluate the potential for offsite pesticide movement on a field-by-field basis. It is based on the NRCS Soil/Pesticide Interaction Screening Procedure (SPISP II) and National Agricultural Pesticide Risk Analysis (NAPRA) generic scenario results. The tool is illustrated in figures 3-4, 3-5, 3-6, 3-7, and 3-8.

Soil/pesticide interaction ratings for all applicable soils and pesticides provide a means to evaluate the potential environmental risks associated with all recommended alternatives. Appropriate mitigation strategies should be matched with alternatives that have substantial environmental risk(s).

Figure 3-3 National Agricultural Pesticide Risk Analysis (NAPRA) at the watershed level using the Natural Resources Inventory and the National Agriculture Statistics Service Cropping Practices Survey—Environmental risk in runoff for humans: 1991 - 1992 baseline



Pest Management

Figure 3-4 WIN-PST soil properties and ratings

WIN_PST

File Edit Form Window Help

SEL_SOIL.WFM: Select Soils from the SOIL_IL WIN-PST Soils Data Table.

KANE COUNTY, ILLINOIS; STSSAID: IL89

Sort by: MUSYM COMPONENT SHOW ALL ONLY SHOW SELECTED SOILS

Show Ratings Show Properties Show Management **SEARCH**

Press Alt-S to Alpha_Search()

| MUSYM | COMP_NAME | TEXT | HYD | KFACT | OM[1] | DEPTH[1] | SLP | SSRP | SARP |
|-------|--------------|------|-----|-------|-------|----------|--------------|--------------|--------------|
| 531B | Markham | SIL | C | 0.37 | 2.5 | 7 | LOW | HIGH | HIGH |
| 531C2 | Markham | SIL | C | 0.37 | 2.5 | 7 | LOW | HIGH | HIGH |
| 570B | Martinsville | L | B | 0.37 | 1.5 | 14 | INTERMEDIATE | INTERMEDIATE | INTERMEDIATE |
| 570C | Martinsville | L | B | 0.37 | 1.5 | 14 | INTERMEDIATE | INTERMEDIATE | INTERMEDIATE |
| 59 | Lisbon | SIL | B | 0.28 | 4.0 | 13 | HIGH (The hi | INTERMEDIATE | INTERMEDIATE |
| 60C2 | La Rose | L | B | 0.32 | 3.0 | 7 | INTERMEDIATE | INTERMEDIATE | INTERMEDIATE |

There is a perched high water table on this soil from MAR to MAY that comes within 3.00 to 6.00 ft. of the surface.

Current Soil: Selected Default OM Range - %

Soil Management: Slope > 15% Default First Horizon Depth: in.

High Water Table is less than 24 inches from the soil surface during the growing season.

There are macropores or cracks in the surface horizon deeper than 24"

Deselect All Soils **Select All Soils** **Clear Management** **Help** **Return to Main Menu**

Soil_il.dbf Excl Rec 7943/8662 Ins

Figure 3-5 WIN-PST pesticide properties and ratings

The screenshot shows the 'WIN-PST' application window with the 'Select Pesticides' dialog box open. The dialog has a menu bar (File, Edit, Form, Window, Help) and a toolbar with icons for printing, cutting, copying, pasting, and navigation. The main area contains a table of pesticide data with columns: AI_NAME, PC_CD, HL, KOC, SOL, Human Tox, MATC*, STV, FOL, and PLP. Below the table are several checkboxes for filtering and management, and a status bar at the bottom.

View: AIs PRODUCTS **Sort by:** ID NAME SHOW ALL ONLY SHOW SELECTED PESTICIDES

Show Ratings Show Properties Show Management

High Residue / Conservation Tillage (X > 30% residue) practices used on this site. **SEARCH**

Press Alt-S to Alpha_Search()

| AI_NAME | PC_CD | HL | KOC | SOL | Human Tox | MATC* | STV | FOL | PLP |
|---------------------------------|--------|-------|---------|--------------|-----------|-------|---------|-----|-------------|
| Atrazine (ANSI) | 080803 | 60.00 | 100 | 33.000 | 3 MCL | 658 | 65847 | Y | INTERMEDIA |
| Dicamba (ANSI) | 029801 | 14.00 | 2 | 400000.000 | 200 HA | 4919 | 9838 | Y | INTERMEDIA |
| Glyphosate, isopropylamine salt | 103601 | 47.00 | 24000 E | 900000.000 E | 700 MCL | 168 | 4032264 | Y | VERY LOW (F |

Current Pesticide: Selected Banded Foliar Low Rate UltraLow Rate Soil Incorporated

Show actively registered products which use this ingredient. **Show Alternate Names For This AI**

Deselect All Pesticides **Select All Pesticides** **Clear Management** **? Help** **Return to Main Menu**

Ais.dbf Excl Rec 190/403 Ins

Figure 3-6 WIN-PST soil/pesticide interaction ratings

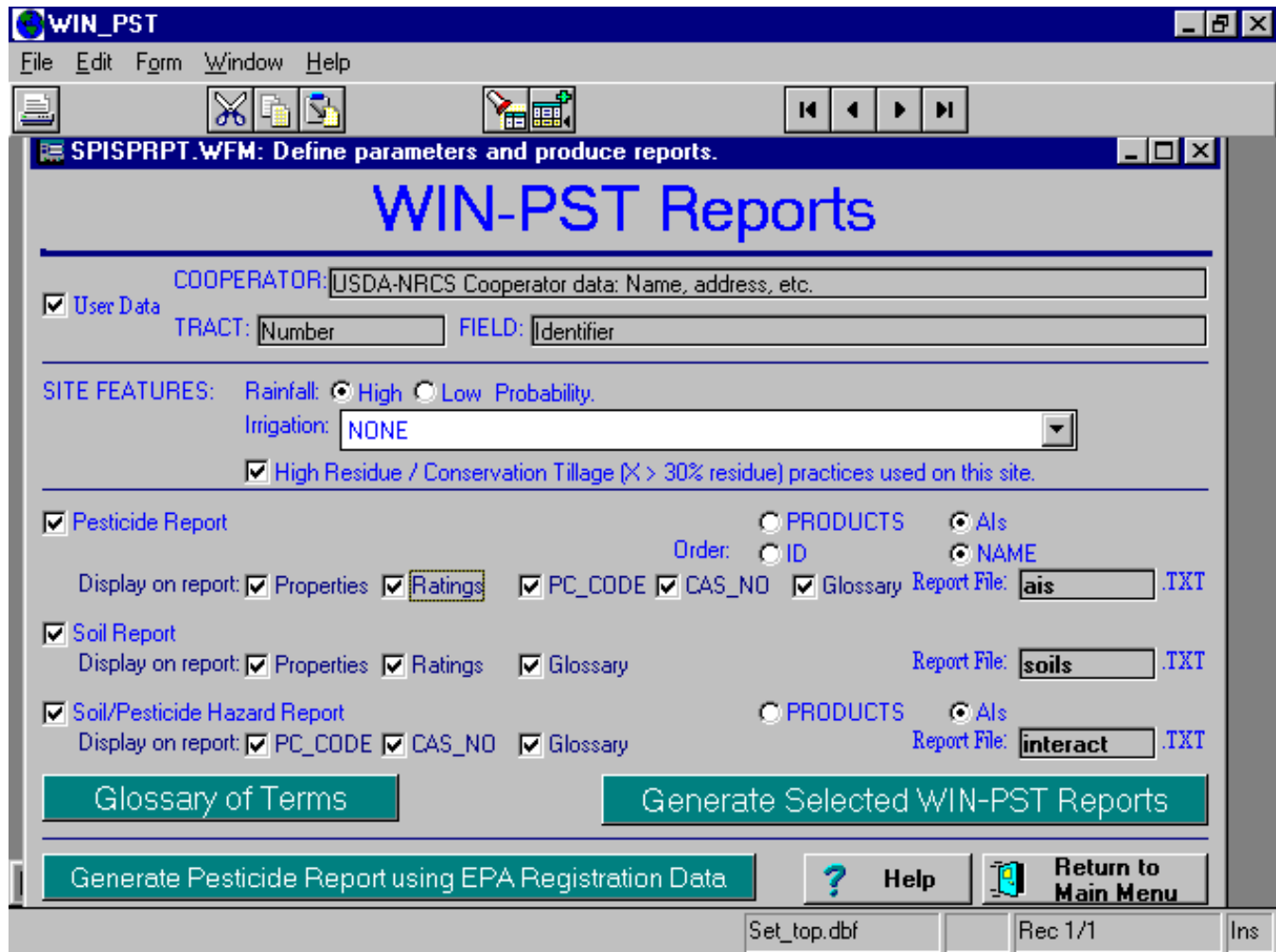
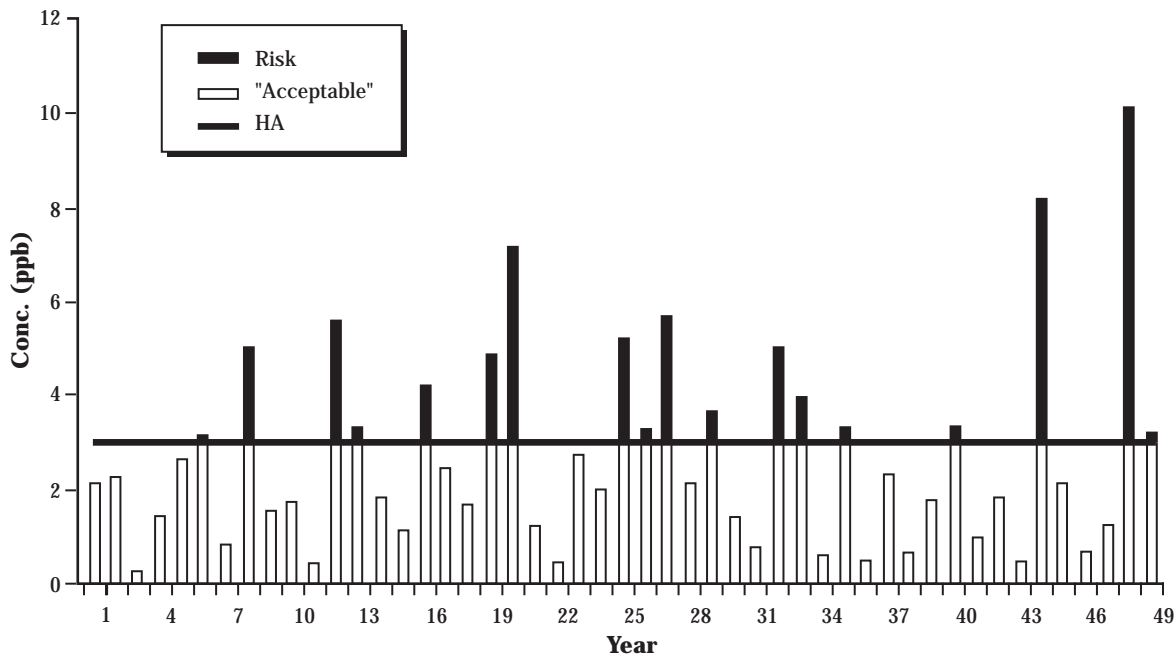
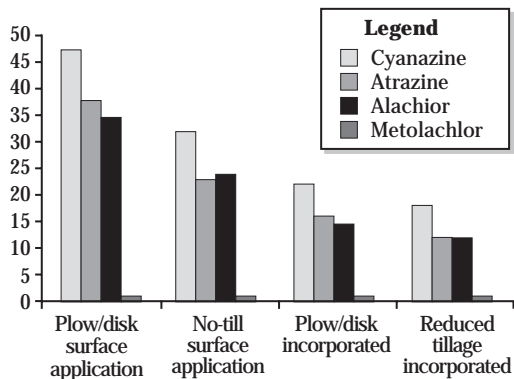


Figure 3-7 Variations in annual pesticide losses and cumulative National Agricultural Pesticide Risk Analysis (NAPRA) risk*



* NAPRA defines risk as a pesticide loss from the field that exceeds a toxicity threshold, such as the human drinking water Health Advisory (HA). Losses can vary greatly from year to year based on the climate, so NAPRA represents the risk associated with a given set of management options as a cumulative risk over time (in this case the sum of the risk over 49 years).

Figure 3-8 Using cumulative NAPRA risk to evaluate management alternatives*



* NAPRA characterizes risk variation associated with different pesticides and different management alternatives.

(The information in Chapter 4, Pesticides in the Environment, is adapted from Module 2 of Nutrient and Pest Management Considerations in a Conservation Management System Plan, NRCS National Employee Development Center self-paced study course, 1999.)

Introduction

Over 1.20 billion pounds of pesticide active ingredients are used annually in the United States in agriculture, forestry, rights-of-way, and by homeowners.

The Federal Insecticide Fungicide and Rodenticide Act (FIFRA) is the primary legislation regulating pesticides in the United States. The Environmental Protection Agency is responsible for the administration of this body of laws. These laws address the registration of pesticide products, prescribing conditions for pesticide use, establishing maximum acceptable levels of pesticide residue in foods, labeling requirements, and other aspects of pesticide regulation.

The 1996 Food Quality Protection Act (FQPA) made substantial amendments to FIFRA. Changes include requiring EPA to:

- Consider all nonoccupational exposure pathways when establishing tolerances.
- Screen pesticides for endocrine disruption.
- Consider cumulative risks of pesticides that have common mechanisms of toxicity.
- Consider risks to infants and children when setting tolerances.
- Expedite approval of "reduced risk" pesticides.
- Report annually to Congress on progress of the pesticide re-registration program.

Pesticide risk analysis

Pesticide registrations and label use restrictions are both based on risk analysis and determining if the benefits of a proposed pesticide use outweigh the potential risks. A *risk assessment* is a detailed risk analysis that includes essentially all potential risks to all species that may be impacted by a particular pesticide use. NRCS pesticide risk analysis is a subset of a

full risk assessment. NRCS focuses on pesticide environmental risk screening tools and the data used to identify sensitive pesticide/soil combinations that need mitigation to adequately protect the natural resource base.

The major components of pesticide risk analysis are:

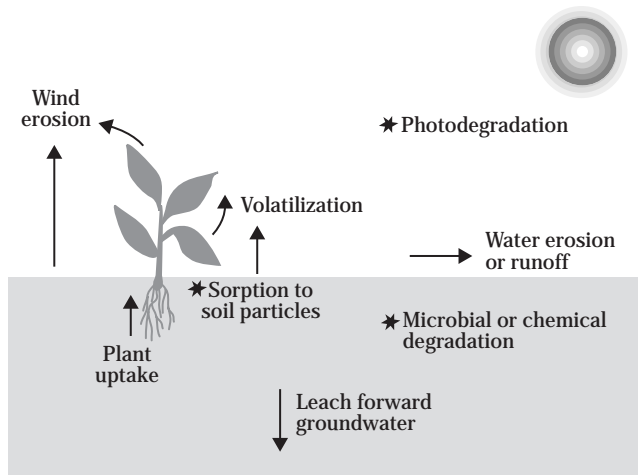
- Determining the potential for exposure to the pesticide
 - Point source exposure
 - ◇ Mixing/loading
 - ◇ Accidental spills
 - ◇ Container disposal
 - Nonpoint source exposure
 - ◇ Field leachate in water
 - ◇ Field runoff in water
 - ◇ Field runoff in sediment
 - ◇ Field volatilization in air
- Determining the toxicological hazard posed by the pesticide
- Characterizing risk by combining pesticide exposure and toxicity]

Environmental fate: understanding pesticide persistence and mobility in soil

Many factors govern the potential for pesticide contamination of ground water or surface water. These factors include soil properties, pesticide properties, hydraulic loading on the soil, and crop management practices.

Fate processes for a pesticide (fig. 4-1) can be grouped into those that affect persistence, (photodegradation, chemical degradation, and microbial degradation) and those that affect mobility (sorption, plant uptake, volatilization, wind erosion, runoff, and leaching) Figure 4-2 illustrates these groupings. Pesticide persistence and mobility are influenced by properties of the pesticide, soil properties, site conditions, weather, and management factors, such as pesticide application method. Some of the most important properties of a pesticide that can be used to predict environmental fate include half-life, soil sorption coefficient, water solubility, and vapor pressure.

Figure 4-1 Pesticide fate processes

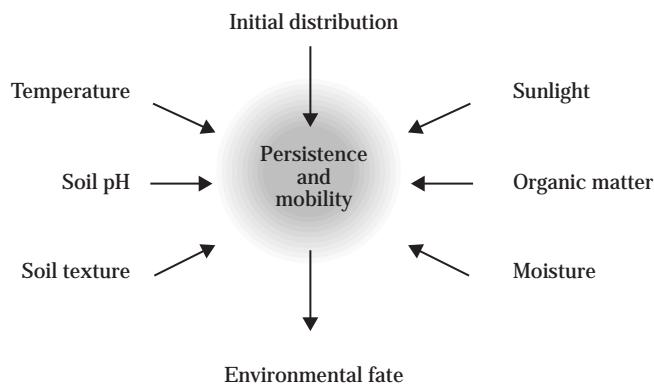


Pesticide persistence is often expressed in terms of field half-life. This is the length of time required for half of the original quantity to break down or dissipate from the field. The half-life values in table 4-1 represent typical field half-life values. Persistence can vary greatly from one site to the next.

Pesticide mobility may result in redistribution within the application site or movement of some amount of pesticide offsite. After application, a pesticide may:

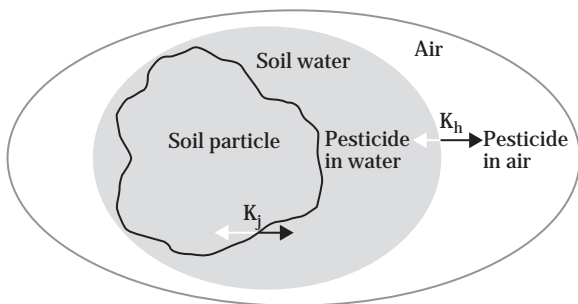
- Dissolve in water and be taken up by plants, move in runoff, or leach
- Volatilize or erode from foliage or soil with wind and become airborne
- Attach (sorb) to soil organic matter and soil particles and either remain near the site of deposition or move with eroded soil in runoff or wind

Figure 4-2 Factors affecting pesticide in soil



Pesticide sorption, water solubility, and vapor pressure affect mobility. Mobility is also influenced by environmental and site characteristics including weather, topography, canopy and ground cover, and soil organic matter, texture, and structure.

Figure 4-3 Distribution coefficient (K_d) and Henry's Law Constant (K_h)



Sorption is determined by the chemical characteristics of the pesticide. The specific mechanisms for the sorbing of a chemical to the soil are not easily defined. Numerous mechanisms may operate in a particular situation, including strong or weak ionic attraction, hydrophobic attraction, and hydrogen-bonding. Sorption of pesticides that are weak acids or bases is also influenced by the pH of the soil.

The sorption of a particular pesticide to a soil is measured in a laboratory by mixing water, pesticide, and soil. After equilibrium has been reached, the amount of pesticide remaining in solution is measured. The concentration of pesticide sorbed to the soil in the mixture is divided by the pesticide concentration still in solution. This yields the distribution coefficient, K_d (fig. 4-3). A low distribution coefficient indicates that more of the pesticide is in solution; a higher value indicates that more of the pesticide is sorbed to soil.

K_{oc} is the distribution coefficient K_d normalized for the amount of organic carbon that is in the tested soil (K_d /percent organic carbon). Soil organic carbon is directly proportional to soil organic matter, which is primarily responsible for a soil's sorption properties.

Pesticide movement pathways

A pesticide in solution can move across cell membranes and be taken up by plants. The amount of uptake is partly determined by the pesticide's water solubility. Adjuvants (additives) can enhance plant uptake of pesticides. Plant uptake of pesticide helps prevent runoff and leaching.

Pesticides may also volatilize or be blown away by the wind (erode). Volatilization from foliage is determined by the pesticide's vapor pressure, which is affected by temperature. Vapor pressure is the pressure exerted by a vapor when it is in equilibrium with the liquid from which it is derived. Pesticides with a high vapor pressure tend to volatilize. Those with a low vapor pressure are less likely to volatilize. The higher the temperature, the greater the volatilization.

Volatilization from moist soil is determined by moisture content of the soil and by the pesticide's vapor pressure (table 4-2), sorption, and water solubility. Because water competes for binding sites, pesticide volatilization is greatest in wet soils.

Airborne pesticide residue is subject to a variety of degradation processes including photodegradation, oxidation, and hydrolysis. The residue is often rapidly degraded in the atmosphere. However, stable airborne pesticide residue and its degradation products may move from the application site and be deposited in dew, rainfall, or dust. This may result in pesticide redistribution within the application site or movement

of pesticide offsite. The offsite airborne movement of a pesticide is known as drift. Drift can be harmful to both human and environmental health and may damage nearby crops. It is important to consider the weather conditions and the environmental behavior of pesticides to minimize drift.

Runoff is the movement of water over a sloping surface. Runoff can carry pesticides dissolved in water and pesticides sorbed to sediment. If heavy irrigation or rainfall shortly after application induces runoff, pesticide can be moved offsite. Heavy rainfall or overhead irrigation soon after application may also dislodge pesticide residue on foliage, adding to runoff losses. With time, residue on foliage is less likely to be washed off as it becomes incorporated in surface waxes.

Leaching is the removal of soluble materials by water passing downward through the soil. Ground water contamination occurs when pesticides move with

Table 4-2 Pesticide vapor pressure and potential for volatile loss

| Vapor pressure | Potential for volatile loss |
|--|-----------------------------|
| Greater than 1.0×10^{-4} | High |
| 1.0×10^{-4} to 1.0×10^{-7} | Medium |
| Less than 1.0×10^{-7} | Low |

Table 4-1 Pesticide environmental fate properties and NRCS soil/pesticide interaction screening procedure (SPISP II) pesticide ratings

| Pesticide | Field 1/2 life (days) | K_{oc} | Solubility in water (mg/L) | Vapor pressure (mm Hg) | Pesticide leaching potential* | Pesticide solution runoff potential* | Pesticide adsorbed runoff potential* |
|----------------------------|-----------------------|----------|----------------------------|------------------------|-------------------------------|--------------------------------------|--------------------------------------|
| Malathion | 1 | 1,800 | 130 | 8.0×10^{-6} | Low | Low | Low |
| 1,3 Dichloropropene | 10 | 32 | 2,250 | 29 | Intermediate | Intermediate | Low |
| Dicamba salt ^{1/} | 14 | 2 | 400,000 | 0 | High | Intermediate | Low |
| Benomyl | 67 | 1,900 | 2 | $<1 \times 10^{-10}$ | Low | High | High |
| Diuron | 90 | 480 | 42 | 6.9×10^{-8} | Intermediate | High | Intermediate |
| Bensulide | 120 | 1,000 | 5.6 | 8.0×10^{-7} | Intermediate | High | High |
| Prometon ^{1/} | 500 | 150 | 720 | 7.7×10^{-6} | High | High | Intermediate |

^{1/} Dicamba is a weak acid; Prometon is a weak base; therefore, sorption and solubility are affected by soil pH.

infiltrating water through the soil profile to the water table. The closer the water table is to the surface, the greater the likelihood that it may become contaminated. Soil permeability also plays a key role in determining the likelihood of a pesticide to leach into ground water.

Pesticide trapping with conservation buffers

Pesticides vary in how tightly they are sorbed (adsorbed and/or absorbed) to soil particles. Degree of soil binding is measured by binding coefficients or **K** values. K_{oc} is a type of **K** value that is normalized for organic carbon content. K_{oc} is a measure of sorption to the organic matter and clay fractions of soil, with higher K_{oc} values indicating tighter binding. K_{oc} values can be used to predict whether a specific pesticide will be carried primarily with organic matter and clay in runoff sediment or dissolved in runoff water. K_{oc} values greater than 1,000 indicate that pesticides are very strongly adsorbed to soil. Eroded soil carries the majority of this kind of chemical leaving fields in runoff. Thus, if conservation buffers are effective in trapping sediment, they will be effective in trapping this type of pesticide.

Pesticides with lower K_{oc} values (less than 300 to 500) tend to move more dissolved in runoff water than sorbed to runoff sediment. Concentrations carried on sediment are higher than concentrations in water, but because water quantities running off fields are so

much greater than eroded soil quantities, water accounts for the majority of this type of chemical leaving fields. To be effective in trapping this type of pesticide, buffers need to increase water infiltration or maximize contact of runoff with vegetation that may sorb pesticide.

Sensitivity and vulnerability of ground and surface water

Sensitivity refers to intrinsic physical and biological characteristics of a particular site that make it more or less susceptible to potential ground or surface water contamination. Sensitivity parameters include climate, soil characteristics (table 4-3), and distance to waterbodies.

Vulnerability refers to extrinsic management factors that could make a sensitive site more or less susceptible to ground or surface water contamination. Vulnerability parameters include cropping practices, tillage practices, pest management practices (including pesticide use practices), and irrigation practices,

Sensitive sites can be carefully managed to reduce ground and surface water vulnerability.

Table 4-3 Windows pesticide screening tool soil leaching and runoff sensitivity

| Component | Texture | Hyd | K factor | Depth | % OM | SLP | SSRP | SARP |
|-----------|---------|-----|----------|-------|------|-----|------|------|
| Markham | sil | C | 0.37 | 7" | 2.5% | L | H | H |
| Ayr | sl | B | 0.17 | 8" | 1.5% | H | I | I |
| Sparta | ls | A | 0.17 | 8" | 1.5% | H | L | L |

Legend:

- Hyd—The hydrologic group assigned to this soil
- K factor—Soil erodability factor
- Depth—Depth of the first soil layer
- % OM—Percent organic matter in the first horizon
- SLP—Soil Leaching Potential
- SSRP—Soil Solution Runoff Potential
- SARP—Soil Adsorbed Runoff Potential
- H—High
- I—Intermediate
- L—Low

Pesticide toxicity: "The dose makes the poison"

One of the more commonly used measures of toxicity is the LD50. The LD50 (lethal dose for 50 percent of the animals tested) of a poison is generally expressed in milligrams of chemical per kilogram of body weight (mg/kg). A chemical with a small LD50 is highly toxic. While a chemical that has a large LD50 is unlikely to have lethal effects, it may still produce illness. Table 4-4 shows exposure measurement.

LC50 (lethal concentration for 50 percent of the animals tested) is often used for toxicity to aquatic species.

LD50 and LC50 vary by species and exposure pathway (for example, oral versus dermal), so comparable studies must be used to evaluate one pesticide versus another.

MATC (maximum acceptable toxicant concentration) is a long-term acceptable toxicity for fish. An MATC can be determined empirically by performing lifetime or long-term toxicity tests for fish. Alternatively, MATC's can be estimated from LC50s (Barntouse, Suter, and Rosen 1990).

Toxicity assessment is complex because environmental stress factors (temperature, food, and light) and species diversity (age, sex, health, and hormonal status) can cause results to vary widely (table 4-5).

Table 4-4 Common exposure measurements

| Dose | Abbreviation | Metric equivalent | Abbreviation | Approximate amount in water |
|-------------------|--------------|---|---------------|----------------------------------|
| Parts per million | ppm | Milligrams per kilogram or milligrams per liter water | mg/kg mg/L | 1 teaspoon per 1,000 gallons |
| Parts per billion | ppb | Micrograms per kilogram or micrograms per liter water | µg/kg µg/L | 1 teaspoon per 1,000,000 gallons |

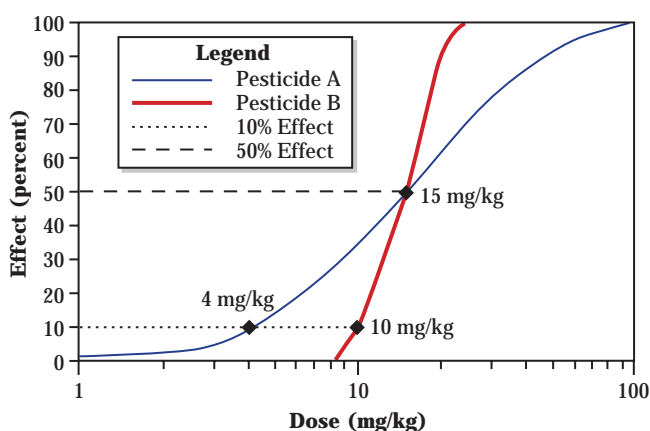
Table 4-5 Toxicity rating scale and labeling requirement for pesticides ^{1/}

| Category | Signal word required on label | Characteristic acute toxicity in experimental animal LD50 and LC50 | Skin/eye irritation | Probable oral lethal dose |
|-----------------------------|-------------------------------|---|---------------------|---------------------------------|
| I. Highly toxic | DANGER- POISON | Oral: 0–50 mg/kg Dermal: 0–200 mg/kg Inhalation: 0–0.2 mg/L | Severe | A few drops to a teaspoon |
| II. Moderately toxic | WARNING | Oral: >50–500 mg/kg Dermal: >200–2,000 mg/kg Inhalation: >0.2–2.0 mg/L | Moderate | More than 1 teaspoon to 1 ounce |
| III. Slightly toxic | CAUTION | Oral: >500–5,000 mg/kg Dermal: >2,000–20,000 mg/kg Inhalation: >2.0–20 mg/L | Slight | More than 1 ounce |
| IV. Practically nontoxic | None required | Oral: >5,000 mg/kg Dermal: >20,000 mg/kg Inhalation: >20 mg/L | None | |

^{1/} Source: 40 CFR 156.10 (1994)

Comparing poisons based on LD50s is an oversimplified approach to comparing chemicals because the LD50 is only one point on the dose-response curve that reflects the potential of the compound to cause death. What is more important in assessing chemical safety is the threshold dose and the slope of the dose-response curve, which shows how fast the response increases as the dose increases. Figure 4-4 is examples of dose-response curves for two chemicals that have the same LD50.

Figure 4-4 Dose response of two chemicals with the same LD50



Note: Although pesticide A and pesticide B have the same LD50, their dose/response curves are quite different. Pesticide A has toxic effects at much lower doses than pesticide B, but once pesticide B reaches a toxic dose, its toxic effects increase much more quickly than pesticide B as the dose is increased.

A true assessment of a chemical's toxicity involves comparisons of numerous dose-response curves covering many types of toxic effects. The determination of which pesticides will be restricted use pesticides uses this approach. Some restricted use pesticides have large LD50s (low acute oral toxicity); however, they may be strong skin or eye irritants that require special handling.

The knowledge gained from dose-response studies in animals is used to set standards for human exposure and the amount of chemical residue that is allowed in the environment. As mentioned previously, numerous dose-response relationships must be determined in many different species. Without this information, the health risks associated with chemical exposure are impossible to accurately predict. Adequate information helps to make informed decisions about chemical exposure so that the risk to human health and the environment is minimized.

Manifestations of toxic effects

Most toxic effects are reversible and do not cause permanent damage, but complete recovery may take a long time. However, some poisons cause irreversible (permanent) damage. Poisons can affect just one particular organ system, or they may produce generalized toxicity by affecting a number of systems. The type of toxicity is generally subdivided into categories based on the major organ systems affected. Some of these are listed in table 4-6.

Table 4-6 General toxicity categories

| Category | System affected | Common symptoms |
|------------------|------------------------------|---|
| Respiratory | Nose, trachea, lungs | Irritation, coughing, choking, tight chest |
| Gastrointestinal | Stomach, intestines | Nausea, vomiting, diarrhea |
| Renal | Kidney | Back pain, urinating more or less than usual |
| Neurological | Brain, spinal cord, behavior | Headache, dizziness, confusion, depression, coma, convulsions |
| Hematological | Blood | Anemia (tiredness, weakness) |
| Dermatological | Skin, eyes | Rashes, itching, redness, swelling |
| Reproductive | Ovaries, testes, fetus | Infertility, miscarriage |

Although natural and synthetic chemicals may cause a variety of toxic effects at high enough doses, the effect that is of most concern in the United States is cancer. This is not surprising considering the high incidence of this disease, its often-fatal outcome, and the overall cost to society. To decide on the risk that a particular carcinogen poses, it is important to determine how much of the chemical will cause how many cases of cancer in a specified population. This value can then be compared to what is considered an acceptable risk. Currently, the commonly accepted increase in risk of cancer is one additional cancer in one million people.

Acceptable carcinogen exposure levels (set by EPA) generally represent what is called the "worst case" exposure. An assumption made in the calculation of worst-case exposure levels is that humans will be exposed to the same concentration of the chemical every day of their lives for 70 years. As a result, the published acceptable risk level does not necessarily represent the "safe level," but rather a target level with the expectation that the true risk to exposure is less than the published value. The exposure criteria are guidelines for the protection of sensitive elements of the population and are calculated with many factors of uncertainty (the relationship of animal toxicity to human toxicity, for instance).

Cholinesterase (ko-li-nes-ter-ace) is one of many important enzymes needed for the proper functioning of the nervous systems of humans, other vertebrates, and insects. Certain chemical classes of pesticides, such as organophosphates (OPs), carbamates, and chlorinated derivatives of nicotine (imidacloprid), work against undesirable bugs by interfering with or inhibiting cholinesterase. While the effects of cholinesterase-inhibiting products are intended for insect pests, these chemicals can also be poisonous or toxic to humans in some situations.

Organophosphate insecticides include some of the most toxic pesticides. They can enter the human body through skin absorption, inhalation, and ingestion. They can affect cholinesterase activity in red blood cells and in blood plasma and can act directly, or in combination with other enzymes, on cholinesterase in the body.

Carbamates are similar to organophosphates in that they vary widely in toxicity and work by inhibiting plasma cholinesterase.

Imidacloprid is a recently introduced synthetic insecticide that is similar to nicotine. It mimics the action of acetylcholine by binding to the postsynaptic nicotinic

receptor. However, nicotine and imidacloprid are insensitive to the action of acetylcholinesterase and, therefore, bind persistently to the receptor that leads to nerve overstimulation. This results in hyperexcitation, convulsions, paralysis, and death. Because the nicotinic neuronal pathway is more abundant in insects, these compounds are selectively more toxic to insects than mammals.

Overexposure to organophosphate and carbamate insecticides can result in low blood pressure, slow heartbeat, breathing difficulty, and possibly death if not promptly treated by a physician.

EPA defines endocrine disruptors as compounds that "interfere with the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body that are responsible for the maintenance of homeostasis (normal cell metabolism), reproduction, development, and/or behavior." Many endocrine disruptors are thought to mimic hormones, such as estrogen or testosterone. They have chemical properties similar to hormones that allow binding to hormone specific receptors on the cells of target organs. A number of pesticides are suspected endocrine disruptors, but EPA has not yet confirmed these preliminary findings.

Pesticide drinking water standards

EPA set standards for pesticide residue in drinking water for about 200 organic chemicals, many of which are pesticides. These standards include health advisories (HAs) in mg/L (ppm) for 1-day, 10-day, and longer-term exposures for children and adults.

The HA is the concentration of a chemical in drinking water that is not expected to cause adverse effects over a lifetime of exposure. It is determined separately for pesticides that have not been shown to cause cancer in laboratory animals and for those that have.

Following a more thorough evaluation, EPA has established maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) for many, but not all, pesticides. MCLs are the maximum permissible level of a contaminant in water that is delivered to any user of a public water system. MCLGs are nonenforceable concentrations of a drinking water contaminant that are protective of adverse human health effects and allow an adequate margin of safety.

EPA's Office of Water also establishes drinking water equivalent levels (DWELs). The DWEL is a lifetime exposure concentration protective of adverse, noncancer health effects that assumes all of the exposure to a contaminant is from a drinking water source.

EPA also establishes a reference dose (RfD) in mg/kg body weight per day for each registered pesticide. The RfD represents the level of daily exposure to a pesticide (through all possible routes of exposure) that is not expected to result in appreciable risks over a human lifetime. This value is based on studies with laboratory animals and usually incorporates a safety factor of 100 to compensate for differences in species sensitivity and sensitive subpopulations. Table 4-7 lists drinking water standards and health advisories for four example pesticides.

Ecological Effects

Chemicals released into the environment may have a variety of adverse ecological effects ranging from fish and wildlife kills to more subtle effects on reproduction or fitness that also can result in population decline. Ecological effects can be long-term or short-lived changes in the normal functioning of an ecosystem, resulting in economic, social, and aesthetic losses. These potential effects are an important reason for regulation of pesticides, toxic substances, or other sources of pollution.

Scientists are most concerned about the effects of chemicals and other pollutants on communities. Short-term and temporary effects are more easily measured than long-term pollution effects on ecosystem communities. Understanding the impact of effects requires knowledge of the time course and variability of these

short-term changes. Pollutants may adversely affect communities by disrupting their normal structure and delicate interdependencies. The structure of a community includes its physical system, generally created by the plant life and geological processes, as well as the relationships between its populations of biota.

A pollutant may eliminate a species essential to the functioning of the entire community; it may promote the dominance of undesirable species (weeds, trash fish); or it may simply decrease the numbers and variety of species present in the community. It may also disrupt the dynamics of the food webs in the community by breaking existing dietary linkages between species. Most of these adverse effects in communities can be measured through changes in productivity in the ecosystem. Under natural stresses, such as unusual temperature and moisture conditions, the community may be unable to tolerate chemical effects that would otherwise cause no harm.

Wildlife may be exposed to pesticides via oral, inhalation, and dermal routes of exposure (and in the case of fish, some amphibians, and many aquatic macroinvertebrates, through the gill). Table 4-8 shows the toxic levels of different exposures. Because pesticides are widespread in the environment and are found in both aquatic and terrestrial ecosystems, wildlife may be exposed in many ways.

Table 4-7 EPA drinking water standards and guidelines

| Pesticide | --- Water quality standards (mg/L) --- | | ----- Health advisories ----- | | | | | | |
|--------------|--|-------|-----------------------------------|--------|-----------|--------------------------|----------|-----------------|-------|
| | MCLG | MCL | 10-kg child (mg/L) drinking water | | | 70-kg adult (mg/L) | | | |
| | | | 1 day | 10 day | long-term | drinking water long-term | lifetime | all routes DWEL | RfD |
| Atrazine | 0.003 | 0.330 | 0.1 | 0.1 | 0.05 | 0.2 | 0.003 | 0.2 | 0.035 |
| 2, 4-D | 0.07 | 0.07 | 1.0 | 0.3 | 0.1 | 0.4 | 0.07 | 0.4 | 0.01 |
| Glyphosate | 0.7 | 0.7 | 20 | 20 | 1 | 1 | 0.7 | 4 | 0.1 |
| Methoxychlor | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.2 | 0.04 | 0.2 | 0.005 |

Table 4-8 Categories of ecotoxicology ^{1/}

| Toxicity category | Birds acute oral LD50 (mg/kg) | Birds dermal LC50 (ppm) | Fish water LC50 (mg/L) |
|----------------------|-------------------------------|-------------------------|------------------------|
| Very highly toxic | <10 | <50 | <0.1 |
| Highly toxic | 10 – 50 | 50 – 500 | 0.1 – 1 |
| Moderately toxic | >50 – 500 | >500 – 1000 | >1 – 10 |
| Slightly toxic | > 500 – 2,000 | >1,000 – 5,000 | >10 – 100 |
| Practically nontoxic | > 2,000 | >5,000 | >100 |

1/ After: Meister, R. (ed.), Farm Chemicals Handbook, Meister Publishing, Willoughby, OH.

A pest management component of the conservation management system is a record of the producers decisions for managing pest populations. The objectives for applying pest management in accordance with the specifications are to manage pest populations while protecting the quantity and quality of agricultural commodities and to minimize negative impacts of pest control on soil, water, and air resources.

Steps to complete the specifications sheet

Step 1. Landowner, date, and assisted by

Complete the spaces provided to identify the landowner, date, and planner providing technical assistance.

Step 2. Tracts/field(s)

Identify the tract and field for which the plan is being developed. More than one tract or field can be included on a single specification sheet if the soils, crop, and target pest are similar and will be managed similarly.

Step 3. Soils

Identify the soil(s) being used to plan the management of the field. If management will be planned differently for each soil, list the soils applicable to this particular specifications sheet. The soils listed will be used in the environmental risk analysis for soil and water quality.

Step 4. Crop sequence/rotation

Identify the crops planned for the field(s). List the crops in the sequence they will be planted, if known. Scheduling the type and sequence of crops can help reduce pest pressures and avoid mistakes, such as crop damage from herbicide carryover. Circle the crop(s) for which this specification sheet is being developed.

Step 5. Management system

Describe the management system applicable to the field(s). Examples include a reduced tillage system with 20 percent residue after planting or a rotational grazing system for dairy cows.

Step 6. Assessment completed for:

Identify if an analysis has been or will be completed for pesticide environmental risk, erosion, or soil quality. If the plan includes the use of pesticides, an

environmental risk analysis based on soil and chemical properties of the pesticide will be made. The analysis should include the potential for the pesticide to move offsite through leaching and surface runoff in solution and attached to sediment. Available analysis tools for pesticide risk analysis include the Soil Pesticide Interaction Screening Procedure (SPISP II), The Windows Pesticide Screening Tool (WIN-PST), and the National Agricultural Pesticide Risk Analysis (NAPRA). Available tools to analyze the impacts of management alternatives on erosion and soil quality are the Revised Universal Soil Loss Equation (RUSLE), Wind Erosion Equation (WEQ), and the Soil Conditioning Index (SCI). Other analysis tools may be available locally.

Step 7. Target pest

Identify each target pest for which the pest management plan is being developed.

Step 8. Management method

Describe the specific method planned for managing each target pest. Include the type of control planned, such as mechanical, cultural, biological, or chemical, and applicable details, such as type of tillage, use of pest resistant varieties, biological predators, or name of the pesticide. Information to help the producer decide on the management method(s) will come from university or state agency guidelines, producer experiences, and sound agronomic practices.

Step 9. Application techniques

Describe in detail the planned application techniques that will be used to manage each target pest. Include specific management details, such as the rate, form, timing, and method. For pesticides, the rate, timing, and method of application are based on university or state agency guidelines, producer experience, and the product label.

Step 10. Additional specifications

Provide additional information needed to ensure the pest management practice is applied correctly. This is an excellent location to provide information on mitigation techniques to maintain or improve the natural resources or to offset potential negative environmental impacts of applying the pest management practice. Mitigation may include conservation practices and management techniques that the landowner would install or put in place on the field, such as residue management, nutrient management, water management, or conservation buffers.

Step 11. Job sketch

Provide a map showing the field location and acres. Also, show the boundaries of any sensitive areas, such as waterbodies, setbacks, or highly erodible soils, where restrictions to pest management methods may occur. If the conservation plan map includes these items, place a reference in the sketch area to the applicable field(s) on the plan map instead of completing a new drawing.

Step 12. Operation and maintenance

Several items must be assessed and performed routinely. These include calibration of equipment, maintaining a safe working environment, and review and update of the pest management component plan. The plan should be reviewed by the producer to determine if any short-term adjustments are needed for the immediate or following crops. Records of implementation shall be kept in accordance with Federal and State guidelines. Monitoring the effectiveness of management practices and the efficacy of the pest management itself is part of the operation and management.

Step 13. Additional notes

Complete additional information or guidance, if needed. This space can be used to describe sensitive areas in detail or to continue items from previous pages, such as additional operation and maintenance.



Pest Management

Conservation Practice Job Sheet

595

Natural Resources Conservation Service (NRCS)

January 1999

Landowner _____

Date _____



What is pest management?

Pest management is the management of pests, including weeds, insects, diseases, and animals. To protect our Nation's natural resources, special care must be taken to:

- Evaluate the environmental risks of pest management.
- Develop appropriate risk reduction strategies.
- Encourage widespread adoption of Integrated Pest Management (IPM) programs.

Purposes

Pest management systems are designed to:

- Enhance the quantity and quality of agricultural commodities.
- Minimize the negative impacts of pest control on soil resources.
- Minimize the negative impacts of pest control on water resources.
- Minimize the negative impacts of pest control on

air resources.

- Minimize the negative impacts of pest control on plant resources.
- Minimize the negative impacts of pest control on animal resources.

Benefits

Pest management systems:

- Maximize economic returns.
- Minimize environmental risks.
- Improve food, water, and air quality.
- Integrate all aspects of pest management within the agricultural production system.

Conservation management systems

Pest management is used as a component of a conservation management system. It should be used in conjunction with crop residue management, nutrient management, conservation buffers, and other practices, which are applied on a site-specific basis to address both natural resource concerns and the landowner's objectives.

General criteria

- Follow the attached pest management specification.
- IPM programs that strive to balance economics, efficacy, and environmental risks will be utilized where available. IPM information available for your crops is attached.
- An appropriate set of mitigation and management techniques must be planned to address the environmental risks of pest management activities. These techniques are incorporated in the attached specification.
- When applying cultural or mechanical control methods of pest management, crop rotation, residue management, and other practices, must comply with the rest of the conservation plan.
- When developing alternatives and applying chemical controls of pest management, the following will apply:
 1. Utilize pesticide label instructions when developing chemical control alternatives. Pay special attention to environmental hazards and site-specific application criteria.
 2. Pesticide environmental risks are incorporated in the attached specification.
 3. When a chosen alternative has significant potential to negatively impact important water resources, an appropriate set of mitigation techniques must be used to address risks to humans and non-target aquatic and terrestrial plants and wildlife. Appropriate mitigation techniques are incorporated in the attached specification.
- Methods of pest management must comply with Federal, State, and local regulations.

Operation, maintenance, and safety

Formulate a safety plan complete with names, locations, and telephone numbers of local treatment centers. For human exposure questions, the local center is:

Name: _____

Location: _____

Phone: _____

A national hotline in Corvallis, OR, is available:

1-800-424-7378

[6:30a.m. - 4:30p.m. Mon.- Fri., Pacific Time]

For emergency assistance with agrichemical spills, the local contact is:

Name: _____

Location: _____

Phone: _____

National emergency assistance is available from

CHEMTREC®: 1-800-424-9300

- Post signs around treated fields according to label directions and Federal, State, and local laws. Follow re-entry intervals and wear protective clothing according to the Worker Protection Standard.
- Dispose of pesticide containers according to label directions and adhere to attached Federal, State, and local regulations.
- Pesticide users must read and follow label directions, maintain appropriate Material Safety Data Sheets and become certified to apply restricted use pesticides.
- Calibrate application equipment frequently. Replace worn nozzle tips, cracked hoses, and faulty gauges.
- Open mixing of chemicals will not occur in the application field near a well or surface waterbody as specified in operations and maintenance. Open mixing should be performed downgradient of wells.
- Records of pest management required by state law and the USDA Pesticide Record Keeping Program will be maintained by the producer as specified in operations and maintenance. USDA requires that they be kept for at least 2 years.

Pest management guidelines

Provide adequate plant nutrients and soil moisture and favorable pH and soil conditions to reduce plant stress, improve plant vigor, and increase the plant's overall ability to tolerate pests.

- Diversify treatment methods to minimize the development of pest resistance.
- Delay pesticide applications when climatic conditions are conducive to offsite pesticide movement.
- Apply conservation practices and management techniques that reduce runoff and erosion.
- Use conservation buffers to reduce offsite movement of pollutants.
- Prevent disruption of Native American artifacts and other cultural resources with land disturbing activities.

DISCLAIMER: Trade names are used solely to provide specific information. Mention of a trade name does not constitute a guarantee of the products by the U.S. Department of Agriculture nor does it imply endorsement by the Department or the Natural Resources Conservation Service over comparable products that are not named.

Pest Management – Specifications Sheet

Landowner _____ Date _____ Assisted by _____
 Tract and field(s) _____ Soils _____
 Crop sequence/rotation _____ (Circle applicable crop(s))
 Management system _____
 Analysis completed for: _____ Pesticide environmental risk (WIN-PST) _____ Erosion (RUSLE) _____ Soil quality _____

| Target pest name | Management method type and name | Application techniques (i.e., rate, timing, and method from Extension publication) | Additional specifications (i.e., mitigation techniques) |
|------------------|---------------------------------|--|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Pest Management – Job Sketch

Sketch a map showing the field location, acreage and location of sensitive resource concerns (including required setback zones, water bodies and buildings).

Scale 1" = _____ ft. (NA indicates sketch not to scale: grid size = 1/2" by 1/2")

Perform the following operations and maintenance:

- Review this pest management plan whenever the production system changes substantially, or at least every () years.
- Post treatment signs according to label directions and/or Federal, State, and local laws. Follow label re-entry intervals.
- Properly clean application equipment and dispose of residue according to label instructions.
- Handle all pesticides with caution and wear appropriate protective clothing according to label instructions.
- Calibrate pesticide application equipment to apply within ± ()% of the recommended rate.
- Open mixing of chemicals will not occur in the application field within () feet of a well or surface waterbody.
- Maintain pest management field application records for () years.

Additional specifications and notes:

The United States Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th & Independence Ave., SW. Washington, D.C., 20250-9410 or call (202) 720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

Pest management should be implemented in conjunction with crop residue management, nutrient management, conservation buffers, and other conservation practices to address natural resource concerns and to maximize economic returns by enhancing the quantity and quality of agricultural commodities. Pest management conservation planning assistance should be targeted at agricultural areas that are known contributors to existing resource impairments or have the potential for impairing resource quality in the future. The potential for impairments can be identified with screening tools. This evaluation can then be used in conjunction with resource sensitivity information to target pest management mitigation measures.

Pest management should consider site features that influence the potential for offsite pesticide movement and water quality impairment. Current pesticide recommendations are acceptable when they perform adequately from efficacy, economic, and environmental standpoints. When they have significant potential to negatively impact the environment, NRCS should work closely with Extension, certified crop advisors, crop consultants, and other pest management advisors to identify viable alternatives that will protect our natural resources.

NRCS policy does not originate specific pesticide recommendations, but we can communicate Extension's pesticide recommendations to our customers and supplement them with natural resource data and environmental risk information. The goal is to develop a suite of environmentally acceptable conservation management alternatives for producers to select from in their conservation plans.

Successful implementation of pest management requires us to partner in all facets of this effort with Extension, certified crop advisors, crop consultants, and farmers. We must strive to leverage our efforts by influencing other farm advisors to consider environmental risks in their recommendations and document the benefits of these efforts during the conservation planning process.

Appendix A

WIN_PST Reports

Soil Sensitivity to Pesticide Loss Rating Report

COOPERATOR: USDA-NRCS Cooperator data: Name, address, etc.
TRACT: Number FIELD: Identifier

WIN-PST SPISP II
SOIL SENSITIVITY TO PESTICIDE LOSS RATING REPORT

Soils Data Table: SOIL_IL Sort Order: MUSYM

KANE COUNTY, ILLINOIS: IL89

| MUSYM/SEQ# | COMPONENT/TEXTURE/MU% | HYD | KFACT | SURFACE | | SPISP II Ratings | | |
|------------|-----------------------|-----|-------|---------|------|------------------|------|------|
| | | | | DEPTH | % OM | SLP | SSRP | SARP |
| 531B 1 | Markham SIL 100% | C | 0.37 | 7" | 2.5% | L | H | H |

(.\REPORTS\SOILS.TXT generated on 06/24/99 at 20:27:27)

Ratings Legend:

Ratings:

- H -- HIGH
- I -- INTERMEDIATE
- L -- LOW
- V -- VERY LOW

Conditions that affect ratings:

- m -- There are macropores or cracks in the surface horizon deeper than 24". +1 SLP
- w -- The high water table comes within 24" of the surface during the growing season. SLP = HIGH
- s -- The slope is greater than 15%. +1 SARP

Pesticide Active Ingredient Rating Report

COOPERATOR: USDA-NRCS Cooperator data: Name, address, etc.
 TRACT: Number FIELD: Identifier

WIN-PST SPISP II
 PESTICIDE ACTIVE INGREDIENT RATING REPORT

AIS Data Table Sort Order: NAME

| Active Ingredient Common Name | pH | Solubility In Water (ppm) | Half- Life (days) | KOC (mL/g) | Human Toxicity (ppb) | MCL | Fish Toxicity | | | SPISP II Ratings | | | Relative Toxicity Category | | | | |
|--|----|---------------------------------|-------------------------|---------------|----------------------------|-----|---------------|-----------|-------|------------------|--------|-------|----------------------------|------|-------|-------|------|
| | | | | | | | MATC* | STV | PLP | PSRP | PARP | Water | Human | Fish | Water | Human | Fish |
| Atrazine (ANSI) PC CODE: 080803 CAS_NO: 0001912249 | | 33 | 60 | 100 | 3 | 3 | 658 | 65846.7 | I (f) | I (f) | L (fr) | H | I | V | | | |
| Dicamba (ANSI) PC CODE: 029801 CAS_NO: 0001918009 | | 400000 | 14 | 2 | 200 | HA | 4919 | 9837.9 | I (f) | L (fr) | L (fr) | L | L | V | | | |
| Glyphosate, isopropylamine salt PC CODE: 103601 CAS_NO: 0038641940 | | 900000 | 47 | 24000 | 700 | MCL | 168 | 4032263.8 | V (f) | I (fr) | I (fr) | V | I | V | | | |

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Ratings Legend:

- Ratings:
- H - HIGH
- I - INTERMEDIATE
- L - LOW
- V - VERY LOW

Conditions that affect ratings:

- i - Soil Incorporated.
- r - High Residue/CT.
- f - Foliar Application.
- b - Banded Application.
- l - Low Rate of Application.
- 1/4 - 1/10 lb/acre (280 - 112 g/ha)
- 1/10 lb./acre (112 g/ha) or less.

Effect on ratings:

- +1 PLP, -1 PSRP, -1 PARP
- 1 PSRP, -1 PARP
- 1 PLP, -1 PSRP, -1 PARP
- 1 PLP, -1 PSRP, -1 PARP
- 1 PLP, -1 PSRP, -1 PARP
- 1 PLP, -1 PSRP, -1 PARP
- 1 PLP, -1 PSRP, -1 PARP
- 2 PLP, -1 PSRP, -1 PARP

Soil/Pesticide Interaction Loss Potential and Hazard Ratings Report

COOPERATOR: USDA-NRCS Cooperator data: Name, address, etc.
 TRACT: Number FIELD: Identifier

WIN-PST SOIL / PESTICIDE INTERACTION
 LOSS POTENTIAL and HAZARD RATINGS REPORT

Soils Data Table: SOIL_IL Sort Order: MUSYM
 Pesticide Data Table Sort Order: NAME

SOILS

531B: Markham SIL 100%
 HYDRO: C
 PESTICIDES KANE COUNTY,
 ILLINOIS: IL89

Atrazine (ANSI) PC_CODE: 080803

| | | | | |
|-------------------------|----------------|--------------|-------------|--|
| CAS_NO: 0001912249 | Loss Potential | Human Hazard | Fish Hazard | |
| | ----- | | | |
| Leaching (ILP): | L (f) | I | L | |
| Solution Runoff (ISRP): | H (fr) | H | H | |
| Adsorbed Runoff (IARP): | I (fr) | | V | |

Dicamba (ANSI) PC_CODE: 029801

| | | | | |
|-------------------------|----------------|--------------|-------------|--|
| CAS_NO: 0001918009 | Loss Potential | Human Hazard | Fish Hazard | |
| | ----- | | | |
| Leaching (ILP): | L (f) | L | L | |
| Solution Runoff (ISRP): | I (fr) | L | L | |
| Adsorbed Runoff (IARP): | I (fr) | | V | |

Glyphosate, isopropylamine salt PC_CODE: 103601

| | | | | |
|-------------------------|----------------|--------------|-------------|--|
| CAS_NO: 0038641940 | Loss Potential | Human Hazard | Fish Hazard | |
| | ----- | | | |
| Leaching (ILP): | V (f) | V | L | |
| Solution Runoff (ISRP): | H (fr) | L | H | |
| Adsorbed Runoff (IARP): | H (fr) | | L | |

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Ratings Legend:

- Ratings:
- H -- HIGH
 - I -- INTERMEDIATE
 - L -- LOW
 - V -- VERY LOW

- | | |
|---------------------------------------|--------------------------|
| Conditions that affect ratings: | Effect on ratings: |
| i -- Soil Incorporated. | +1 PLP, -1 PSRP, -1 PARP |
| r -- High Residue/CT. | -1 PSRP, -1 PARP |
| f -- Foliar Application. | -1 PLP, -1 PSRP, -1 PARP |
| b -- Banded Application. | -1 PLP, -1 PSRP, -1 PARP |
| l -- Low Rate of Application. | |
| 1/4 - 1/10 lb/acre (280 - 112 g/ha) | -1 PLP, -1 PSRP, -1 PARP |
| -- Ultralow Rate of Application. | |
| 1/10 lb./acre (112 g/ha) or less. | -2 PLP, -1 PSRP, -1 PARP |

Pest Management

Soil/Pesticide Interaction Loss Potential and Hazard Ratings Report—Continued

| | | | | |
|------|--|--------------------------|------------|---------|
| m | -- There are macropores or cracks in the surface horizon deeper than 24". | +1 SLP | | |
| w | -- The high water table comes within 24" of the surface during the growing season. | | SLP = HIGH | |
| s | -- The slope is greater than 15%. | | | +1 SARP |
| <ln> | -- Low probability of rain, No irrigation. | -1 ILP, -1 ISRP, -1 IARP | | |
| <lh> | -- Low probability of rain, High efficiency irrigation. | -1 ILP, -1 ISRP, -1 IARP | | |
| <hl> | -- High probability of rain, Low efficiency irrigation. | +1 ILP, +1 ISRP, +1 IARP | | |

Glossary

.\REPORTS\GLOSSARY.TXT: WIN-PST glossary of terms and definitions.

Printed on 06/24/99 at 20:37:02

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=====
% OM      | Default soil organic matter value or a user-supplied value that represents percent organic matter
          | in the first soil horizon. Organic matter is used to compute the SLP rating.
          |
-----
*         | Indicates value is calculated.
          |
96-hour LC50 | Lethal concentration that kills 50% of a fish species' population over a 96-hour (4 Day) period. A
          | type of acute fish toxicity. Stored in ppb in the NAPRA PPD.
          |
-----
<hl>     | High probability of rain, low efficiency irrigation. +1 ILP, +1 ISRP, +1 IARP
-----
<lh>     | Low probability of rain, high efficiency irrigation. -1 ILP, -1 ISRP, -1 IARP
-----
<ln>     | Low probability of rain, no irrigation. -1 ILP, -1 ISRP, -1 IARP
-----
Active Ingredient | Common name associated with an active ingredient. Common name followed by '(ANSI)' indicates
Common Name      | acceptance of name by American National Standards Institute.
-----
AGE            | Age of fish tested. A field in the fish toxicity data table.
-----
Banded Application | Pesticide application over rows but not between rows. Banded pesticide application over a crop can
          | reduce the P-Ratings by one class since it increases interception of pesticide by the plant and
          | reduces direct contact between the soil and the pesticide.
-----
CALC_NOTES    | A reference to the algorithm used to calculate the toxicity. A field in the fish toxicity data
          | table.
-----
Cancer Slope   | See QSTAR.
-----
CANCERGRP     | EPA Cancer Class (synonymous with EPA Cancer Group). Affects the way an HA* is computed from an
          | RFD. See the definition for HA*. A field in the human toxicity data table.
          |
          | Current EPA Categories
          | (EPA is in the process of revising the Cancer Guidelines)
          | =====
          | Group A: Human Carcinogen
          | Sufficient evidence in epidemiological studies to support causal association between
          | exposure and cancer.
          | Group B: Probable Human Carcinogen
          | Limited evidence in epidemiological studies (Group B1) and/or sufficient evidence from
          | animal studies (Group B2).

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Glossary—Continued

Group C: Possible Human Carcinogen
 Limited evidence from animal studies and inadequate or no data in humans.

Group D: Not Classifiable
 Inadequate or no human and animal evidence of carcinogenicity.

Group E: No Evidence of Carcinogenicity for Humans
 No evidence of carcinogenicity in at least two adequate animal tests in different species or in adequate epidemiological and animal studies.

=====
 Reference:
 "Drinking Water Regulations and Health Advisories"
 Office of Water, US EPA, Washington, D.C. February 1996

 CASRN
 Chemical Abstract Service Registration Number for an active ingredient.
 Format: XXXXXX-YY-Z.
 7 digits with no leading zeroes, a dash, then 2 digits with possible leading zeroes, a dash, then 1 digit.
 This is the most common form of the CAS_NO. CASRN represents the same information as the CAS_NO, except that the format of the digits is different.

 CAS_NO
 Chemical Abstract Service Registration Number for an active ingredient.
 Format: XXXXXXYYZ.
 10 digits, no dashes, with leading zeroes as necessary.
 Matches the CAS_NO field in the EPA REG DB. CASRN represents the same information as the CAS_NO, except that the format of the digits is different.

 CHCL*
 Chronic Human Carcinogen Level, calculated.
 The concentration at which there is a 1/100,000 probability of contracting cancer calculated by using the EPA algorithm based on QSTAR from animal studies. This probability level provides a concentration comparable to the MCL.

 Algorithm:
 $CHCL^* = (70 \text{ Kg} * 10^{-5}) / (2 \text{ L/day} * QSTAR)$
 10⁻⁵ represents a 1/100,000 chance of contracting cancer.
 70 Kg represents the average weight of an adult.
 2 L/day represents average consumption of water each day by an adult.

Glossary—Continued

| | |
|--|---|
| Reference: | "Drinking Water Health Advisory: Pesticides" (Book) |
| | United States Environmental Protection Agency |
| | Office of Drinking Water Health Advisories |
| | Lewis Publishers |
| | Pages viii - xiii, 1994 |
| ----- | |
| CHEMICAL | Pesticide common name. |
| ----- | |
| CHEM_ID | NAPRA PPD active ingredient identification number. |
| ----- | |
| COMMENT | Notes we have made in the course of maintaining the toxicity data tables. A field in the fish and human toxicity data tables. |
| ----- | |
| COMPONENT/TEXTURE/ MU% | Component name and texture of a soil, plus the percent of this component in the current soil map unit (MU%). |
| ----- | |
| Conditions that affect SPISP II Pesticide Loss Potential Ratings | Different management techniques may increase or decrease the initial P-Ratings. WIN-PST allows the user to select one of the management techniques listed below if they exist onsite. The adjusted rating is then carried forward to the appropriate interaction matrix. |
| ----- | |
| WIN-PST Pesticide Report Management Techniques; Abbreviations and Effects: | |
| i | -- Soil Incorporated. +1 PLP, -1 PSRP, -1 PARP |
| r | -- High Residue/CT. -1 PSRP, -1 PARP |
| f | -- Foliar Application. -1 PLP, -1 PSRP, -1 PARP |
| b | -- Banded Application. -1 PLP, -1 PSRP, -1 PARP |
| l | -- Low Rate of Application. 1/4 - 1/10 lb./acre (280 - 112 g/ha) -1 PLP, -1 PSRP, -1 PARP |
| | -- Ultralow Rate of Application. 1/10 lb./acre (112 g/ha) or less. -2 PLP, -1 PSRP, -1 PARP |
| ----- | |
| Conditions that affect SPISP II Soil / Pesticide Interaction Ratings | Differing environmental conditions or management techniques may increase or decrease the I-Ratings. WIN-PST allows the user to select one of the conditions listed below if they exist onsite. The adjusted rating is then either used in the evaluation or carried forward to be used in the ITOX Rating Matrix. |
| ----- | |
| Environmental Conditions or Management Techniques: | |
| High Probability of Rainfall, No Irrigation | - no effect on ratings. |
| High Probability of Rainfall, High Efficiency Irrigation | - no effect on ratings. |
| High Probability of Rainfall, Low Efficiency Irrigation | - increases ILP, ISLP, and IARP by one class. |
| Low Probability of Rainfall, No Irrigation | - decreases ILP, ISLP, and IARP by one class. |
| Low Probability of Rainfall, High Efficiency Irrigation | - decreases ILP, ISLP, and IARP by one class. |
| Low Probability of Rainfall, Low Efficiency Irrigation | - no effect on ratings. |

Glossary—Continued

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-----
| WIN-PST Soil / Pesticide Interaction Report
| Site Conditions and Management Techniques;
| Abbreviations and Effects:
|
| i -- Soil Incorporated. +1 PLP, -1 PSRP, -1 PARP
| r -- High Residue/CT. -1 PSRP, -1 PARP
| f -- Foliar Application. -1 PLP, -1 PSRP, -1 PARP
| b -- Banded Application. -1 PLP, -1 PSRP, -1 PARP
| l -- Low Rate of Application. 1/4 - 1/10 lb/acre (280 - 112 g/ha). -1 PLP, -1 PSRP, -1 PARP
| <ul> -- Ultralow Rate of Application. 1/10 lb./acre (112 g/ha) or less. -2 PLP, -1 PSRP, -1 PARP
|
| m -- There are macropores or cracks in the surface horizon deeper than 24". +1 SLP
| w -- The high water table comes within 24" of the surface during the growing season. SLP = HIGH
| s -- The slope is greater than 15%. +1 SARP
|
| <ln> -- Low probability of rain; No irrigation. -1 ILP, -1 ISRP, -1 IARP
| <lh> -- Low probability of rain; High efficiency irrigation. -1 ILP, -1 ISRP, -1 IARP
| <hl> -- High probability of rain; Low efficiency irrigation. +1 ILP, +1 ISRP, +1 IARP
|
| -----
| Conditions that
| affect SPISP II Soil
| Sensitivity Ratings
|
| -----
| WIN-PST Soil Report
| Site Conditions; Abbreviations and Effects:
|
| m -- There are macropores or cracks in the surface horizon deeper than 24". +1 SLP
| w -- The high water table comes within 24" of the surface during the growing season. SLP = HIGH
| s -- The slope is greater than 15%. +1 SARP
|
| -----
| Cracks
| See 'Macropores or Cracks'.
|
| -----
| Don Goss
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| goss@brcsun0.tamu.edu
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| (June 1998)
|

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Glossary—Continued

| | |
|--|---|
| Effect of management and site conditions on SPISP II Ratings | Ratings on the WIN-PST reports are not necessarily SPISP II ratings. These ratings may have been adjusted for management or site characteristics. See "Conditions that affect Soil Sensitivity Ratings", "Conditions that affect SPISP II Pesticide Loss Potential Ratings", and "Conditions that affect SPISP II Soil / Pesticide Interaction Ratings" for more information. |
| Understanding the notation : | ----- |
| The legend on each of the WIN-PST reports contains a list of abbreviations that may have been used in the body of the report. These represent site conditions or management. Each of these conditions has an effect on the SPISP II ratings, as explained in the definition for each abbreviation. For example, in the legend on the Pesticide Loss Report, you see the notation -1 PLP next to the condition "Low Rate of Application". This means that the effect of using a low rate of application can reduce your Pesticide Loss Potential Rating by one class. | ----- |
| WIN-PST evaluates the cumulative effect of these conditions on the ratings as follows: | ----- |
| 1) All of the conditions for a given loss category are assessed collectively. Each condition contributes an incremental (+ -- increased risk/sensitivity) or decremental (- -- decreased risk/sensitivity) effect on the ratings. The sum of all of these conditions is used in step 2, below. | ----- |
| 2a) If the sum of all of the conditions is negative, the rating is reduced by one class. If the sum of all the conditions is positive, the rating is increased by one class. Thus, two or more 'Incremental' or 'Detrimental' conditions only change the original SPISP II rating by one class. | ----- |
| 2b) The only exceptions to rule 2a are for an ultralow rate of pesticide application, which can reduce the PLP by two classes; or the presence of a high water table during the growing season, which makes the SLP HIGH, no matter what. | ----- |
| EPA Cancer Class / Group | See CANCERGRP. |
| EPA OPP | United States Environmental Protection Agency Office of Pesticide Programs (EPA OPP). |
| EPA REG DB | EPA Registration Database. Updated monthly. This database can be accessed online at http://www.epa.gov/opppmsd1/PPISdata/index.html |
| EPARFD | EPA assigned Reference Dose. |
| Fish Hazard | I-ratings combined with fish relative toxicity categories. Only combine the ILP with a fish toxicity when using tile drainage. Only combine the ILP or ISRP with an MATC*. Only combine the IARP with an STV. |
| Fish Toxicity | Fish toxicity threshold for an active ingredient in parts per billion (ppb). Fish toxicity types: LOC*, MATC, MATC*. |

Glossary—Continued

| | |
|--------------------------------------|--|
| Fish Toxicity Categories | <p>Ratings based on long-term MATC* fish toxicity ranges. Used to determine relative hazard. These ratings combined with the I-Ratings in the ITOX Matrix evaluate the relative risk to the environment of a pesticide active ingredient.</p> <p>These thresholds were based on extrapolation and simplification of short-term (acute) thresholds established by EPA.</p> <p>Fish Long-term (chronic) Toxicity Categories</p> <pre> ===== HIGH 100 ppb > X (MATC*) INTERMEDIATE 1,500 ppb > X (MATC*) >= 100 ppb LOW 5,000 ppb > X (MATC*) >= 1,500 ppb VERY LOW X (MATC*) >= 5,000 ppb </pre> |
| Fish Toxicity Rating, based on MATC* | <p>Soluble pesticide toxicity level for fish. Compare the MATC to the following thresholds to compute the MATC Fish Toxicity Rating:</p> <pre> if (MATC < 100 ppb) MATC Fish Toxicity Rating = HIGH otherwise if (MATC < 1500 ppb) MATC Fish Toxicity Rating = INTERMEDIATE otherwise if (MATC < 5000 ppb) MATC Fish Toxicity Rating = LOW otherwise MATC Fish Toxicity Rating = VERY LOW </pre> |
| Fish Toxicity Rating, based on STV | <p>Pesticide adsorbed to sediment toxicity level for fish. Compare the STV to the following thresholds to compute the STV Fish Toxicity Rating:</p> <pre> If (STV < 100 ppb) STV Fish Toxicity Rating = HIGH otherwise if (STV < 1500 ppb) STV Fish Toxicity Rating = INTERMEDIATE otherwise if (STV < 5000 ppb) STV Fish Toxicity Rating = LOW otherwise STV Fish Toxicity Rating = VERY LOW </pre> |
| Foliar Application | <p>Foliar pesticide application over a crop increases interception of pesticide by the plant and decreases contact with the soil. Foliar application allows reduction of the P-Ratings by one class.</p> |

Glossary—Continued

 | G/E | The G/E field in the NAPRA PPD indicates the quality of the representative value.
 |-----|
 | | NAPRA PPD pesticide property data (KOC, solubility in water, and field half-life) is comprised from
 | | a variety of sources:
 | | -- Pesticide Properties in the Environment; Wauchope et. al., 1996. (PPE)
 | | -- Personal communications with Dr. Wauchope.
 | | -- EPA OPP "EFGWB One Liner Data Base"; Version 3.04; data table dated 3-18-98.
 | | -- Personal communications with chemical companies.
 |-----|
 | | All of the values in the NAPRA PPD were selected from literature with the intent that these values
 | | would be used in pesticide models, which requires the use of a 'representative value' rather than a
 | | range of values, which more correctly describes the range of values each property could take for
 | | each chemical.
 |-----|
 | | The values in the G/E field indicate the quality of each data element:
 |-----|
 | | G -- A 'Guess' value from PPE and subsequent personal communication with Dr. Wauchope (ARS).
 | | Indicates that some degree of uncertainty exists in the value. 'G' is used when no value is
 | | known to exist but the authors of PPE believe that the parameter can be estimated by a similar
 | | compound. (PPE Pg. 23) i.e. 'G' denotes a 'guess' value -- neither an experimental value nor a good
 | | estimation procedure was available. (PPE Pg. 33)
 | | Solubilities marked with an 'G' are expected to be accurate within a factor of 10. A total
 | | guess was required only for petroleum oil, a mixture of hydrocarbons. (PPE Pg. 9, section 3.3.1)
 |-----|
 | | E -- An 'Estimate' value from PPE and subsequent personal communication with Dr. Wauchope (ARS).
 | | Indicates that some degree of uncertainty exists in the value. 'E' is used to indicate that
 | | existing data are so diverse that selection of a representative value is a matter of scientific
 | | judgement by the authors of PPE or that the value is calculated from some more fundamental
 | | property. (PPE Pg. 23) i.e. 'E' denotes that a value is an 'estimate', meaning either: (a) an
 | | unusually wide range of values have been reported and we (the authors of PPE) had no reason to
 | | select any one value as a 'best' value, or (b) no experimental value is available but a reasonable
 | | estimation was possible. (PPE Pg. 33)
 | | Solubilities marked with an 'E' are expected to be accurate within a factor of 2. About 10% of
 | | the solubilities in PPE were estimated. In some cases, the solubility of a similar compound was
 | | used as an estimate. (PPE Pg. 9, section 3.3.1)
 |-----|
 | | n -- A 'NAPRA Selected Value'. Equates to a <BLANK>. (These values have not been peer reviewed.)
 |-----|
 | | g -- A 'Guess' value developed by the NAPRA Team using Dr. Wauchope's 'Guess' methodology. (These
 | | values have not been peer reviewed.)
 |-----|
 | | e -- An 'Estimate' value developed by the NAPRA Team using Dr. Wauchope's 'Estimate' methodology.
 | | (These values have not been peer reviewed.)
 |-----|
 | | <BLANK> -- A value from PPE and subsequent personal communication with Dr. Wauchope (ARS). The set
 | | of all pesticides which are not designated by a G, E, n, g, or e.

Glossary—Continued

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|----------------|--|
| GT_LT | A field in the fish toxicity data table. Indicates that the actual toxicity is greater than (>) or less than (<) the value listed. |
| ----- | |
| GUIDELINE | Fish toxicity data table: EPA code for normal environment of species tested (e.g., fresh water, estuary). |
| ----- | |
| HA | Health Advisory, determined by EPA's Office of Water (OW). The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects over a lifetime exposure with a margin of safety. HA is compared to the PLP or PSRP for humans. |
| ----- | |
| HA* | Health Advisory calculated using the EPA method for calculating HA based on Reference Dose (RFD). RFD values are from the EPA Office of Pesticide Programs (OPP), EPA or World Health Organization (WHO). |
| ----- | |
| | The EPA OPP RFD is updated regularly and when available is used to determine HA*. If the RFD from EPA OPP is not available, then the EPA RFD is used. EPA RFD is an agency wide value that is not updated as regularly or as often as the OPP RFD. If neither of these values are available, then the WHO RFD is used. |
| ----- | |
| | In accordance with OW policy, Health Advisories are not calculated for chemicals that are known or probable human carcinogens (EPA Cancer Class A and B). |
| ----- | |
| | -- If the EPA Cancer Class is C: HA* = RFD * 700 |
| | -- If the EPA Cancer Class is D, E, or unclassified: HA* = RFD * 7000 |
| | -- If EPA Cancer Class is A or B: MCL is used if available from EPA OW. CHCL* is determined in lieu of MCL when MCL is not available. |
| ----- | |
| | References: |
| | "Drinking Water Regulations and Health Advisories". US EPA Office of Water, 4304. EPA 822-B-96-002. October, 1996. |
| | "EPA Office of Pesticide Programs Reference Dose Tracking Report". US EPA Office of Pesticide Programs. February, 1997. |
| ----- | |
| Half-Life (HL) | Soil half-life of an active ingredient under field conditions, in days. Used to compute the P-Ratings. |
| ----- | |
| | Half-life is the time required for pesticides in the soil to degrade to one-half of their previous concentration. Each successive elapsed half-life will decrease the pesticide concentration by half. For example, a period of two half-lives will reduce a pesticide concentration to one-fourth of the initial amount. Half-life can vary by a factor of three or more from reported values depending on soil moisture, temperature, oxygen status, soil microbial population, and other factors. Additionally, resistance to degradation can change as the initial concentration of a chemical decreases. It may take longer to decrease the last one-fourth of a chemical to one-eighth than it took to decrease the initial concentration to one-half. In general, the longer the half-life, the greater the potential for pesticide movement. |

Glossary—Continued

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|---------------------------|--|
| Hazard | Pesticide toxicity combined with potential exposure. |
| High Residue/CT | High residue management and conservation tillage leaves crop residue on the field. High residue is defined as greater than 30% residue. Residue decreases field soil loss with adsorbed pesticide. Residue can reduce the PSRP and PARP by one class. |
| High Water Table (HWT) | The water table comes within 24" of the surface during the growing season. Increases the SLP to HIGH, no matter what other conditions exist. |
| Horiz[l] | See SURFACE DEPTH. |
| Horiz_1_Depth | See SURFACE DEPTH. |
| Human Hazard | I-ratings combined with human relative toxicity categories. Combine the ILP or ISRP with an MCL, HA, HA*, or CHCL. IARP cannot be combined with a human toxicity. |
| Human Toxicity | Long-term human toxicity of an active ingredient in parts per billion (ppb). Toxicities are based on availability in the priority order: MCL, HA, HA* (HA and HA* are used for Cancer Groups C, D, E and unclassified) and CHCL*. MCL is used whenever available by the EPA Office of Water. HA and HA* are used for Cancer Groups C, D, E and unclassified. CHCL* is used for Cancer Groups A, B1 and B2 when MCL is unavailable. |
| Human Toxicity Categories | The long-term human toxicity ranges based on MCL, HA, HA* or CHCL*. Ranges are used to determine relative hazard. These toxicity ratings combined with I-Ratings in the ITOX Matrix to evaluate the relative risk to the environment of a pesticide active ingredient. These chronic ranges were based on acute ranges established by EPA. |
| Human Toxicity Rating | <pre> Human Relative Toxicity Categories ===== HIGH 10 ppb > X INTERMEDIATE 100 ppb > X >= 10 ppb LOW 300 ppb > X >= 100 ppb VERY LOW X >= 300 ppb </pre> <p>Rating that determines soluble pesticide toxicity level for humans. Compare the long-term human toxicity value to the following thresholds to compute the Human Toxicity Rating:</p> <pre> if (tox_ppb < 10 ppb) Human Toxicity Rating = HIGH otherwise if (tox_ppb < 100 ppb) Human Toxicity Rating = INTERMEDIATE otherwise if (tox_ppb < 300 ppb) Human Toxicity Rating = LOW </pre> |

Glossary—Continued

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|-------------------------------|---|--------------|--|------------------|--|--|--|--|------|--|------------------|--|--|------|--|------|--|--|--------------|--|------------------|--|--|-----|--|------------------|--|--|-----|--|-----|
| <p>Hydrologic Group (HYD)</p> | <p>otherwise Human Toxicity Rating = VERY LOW</p> <p>Soil hydrologic group. HYDRO group is designated by a character from A to D.</p> <p>A -- low runoff, high percolation (infiltration).</p> <p>B -- moderate runoff and percolation.</p> <p>C -- a less permeable soil that tends to have high runoff and low percolation.</p> <p>D -- high runoff, very low or no percolation.</p> <p>Dual hydro group soils are listed twice: Once for the drained condition, and again for the undrained condition. HYDRO is used to compute the S-Ratings.</p> <p>Soil Hydrologic Group is a group of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, intake rate and permeability after prolonged wetting, and depth to a very slow permeable layer.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>I-Ratings</p> | <p>SPISP II Soil vulnerability / pesticide loss interaction ratings: ILP, ISRP, and IARP.</p> <p>I-Ratings combine a pesticide's runoff or leaching rating with a soil rating developed for individual soil mapping units. The individual soil and pesticide ratings are found in Section II (Water Quality) of the USDA-NRCS Technical Guide for your state. Combining the pesticide rating and the soil rating simulates the interaction of pesticide properties and soil properties and results in a relative rating for a soil/pesticide combination. Soil/pesticide interaction ratings are developed for both pesticide movement below the root zone and pesticide movement in runoff in solution or with sediment transported to the field's edge.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>IARP</p> | <p>SPISP II Soil / Pesticide Interaction Adsorbed Runoff Potential.</p> <p>Compute the IARP based on the PARP and the SARP, according to the matrix below, then adjust for rainfall and irrigation.</p> <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 10px;">SARP</td> <td style="padding-right: 10px;"> </td> <td style="padding-right: 10px;">PARP</td> <td style="padding-right: 10px;"> </td> <td></td> </tr> <tr> <td></td> <td></td> <td style="padding-right: 10px;">High</td> <td></td> <td style="padding-right: 10px;">Intermediate Low</td> </tr> <tr> <td></td> <td></td> <td style="padding-right: 10px;">High</td> <td></td> <td style="padding-right: 10px;">High</td> </tr> <tr> <td></td> <td></td> <td style="padding-right: 10px;">Intermediate</td> <td></td> <td style="padding-right: 10px;">Intermediate Low</td> </tr> <tr> <td></td> <td></td> <td style="padding-right: 10px;">Low</td> <td></td> <td style="padding-right: 10px;">Intermediate Low</td> </tr> <tr> <td></td> <td></td> <td style="padding-right: 10px;">Low</td> <td></td> <td style="padding-right: 10px;">Low</td> </tr> </table> <p>If there is a high probability of rain, and you are using low efficiency irrigation, increase the IARP by one class.</p> <p>If there is a low probability of rain, and you are not irrigating the field or you are using a highly efficient irrigation system, decrease the IARP by one class.</p> | SARP | | PARP | | | | | High | | Intermediate Low | | | High | | High | | | Intermediate | | Intermediate Low | | | Low | | Intermediate Low | | | Low | | Low |
| SARP | | PARP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | High | | Intermediate Low | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | High | | High | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Intermediate | | Intermediate Low | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Low | | Intermediate Low | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Low | | Low | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Glossary—Continued

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|------------|--|------------------|------|------------------|--|------|------------------|--|--------------|--------------|--|-----|------------------|--|----------|-----|--|--|----------|--|--|----------|
| ILP | <p>SPISP II Soil / Pesticide Interaction Leaching Potential.</p> <p>Compute the ILP based on the PLP and the SLP, according to the matrix below, then adjust for rainfall and irrigation.</p> <table border="0"> <tr> <td>SLP</td> <td>PLP</td> <td>Very Low</td> </tr> <tr> <td></td> <td>High</td> <td>Intermediate Low</td> </tr> <tr> <td></td> <td>Intermediate</td> <td>High</td> </tr> <tr> <td></td> <td>Low</td> <td>Intermediate Low</td> </tr> <tr> <td></td> <td>Very Low</td> <td>Low</td> </tr> <tr> <td></td> <td></td> <td>Very Low</td> </tr> <tr> <td></td> <td></td> <td>Very Low</td> </tr> </table> <p>If there is a high probability of rain, and you are using low efficiency irrigation, increase the ILP by one class.</p> <p>If there is a low probability of rain, and you are not irrigating the field or you are using a highly efficient irrigation system, decrease the ILP by one class.</p> | SLP | PLP | Very Low | | High | Intermediate Low | | Intermediate | High | | Low | Intermediate Low | | Very Low | Low | | | Very Low | | | Very Low |
| SLP | PLP | Very Low | | | | | | | | | | | | | | | | | | | | |
| | High | Intermediate Low | | | | | | | | | | | | | | | | | | | | |
| | Intermediate | High | | | | | | | | | | | | | | | | | | | | |
| | Low | Intermediate Low | | | | | | | | | | | | | | | | | | | | |
| | Very Low | Low | | | | | | | | | | | | | | | | | | | | |
| | | Very Low | | | | | | | | | | | | | | | | | | | | |
| | | Very Low | | | | | | | | | | | | | | | | | | | | |
| Irrigation | <p>Crop irrigation:</p> <p>NONE -- No irrigation within 7-10 days of pesticide application.</p> <p>HIGH -- High efficiency system / management with insignificant runoff or deep percolation.</p> <p>LOW -- Low efficiency system / management with significant runoff or deep percolation.</p> <p>Affects the I-Ratings.</p> | | | | | | | | | | | | | | | | | | | | | |
| ISRP | <p>SPISP II Soil / Pesticide Interaction Solution Runoff Potential.</p> <p>Compute the ISRP based on the PSRP and the SSRP, according to the matrix below, then adjust for rainfall and irrigation.</p> <table border="0"> <tr> <td>SSLP</td> <td>PSLP</td> <td>Intermediate Low</td> </tr> <tr> <td></td> <td>High</td> <td>High</td> </tr> <tr> <td></td> <td>Intermediate</td> <td>Intermediate</td> </tr> <tr> <td></td> <td>Low</td> <td>Intermediate Low</td> </tr> <tr> <td></td> <td></td> <td>Low</td> </tr> </table> <p>If there is a high probability of rain, and you are using low efficiency irrigation, increase the ISRP by one class.</p> <p>If there is a low probability of rain, and you are not irrigating the field or you are using a highly efficient irrigation system, decrease the ISRP by one class.</p> | SSLP | PSLP | Intermediate Low | | High | High | | Intermediate | Intermediate | | Low | Intermediate Low | | | Low | | | | | | |
| SSLP | PSLP | Intermediate Low | | | | | | | | | | | | | | | | | | | | |
| | High | High | | | | | | | | | | | | | | | | | | | | |
| | Intermediate | Intermediate | | | | | | | | | | | | | | | | | | | | |
| | Low | Intermediate Low | | | | | | | | | | | | | | | | | | | | |
| | | Low | | | | | | | | | | | | | | | | | | | | |

Glossary—Continued

ITOX Rating Matrix -----
 ITOX Ratings are I-Ratings combined with toxicity ratings. The ITOX Rating matrix below combines a pesticide's I-Ratings with its potential toxicity or risk to the environment. Individual pesticide toxicity ratings are found in Section II (Water Quality) of the USDA-NRCS Technical Guide for each state. Combining pesticide long-term toxicity ratings and I-Ratings in the ITOX Rating Matrix below evaluates relative risk to the environment by a pesticide. ITOX ratings are developed for both pesticide movement below the root zone and in runoff in solution or with sediment transported beyond the edge of the field. The soil / pesticide / toxicity interaction ratings are approximations of pesticide movement and risk potential and should not by themselves be used to make pest management recommendations.

ITOX Rating Matrix

| Toxicity Rating | I-Rating | ITOX Rating |
|-----------------|-----------------------|------------------|
| HIGH | + HIGH | --> HIGH |
| HIGH | + INTERMEDIATE | --> HIGH |
| HIGH | + LOW | --> INTERMEDIATE |
| HIGH | + VERY LOW (ILP Only) | --> LOW |
| INTERMEDIATE | + HIGH | --> HIGH |
| INTERMEDIATE | + INTERMEDIATE | --> INTERMEDIATE |
| INTERMEDIATE | + LOW | --> LOW |
| INTERMEDIATE | + VERY LOW (ILP Only) | --> LOW |
| LOW | + HIGH | --> INTERMEDIATE |
| LOW | + INTERMEDIATE | --> LOW |
| LOW | + LOW | --> LOW |
| LOW | + VERY LOW (ILP Only) | --> VERY LOW |
| VERY LOW | + HIGH | --> LOW |
| VERY LOW | + INTERMEDIATE | --> VERY LOW |
| VERY LOW | + LOW | --> VERY LOW |
| VERY LOW | + VERY LOW (ILP Only) | --> VERY LOW |

Kads -----
 Kd, absorbed.
 Kads can be used to compute a KOC if it was available. KOC = Kads * 100, assuming 2% OM. -- SP 5-10-99.

KFACT -----
 Soil Erodability factor (K). Used to compute the SLP and SARP ratings. Valid range: 0.02 - 0.69.
 Soil Erodability Factor (K) is the rate of soil loss per rainfall erosion index unit [ton*acre*h(hundreds of acre*ft-tonf*in) -1] as measured on a unit plot. The unit plot is 72.6 ft. long, 6 ft. in width, has a 9 percent slope, and is continuously in a clean-tilled fallow condition with tillage performed upslope and downslope. The soil properties that influence assigned K factor values to specific soils are soil texture, organic matter content, structure, and permeability.

Glossary—Continued

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|----------------------|--|
| KOC | <p>If the soil hydrologic group is D and KFACT is 0, a KFACT of 0.02, the lowest valid KFACT, is used in the SPISP II Ratings algorithms. A KFACT of 0 is OK in the database if you have a D hydro group because if erosivity is a non-issue, a KFACT was purposely not computed. This is an indication of a field that has virtually no erosion. i.e. A nonerosive soil.</p> <p>Soil organic carbon sorption coefficient of this active ingredient in mL/g. Used to compute the P-Ratings.</p> <p>Pesticides vary in how tightly they are adsorbed to soil particles. The higher the Koc value, the stronger the tendency to attach to and move with soil. A pesticide with ionic properties would have a KOC set low to account for that pesticide's inability to sorb to soil particles. Pesticide KOC values greater than 1,000 indicate strong adsorption to soil. Pesticides with lower KOC values (less than 500) tend to move more with water than adsorbed to sediment.</p> |
| LOC* | <p>Level of Concern. Acute fish toxicity value determined by dividing 96-hour LC50 by two.</p> <p>LOC is used by EPA for risk assessment.</p> |
| Loss Potential | <p>Reference: "Hazard Evaluation Division Standard Evaluation Procedure" 'Ecological Risk Assessment.' EPA-540/9-85-001. Published June, 1986. EPA Office of Pesticide Programs, Washington, DC 20460.</p> <p>Potential for pesticide to move off the edge of the field and percolate below the root zone. Determined from soil/pesticide interaction ratings (I-Ratings) that result from combining soil ratings and pesticide ratings.</p> |
| Low Rate | <p>A pesticide application rate of one-tenth to one-quarter of a pound of active ingredient per acre. (112 to 280 grams per hectare.) A low application rate can reduce the P-Ratings by one class.</p> |
| Macropores or Cracks | <p>Holes or cracks at the soil surface. If there are macropores or cracks deeper than 24" in the surface horizon then SLP can be increased by one class.</p> |
| MATC* | <p>Calculated Maximum Acceptable Toxicant Concentration (MATC*) in ppb. MATC* is the long-term toxicity value for fish. Because MATC's are not currently available for most pesticides, all MATC's are calculated. This value is combined with the PLP or PSRP.</p> <p>MATC* is used in WIN-PST as a long-term acceptable toxicity value for fish. Pesticide concentration below MATC will not compromise a species population over the long-term. An MATC can be determined empirically by performing lifetime or long-term toxicity tests including sensitive early life stages. Alternatively, an MATC* can be calculated from 96-hour LC50's using the method of Barnthouse, Suter and Rosen (1990).</p> |

Glossary—Continued

 | Reference:
 | Barnhouse, L.W., G.W. Suter II and A.E. Rosen, 1990.
 | "Risks of Toxic Contaminants to Exploited Fish Populations: Influence of Life History, Data
 | Uncertainty and Exploitation Intensity."
 | Environmental Toxicology and Chemistry. 9:297-311.

 | EPA's Maximum Contaminant Level. Maximum permissible long-term pesticide concentration allowed in a
 | public water source. MCL is used in WIN-PST for any pesticide for which EPA has an assigned value.
 | In the absence of an MCL, an HA, HA* or CHCL* is used in WIN-PST.

 | Map unit symbol and sequence number associated with a soil.

 | Common name of fish species tested. A field in the fish toxicity data table.

 | National Agricultural Pesticide Risk Analysis.

 | NAPRA Pesticide Properties Database. Comprised of data from a variety of sources, this database
 | contains EPA registration data (EPA REG DB), representative value pesticide property data (source
 | indicated by the G/E field in the data tables), and toxicity data for humans and fish (from Stephen
 | Plotkin's toxicity database). The NAPRA PPD is maintained by Morgan S. Hugo, NAPRA Team,
 | Massachusetts.

 | The team that created NAPRA and WIN-PST.

 | Joseph K. Bagdon, Team Leader
 | Eric S. Hesketh, Soil Scientist
 | Stephen Plotkin, Water Quality Specialist
 | Morgan S. Hugo, Software Engineer

 | National Pesticide/soils database and User decision support system for Risk assessment of Ground
 | and surface water contamination. Based on the SPISP I algorithms.

 | EPA's Office of Pesticide Programs Reference Dose. A field in the human toxicity data table.

 | Organic matter content of the surface horizon of the soil. By default, this is the average of the
 | high and low values stored in the soils data table. The user can vary this parameter based on site
 | characteristics. Used to compute the SLP.

 | Soil organic matter is the organic fraction of the soil that includes plant and animal residues at
 | various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by
 | the soil population.

 | EPA Office of Water (EPA-OW).

 | EPA's Office of Water Reference Dose. A field in the human toxicity data table.

 | SPISP II Pesticide loss ratings: PLP, PSRP, PARP.

Glossary—Continued

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|---|---|
| PARP | SPISP II Pesticide Adsorbed Runoff Potential. PARP indicates the tendency of a pesticide to move in surface runoff attached to soil particles. A low rating indicates minimal potential for pesticide movement adsorbed to sediment, and no mitigation is required. |
| * | ===== |
| * | ===== |
| | Compute the PARP according to the following algorithm, then adjust for management. |
| HL -- | Half-life in the soil in days. |
| SOL -- | Solubility in water in mg/L. (ppm) |
| KOC -- | Soil organic carbon sorption coefficient in mL/g. |
| * | ===== |
| * | ===== |
| | If ((HL >= 40) and (KOC >= 1000)) or |
| | ((HL >= 40) and (KOC >= 500) and (SOL <= 0.5)) |
| | PARP = HIGH |
| | otherwise |
| | if (HL <= 1) or |
| | ((HL <= 2) and (KOC <= 500)) or |
| | ((HL <= 4) and (KOC <= 900) and (SOL >= 0.5)) or |
| | ((HL <= 40) and (KOC <= 500) and (SOL >= 0.5)) or |
| | ((HL <= 40) and (KOC <= 900) and (SOL >= 2)) |
| | PARP = LOW |
| | otherwise |
| | PARP = INTERMEDIATE |
| * | ===== |
| * | ===== |
| | Adjust the PARP according to management. See 'Effect of management and site conditions on SPISP II Ratings' for how to adjust the ratings for these conditions: |
| | Soil Incorporated: -1 |
| | High residue or conservation tillage management strategy: -1 |
| | Foliar: -1 |
| | Banded: -1 |
| | Low or ultra-low rate of application: -1 |
| PC_CODE | EPA active ingredient registration number. (AKA Shaughnessy Code) |
| Pesticide Properties in the Environment (PPE) | Pesticide Properties in the Environment |
| | Arthur G. Hornsby, R. Don Wauchope, Albert E. Herner |
| | Springer-Verlag, 1996 |
| | ISBN (Disk) 0-387-94353-6 |
| | ISBN (Without Disk) 0-540-94353-6 |
| | This book provides the basis for the pesticide property data in the NAPRA PPD. |

Glossary—Continued

pH
 | pH value at which pesticide properties are valid. When determining P-Ratings or I-Ratings,
 | appropriate properties are selected based on field soil pH. If pH designation is blank, pesticide
 | properties are insensitive to pH and therefore properties are valid at any soil pH.

PLP
 | SPISP II Pesticide Leaching Potential. PLP indicates the tendency of a pesticide to move in
 | solution with water and leach below the root zone. A low rating indicates minimal movement and no
 | need for mitigation.
 | * =====
 | * =====
 | Compute the PLP according to the following algorithm, then adjust for management.
 |
 | HL -- Half-life in the soil in days.
 | SOL -- Solubility in water in mg/L. (ppm)
 | KOC -- Soil organic carbon sorption coefficient in mL/g.
 |
 | Please note: The log() function used below is log, base 10.
 | * =====
 | * =====
 | First, compute a log value:
 | log_val = log(HL) * (4-log(KOC))
 | * =====
 | * =====
 | Second, use log_val in the following algorithm:
 | If (log_val >= 2.8)
 | PLP = HIGH
 | otherwise
 | if ((log_val < 0.0) or ((SOL < 1) and (HL <= 1)))
 | PLP = VERY LOW
 | otherwise
 | if (log_val <= 1.8)
 | PLP = LOW
 | otherwise
 | PLP = INTERMEDIATE
 | * =====
 | * =====
 | Third, adjust the PLP according to management. See 'Effect of management and site conditions on
 | SPISP II Ratings' for how to adjust the ratings for these conditions:
 |
 | Soil Incorporated: +1
 | Foliar: -1
 | Banded: -1
 | Low rate of application: -1
 | Ultralow rate of application: -2 (The only condition, other than HWT, that can adjust ratings by
 | more than one class.)

Glossary—Continued

| | |
|----------|--|
| PSRP | SPISP II Pesticide Solution Runoff Potential. PSRP indicates the tendency of a pesticide to move in surface runoff in the solution phase. A high rating indicates the greatest potential for pesticide loss in solution runoff. |
| * | ===== |
| * | ===== |
| | Compute the PSRP according to the following algorithm, then adjust for management. |
| HL -- | Half-life in the soil in days. |
| SOL -- | Solubility in water in mg/L. (ppm) |
| KOC -- | Soil organic carbon sorption coefficient in mL/g. |
| * | ===== |
| * | ===== |
| | If ((SOL >= 1) and (HL > 35) and (KOC < 100000)) or ((SOL >= 10) and (SOL < 100) and (KOC <= 700)) PSRP = HIGH |
| | otherwise |
| | if (KOC >= 100000) or ((KOC >= 1000) and (HL <= 1)) or ((SOL < 0.5) and (HL < 35)) PSRP = LOW |
| | otherwise |
| | PSRP = INTERMEDIATE |
| * | ===== |
| * | ===== |
| | Adjust the PSRP according to management. See 'Effect of management and site conditions on SPISP II Ratings' for how to adjust the ratings for these conditions: |
| | Soil Incorporated: -1 |
| | High residue or conservation tillage management strategy: -1 |
| | Foliar: -1 |
| | Banded: -1 |
| | Low or ultra-low rate of application: -1 |
| QSTAR | EPA OPP Cancer Slope Value. Determined from animal studies; QSTAR values are assigned by EPA and used to estimate the probability of contracting cancer from a pesticide. Used to determine CHCL*. QSTAR is a field in the human toxicity data table. |
| Rainfall | Probability of Precipitation: NONE -- No precipitation within 7-10 days of pesticide application. LOW -- Low probability of rainfall causing runoff or deep percolation in 7-10 days. HIGH -- High probability of rainfall causing runoff or deep percolation in 7-10 days. |
| | Affects the I-Ratings. |

Glossary—Continued

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-----
RFD | Reference Dose. RFD's based on animal studies are used for human toxicity determination. They are
    | reported by the EPA OW and EPA OPP. A field in the human toxicity data table.
-----
S-Ratings | SPISP II Soil vulnerability ratings: SLP, SSRP, SARP.
-----
SARP | Soil Adsorbed Runoff Potential. Represents sensitivity of a soil to pesticide loss adsorbed to
    | sediment and organic matter that leaves the edge of the field.
    |
    | SARP characterizes those soil properties that would increase or decrease the tendency of a
    | pesticide to move in surface runoff attached to soil particles. A high rating indicates the
    | greatest potential for sediment/pesticide transport.
    |
    | * =====
    | * =====
    | Compute the SARP according to the following algorithm, then adjust for site conditions.
    |
    | HYD -- Hydrologic Group.
    | KFACT -- Soil K factor.
    |
    | * =====
    | * =====
    | If (HYD == "D") and (KFACT == 0) use a KFACT of 0.02 in the algorithm below. See the definition for
    | KFACT.
    |
    | * =====
    | * =====
    | If ((HYD == "C") and (KFACT >= 0.21)) or
    | ((HYD == "D") and (KFACT >= 0.10))
    |     SARP = HIGH
    | otherwise
    |     if (HYD == "A") .or.;
    |         ((HYD == "B") .and. (KFACT <= 0.10)) .or.;
    |         ((HYD == "C") .and. (KFACT <= 0.07)) .or.;
    |         ((HYD == "D") .and. (KFACT <= 0.02))
    |     SARP = LOW
    | otherwise
    |     SARP = INTERMEDIATE
    |
    | * =====
    | * =====
    | Adjust the SARP according to management. See 'Effect of management and site conditions on SPISP II
    | Ratings' for how to adjust the ratings for these conditions:
    |
    | If there is a slope on the field greater than 15%, increase the rating by one class.
    |
    |-----
    | Slope | Field slope. SARP is increased one class where a slope is greater than 15%.
    |-----

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Glossary—Continued

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SLP -----
SPISP II Soil Leaching Potential. The sensitivity of a given soil to pesticide leaching below the
rootzone.

SLP characterizes those soil properties that would increase or decrease the tendency of a pesticide
to move in solution with water and leach below the root zone. A high rating indicates the greatest
potential for leaching.

* =====
* =====
Compute the SLP according to the following algorithm, then adjust for site conditions.

HYD -- Hydrologic Group.
KFACT -- Soil K factor.
OM1 -- % surface horizon organic matter content.
Horiz_1_Depth -- Depth of the first soil horizon, in inches.

* =====
* =====
If (HYD == "D") and (KFACT == 0) use a KFACT of 0.02 in the algorithm below. See the definition for
KFACT.

* =====
* =====
If ((HYD == "A") and ((OM1 * Horiz_1_Depth) <= 30)) or
((HYD == "B") and ((OM1 * Horiz_1_Depth) <= 9) and (KFACT <= 0.48)) or
((HYD == "B") and ((OM1 * Horiz_1_Depth) <= 15) and (KFACT <= 0.26))
  SLP = HIGH
otherwise
  if ((HYD == "B") and ((OM1 * Horiz_1_Depth) >= 35) and (KFACT >= 0.40)) or
    ((HYD == "B") and ((OM1 * Horiz_1_Depth) >= 45) and (KFACT >= 0.20)) or
    ((HYD == "C") and ((OM1 * Horiz_1_Depth) <= 10) and (KFACT >= 0.28)) or
    ((HYD == "C") and ((OM1 * Horiz_1_Depth) >= 10))
    SLP = LOW
  otherwise
    if (HYD == "D")
      SLP = VERY LOW
    otherwise
      SLP = INTERMEDIATE

* =====
* =====
Adjust the SLP according to management. See 'Effect of management and site conditions on SPISP II
Ratings' for how to adjust the ratings for these conditions:

If there are cracks or macropores in the surface horizon of the soil greater than 24", then
increase the SLP by one class.
If the high water table comes within 24" of the surface during the growing season, change the SLP
to HIGH, no matter what, and do not adjust the rating in any other way.

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Glossary—Continued

 Soil / Pesticide Interaction Ratings | See I-Ratings.

 Soil Incorporated | Pesticide incorporated into soil. Incorporation decreases pesticide runoff but increases percolation. PLP is increased one class while PSRP and PARP are reduced one class.

 Solubility (SOL) | Solubility of an active ingredient in water at room temperature, in mg/L (ppm). Used to compute P-Ratings.

 | Solubility is a fundamental physical property of a chemical and affects the ease of wash off and leaching through soil. In general, the higher the solubility value, the greater the likelihood for movement.

 SOURCE | Source of toxicity data. A field in the toxicity data tables.

 | Fish toxicity data table:
 | Source of toxicity data from which MATC* and STV values were calculated.

 | Human toxicity data table:
 | Source of toxicity data:
 | OW -- This toxicity (HA or MCL) is from EPA's Office of Water (EPA-OW).
 | <BLANK> -- HA* and CHCL* from various sources. See definitions for HA* and CHCL*.

 SPISP II | Soil / Pesticide Interaction Screening Procedure version II.

 | Reference:
 | "The SCS/ARS/CES Pesticide Properties Database: II, Using it with soils data in a screening procedure."
 | Don Goss and R. Don Wauchope
 | Pesticides in the Next Decade: The Challenges Ahead, Proceedings of the Third National Research Conference On Pesticides, November 8-9, 1990.
 | Diana L. Weigmann, Editor, Virginia Water Resources Research Center, Virginia Polytechnic Institute & State University.
 | Pg. 471-487

 SPISP II Ratings | Ratings of pesticides, soils and pesticide/soil interaction that indicate potential for pesticide movement. Rating class abbreviations used in the WIN-PST reports include:
 | H -- HIGH
 | I -- INTERMEDIATE
 | L -- LOW
 | V -- VERY LOW (Leaching Only)

 | Ratings on the WIN-PST reports are SPISP II ratings modified for management. See 'Conditions that affect SPISP II Pesticide Loss Potential Ratings', 'Conditions that affect SPISP II Soil / Pesticide Interaction Ratings', 'Conditions that affect SPISP II Soil Sensitivity Ratings', and 'Effect of management and site conditions on SPISP II Ratings'.

Glossary—Continued

SSRP | SPISP II Soil Solution Runoff Potential. The sensitivity of a given soil to pesticide loss
| dissolved in surface runoff that leaves the edge of the field. A high rating indicates the greatest
| potential for solution surface loss.
| * =====
| * =====
| Compute the SSRP according to the following algorithm.
| -----
| HYD -- Hydrologic Group.
| * =====
| * =====
| If ((HYD == "C") or (HYD == "D"))
| SSRP = "HIGH"
| otherwise
| if (HYD == "A")
| SSRP = "LOW"
| otherwise
| if (HYD == "B")
| SSRP = "INTERMEDIATE"
| -----
STSSAID | State and Soil Survey Area ID.
| -----
STUDY_CAS | CAS_NO reported in toxicity studies for a pesticide. A field in the human and fish toxicity data
| tables. The STUDY_CAS may differ from the value in the CAS_NO field if the STUDY_CAS was believed
| to be incorrect.
| -----
STUDY_PC | PC_CODE reported in toxicity studies for a pesticide. A field in the human and fish toxicity data
| tables. The STUDY_PC may differ from the value in the PC_CODE field if the STUDY_PC was believed to
| be incorrect.
| -----
STV | Sediment Toxicity Value. STV = MATC x KOC. Compared to the PARP when the species of concern are
| fish.
| -----
| STV provides toxicity of pesticide sorbed to detached soil leaving the field. KOC is used in STV
| determination to estimate pesticide concentration in sediment pore water. Fish MATC is used in lieu
| of toxicity data to sediment dwelling animals for which test data are rare. STV threshold ratings
| are the same as those used for MATC evaluation. The method for sediment short-term toxicity of
| nonionic pesticides (Di Torro et al., 1991), was modified to determine long-term toxicity. STV is
| also used to evaluate ionic pesticide which account for about 25% of pesticides. This is achieved
| by use of an adjusted KOC in the NAPRA PPD, which accounts for pesticide ionic properties.
| -----
| Reference:
| Di Torro, D.M., C.S. Zarba, D.J. Hansen, W.J. Berry, R.C. Swartz, C.E. Cowan, S.P. Pavlou, H.E.
| Allen, N.A. Thomas, P.R. Paquin. 1991.
| "Technical Basis for Establishing Sediment Quality Criteria for Nonionic Organic Chemicals Using
| Equilibrium Partitioning."
| Environmental Toxicology and Chemistry. 10:1541-1583
| -----

Glossary—Continued

| | |
|---------------|--|
| SURFACE DEPTH | Depth of the soil surface horizon. Used to compute the SLP. This can be a default (average of the range in the USDA-NRCS soils database) or user-supplied value (field condition). |
| TAXA | Animal group tested. A field in the fish toxicity data table. |
| TAXONOMIC | Genus and species of the fish tested. A field in the fish toxicity data table. |
| TEXTURE | Soil texture class designations. |
| TERM | DESCRIPTION |
| ===== | ===== |
| ===== | Texture Modifiers |
| BY | Bouldery |
| BYV | Very bouldery |
| BYX | Extremely bouldery |
| CB | Cobbly |
| CBA | Angular cobbly |
| CBV | Very cobbly |
| CBX | Extremely cobbly |
| CN | Channery |
| CNV | Very channery |
| CNX | Extremely channery |
| FL | Flaggy |
| FLV | Very flaggy |
| FLX | Extremely flaggy |
| GR | Gravelly |
| GRC | Coarse gravelly |
| GRF | Fine gravelly |
| GRV | Very gravelly |
| GRX | Extremely gravelly |
| MK | Mucky |
| PT | Peaty |
| RB | Rubblly |
| SR | Stratified |
| ST | Stony |
| STV | Very stony |
| STX | Extremely stony |
| ===== | Texture Terms |
| COS | Coarse sand |
| S | Sand |
| FS | Fine sand |
| VFS | Very fine sand |
| LCOS | Loamy coarse sand |
| LS | Loamy sand |
| LFS | Loamy fine sand |

Glossary—Continued

| LVFS Loamy very fine sand
 | COSL Coarse sandy loam
 | SL Sandy loam
 | FSL Fine sandy loam
 | VFSL Very fine sandy loam
 | L Loam
 | SIL Silt loam
 | SI Silt
 | SCL Sandy clay loam
 | CL Clay loam
 | SICL Silty clay loam
 | SC Sandy clay
 | SIC Silty clay
 | C Clay
 |
 | ===== Terms used in lieu of texture
 | CE Coprogenous earth
 | CEM Cemented
 | CIND Cinders
 | DE Diatomaceous earth
 | FB Fibric material
 | FRAG Fragmental material
 | G Gravel
 | GYP Gypsiferous material
 | HM Hemic material
 | ICE Ice or frozen soil
 | IND Indurated
 | MARL Marl
 | MPT Mucky-peat
 | MUCK Muck
 | PEAT Peat
 | SG Sand and gravel
 | SP Sapric material
 | UWB Unweathered bedrock
 | VAR Variable
 | WB Weathered bedrock

 TOX_PPB | Toxic concentration of pesticide in parts per billion (ppb) .

TOX_TIME | Timeframe associated with a toxicity.
 | WIN-PST PPD, Fish: {MATC -- long-term | LOC -- 4-Day} .
 | WIN-PST PPD, Human: {Lifetime} .

TOX_TYPE | Toxicity type that applies to an animal, fish or humans.

=====

FISH: Toxicity types in the WIN-PST fish toxicity data table: 96-hour LC50, LOC, MATC*, and STV.

Glossary—Continued

=====

HUMAN: Toxicity types in the WIN-PST human toxicity data table: MCL, HA, HA*, and CHCL. Based on availability, usage priority in this database is: MCL, HA, HA* and CHCL. This order was determined by considering:

1. MCL is EPA's drinking water regulation of choice.
2. HA has been determined by the EPA Office of Water (OW).
3. HA* is calculated by the same method used by the OW for noncarcinogens and possible human carcinogens as determined by OW.
4. CHCL is determined for probable and known carcinogens. It is comparable to the MCL.

Ultralow Rate | A pesticide application rate of one-tenth of a pound or less of active ingredient per acre. (112 grams per hectare.) An ultra low rate of application allows reduction of the PLP by two classes, and the PSRP and PARP by one class.

WHO | World Health Organization.

WHORFD | World Health Organization Reference Dose. RFD's from WHO are used to calculate HA* when RFD's are unavailable from EPA OPP or EPA. A field in the human toxicity data table.

WIN-PST / WIN_PST () | Windows Pesticide Screening Tool. WIN-PST was developed by the NAPRA Team, Amherst, Massachusetts. WIN-PST replaces NPURG. WIN-PST is based on the SPIISP II algorithms, but allows a user to modify the ratings based on site conditions or management. WIN-PST can be used to help determine the potential for agricultural pesticides to move towards water resources. WIN-PST allows the user to combine the effect of pesticide and soils properties to determine potential environmental risk from pesticide movement below the rootzone and beyond the edge of the field.

WIN-PST Fish Toxicity Data Table | The fish toxicity data table in the WIN-PST PPD; FISHTOX.DBF. Maintained by Stephen Plotkin, NAPRA Team, Massachusetts.

WIN-PST Human Toxicity Data Table | The fish toxicity data table in the WIN-PST PPD; HUMTOX.DBF. Maintained by Stephen Plotkin, NAPRA Team, Massachusetts.

WIN-PST PPD | The subset of data tables from the NAPRA PPD used by the WIN-PST program.

WIN-PST Soils Data | The current WIN-PST soils data tables primarily derive from the national NRCS State Soil Survey Database (SSSD) that was held in Ames, IA. Additionally, a limited amount of data was also acquired from the USDA-NRCS Soil Survey Division: National MUIR Database Download found online at <http://www.statlab.iastate.edu/cgi-bin/dmuir.cgi?F>

WIN-PST Soils Database | The WIN-PST soils database will be replaced with NASIS data in the near future, after the import / export procedure from NASIS to WIN-PST is refined.

DRAFT
NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

595 - 1

PEST MANAGEMENT
(Acre)

CODE 595

DEFINITION

Managing pests including weeds, insects, diseases and animals.

PURPOSES

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- Enhance quantity and quality of agricultural commodities
- Minimize negative impacts of pest control on soil resources
- Minimize negative impacts of pest control on water resources
- Minimize negative impacts of pest control on air resources
- Minimize negative impacts of pest control on plant resources
- Minimize negative impacts of pest control on animal resources

CONDITIONS WHERE PRACTICE APPLIES

Wherever pest management is needed.

CRITERIA

General Criteria Applicable to All Purposes

A pest management component of a conservation plan will be developed. Methods of pest management must comply with Federal, State, and local regulations. Integrated Pest Management (IPM) programs that strive to balance economics, efficacy and environmental risks will be utilized where available. (IPM is an approach to pest control that combines biological, cultural and other alternatives to chemical controls with the judicious use of pesticides. The objective of IPM is to maintain pest levels below

economically damaging levels while minimizing harmful effects of pest control on human health and environmental resources.)

An appropriate set of mitigation techniques must be implemented to address the environmental risks of pest management activities in order to adequately treat identified resource concerns. Mitigation techniques include practices like filter strips and crop rotation, and management techniques like application timing and method.

Cultural and mechanical methods of pest management must comply with the rest of the conservation plan.

This practice has the potential to affect National Registered listed or eligible (significant) cultural resources. Follow NRCS State policy for considering cultural resources during planning, application and maintenance.

When developing alternatives and applying chemical controls of pest management, the following will apply:

- Both label instructions and Extension recommendations (where available) will be followed when developing chemical control alternatives. Pay special attention to environmental hazards and site-specific application criteria.
- Compliance with Federal, State and local laws is required (e.g., Food Quality Protection Act (FQPA), Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Worker Protection Standard (WPS) and Interim Endangered Species Protection Program (H7506C)).

Additional Criteria to Protect Quantity and Quality of Agricultural Commodities

IPM will be used where available, however, if IPM programs are not available, the level of pest control must be the minimum necessary to meet the

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

NRCS, NHCP
May 1999

producer's objectives for commodity quantity and quality. [State Standards will identify their commodity-specific IPM programs.]

Additional Criteria to Protect Soil Resources

In conjunction with other conservation practices, the number, sequence and timing of tillage operations shall be managed to maintain soil quality and maintain soil loss below or equal to the soil loss tolerance (T) or any other planned soil loss objective. Label restrictions shall be followed for pesticides that can carry over in the soil and harm subsequent crops.

Additional Criteria to Protect Water Resources

Pesticide environmental risks, including the impacts of pesticides in ground and surface water on non-target plants, animals and humans, must be evaluated for all identified water resource concerns. [State Standards will include approved evaluation procedures such as NRCS' Soil/Pesticide Interaction Screening Procedure (SPISP), Windows Pesticide Screening Tool (WIN-PST) and National Agricultural Pesticide Risk Analysis (NAPRA).]

When a chosen alternative has significant potential to negatively impact important water resources, (for example: SPISP "High" and "Intermediate" soil/pesticide combinations in the drainage area of a drinking water reservoir), an appropriate set of mitigating practices must be put in place to address risks to humans and non-target aquatic and terrestrial plants and wildlife. [State Standards will identify appropriate mitigation practices by pesticide loss pathway and resource concern. For example: for pesticide sorbed to eroded soil in a surface water concern area, residue management, water management and filter strips may be appropriate mitigation practices.]

Open mixing of chemicals will not occur in the application field within a minimum of 100 feet from a well or surface water body. Open mixing should be performed down gradient of wells (State or local regulations may be more restrictive).

The number, sequence and timing of tillage operations shall be managed in conjunction with other sediment control tactics and practices, in order to minimize sediment losses to nearby surface water bodies.

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May 1999**

Additional Criteria to Protect Air Resources

Follow pesticide label instructions for minimizing volatilization and drift that may impact non-target plants, animals and humans.

Additional Criteria to Protect Plant Resources

Prevent misdirected pest management control measures that negatively impact plants (e.g., removing pesticide residues from sprayers before moving to next crop and properly adjusting cultivator teeth and flame burners).

Follow pesticide label directions specific to the appropriate climatic conditions, crop stage, soil moisture, pH, and organic matter in order to protect plant health.

Additional Criteria to Protect Animal Resources

Follow pesticide label instructions for minimizing negative impacts to both target and non-target animals.

CONSIDERATIONS

When IPM programs are not available, basic IPM principles should be strongly encouraged. [State Standards should include all appropriate IPM principles such as using mechanical, biological, and cultural control methods in lieu of chemical controls, scouting pest populations to avoid routine preventative pest control measures, and the utilization of spot treatments.]

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

PLANS AND SPECIFICATIONS

The pest management component of a conservation 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.

As a minimum, the pest management component of a conservation plan will include:

- plan and soil map of managed fields
- location of sensitive resources and setbacks
- crop sequence and rotation if applicable

- identification of target pests (and IPM scheme for monitoring pest pressure when available)
- recommended methods of pest management (biological, cultural, mechanical or chemical), including rates, product and form, timing, and method of applying pest management
- results of pest management environmental assessments (SPISP, WIN-PST, NAPRA, RUSLE etc.) and a narrative describing potential impacts on non-target plants and animals, through soil, water and air resources as appropriate
- operation and maintenance instructions
- The requirement that the producer will maintain records of pest management for at least two years. Pesticide application records will be in accordance with USDA Agricultural Marketing Service's Pesticide Record Keeping Program and state specific requirements. [State Standards will describe record keeping requirements.]

OPERATION AND MAINTENANCE

The pest management component of a conservation plan will include the following operation and maintenance items:

- A safety plan complete with telephone numbers and addresses for emergency treatment centers for personnel exposed to chemicals. For human exposure questions, the telephone number for the nearest poison control center should be provided. The telephone number for the national hotline in Corvallis, Oregon may also be given:

1-800-424-7378

Monday - Friday

6:30 a.m. to 4:30 p.m. Pacific Time

For advice and assistance with emergency spills that involve agrichemicals, the local emergency telephone number should be provided. The national CHEMTREC telephone number may also be given:

1-800-424-9300

- Posting of signs according to label directions and/or Federal, State, and local laws around fields that have been treated. Follow re-entry times.
- Disposal of pesticides and pesticide containers must be in accordance with label directions and adhere to Federal, State, and local regulations.
- The requirement that pesticide users must read and follow label directions, maintain appropriate Material Safety Data Sheets (MSDS), and become certified to apply restricted use pesticides.
- Calibration of application equipment according to Extension Service recommendations before each seasonal use and with each major chemical change.
- The requirement that worn nozzle tips, cracked hoses, and faulty gauges must be replaced.

