Iowa Commercial Pesticide Applicator Manual

Category

9

Regulatory Pest Control

IOWA STATE UNIVERSITY
Extension and Outreach

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This manual has been developed for individuals wishing to become certified in commercial pesticide applicator Category 9, Regulatory Pest Control. It contains specific information that an individual must know before becoming certified in Category 9. Exam questions for certification in Category 9 will cover both the Regulatory Pest Control Manual and the Core Manual. The manual has been designed to supplement the general information contained in the Core Manual, **Apply Pesticides Correctly—A guide for commercial applicators** (plus an Iowa State University supplement) and should not be used for certification preparation without referring to the Core Manual as well.

Contents

Acknowledgments

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Introduction

The U.S. Environmental Protection Agency (EPA) has set the following standards for certification in the category of Regulatory Pest Control:

"Applicators shall demonstrate practical knowledge of regulated pests, applicable laws relating to quarantine and other regulation of pests, and the potential impact on the environment of restricted-use pesticides used in suppression and eradication programs. They shall demonstrate knowledge of factors influencing introduction, spread and population dynamics of relevant pests. Their knowledge shall extend beyond that required by their immediate duties since their services are frequently required in other areas of the country where emergency measures are invoked to control regulated pests and where individual judgments must be made in new situations."

Regulatory pest control

The objective of regulatory pest control is to prevent the introduction and/or spread of pests and diseases through the application of suppression, control, and eradication measures. The objective is achieved through limiting movement of commodities and materials, and through the treatment of commodities, materials, and the environment to prevent the establishment of pests and diseases where they have not been previously established. An organism can become a regulated pest when it interferes with:

- health;
- comfort;
- leisure;
- aesthetic satisfaction;
- recreation;
- stability of existing biological systems; or
- agricultural and material production.

Organisms that may be considered pests include:

- insects;
- nematodes;
- fungi;
- weeds;
- diseases;
- vertebrate animals, and
- other organisms as defined in the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended.

Regulatory pest control measures may be taken if:

- the pest offers an actual or expected threat;
- the objective is reasonably attainable; or
- the economic gains outweigh the costs of application of control measures.

Statutory authorities

One of the principal reasons for the spread of pests and diseases shipped throughout the world is inadequate control of such pests in the country of origin. Regulations cannot prevent, though they may hinder or delay, the spread of pests to new territories. Adequate control of pests in countries of origin is the best safeguard against their spread to other countries, including the United States. Although this principle is widely accepted, its practical application is very slow. In the meantime, we must continue to depend on laws and regulations to protect against outside pests and to control pests within our borders.

The existence and responsibilities of Federal regulatory programs are provided for by congressional acts and by delegations made by the Secretary of Agriculture. These acts provide the Secretary of Agriculture with authority to:

- establish restrictive and prohibitory quarantines and regulations against imports likely to introduce pests not known to be present or widely distributed in the United States.
- establish quarantines and regulations to carry out cooperative United States-Mexican suppression, control, or eradication measures against designated pests that become established in the United States or Mexico.
- provide certification of domestic products for export when requested by interested shippers or other parties.

These acts, and the regulations based on them, provide the foundation for a flexible but effective program for protecting the country against foreign pests. Under the acts, the United States Department of Agriculture (USDA) has broad authority to take appropriate measures against threatening pests and to promulgate or modify existing regulations whenever necessary.

Federal acts

1. The Plant Quarantine Act (August 20, 1912). The powers of restriction on imports granted under this Act are broad. It appears Congress intended to give the Secretary of Agriculture authority to restrict and control the entry of plants and plant products into the United States to the extent necessary to prevent the entry of plant pests. Sections one through seven are the basis for quarantines established on foreign plants and plant products.

Eighty-five quarantines have been promulgated under the Act in the 84 years of its existence. Thirty of these have been related to imports of plants and plant products from foreign countries, 45 to interstate movement, and 10 to movement of host material between the U.S. mainland and its offshore states and territories. Currently, there are 11 domestic quarantines, 15 foreign quarantines, and 7 territorial quarantines.

The Act has been amended five times since it was enacted in 1912. The fifth and last amendment to the Plant Quarantine Act was made May 1, 1928. This amendment granted authority “to stop—and without warrant—to inspect, search and examine persons, vehicles, receptacles, boats, ships or vessels and to seize and destroy or otherwise dispose of plants and plant products or other articles found to be moving or to have moved in interstate commerce or to have been brought into the United States in violation of the Act of 1912, or of any quarantine order thereunder."

In 1929, a proposed amendment to the Act would have deprived the Secretary of authority to forbid the importation of nursery stock, fruits, vegetables, and other plant products unless such items were infected or infested with foreign plant pests or unless the Secretary had good reason to believe such pests were present. Because inspection alone cannot determine the presence of such pests, the Department of Agriculture strongly opposed the bill. On September 18, 1929, after an extended Senate discussion, the bill was dropped by common consent. There has been no serious challenge to the Act since that date.

2. Federal Plant Pest Act (May 23, 1957). One of the purposes of this Act was to provide the USDA authority to regulate the movement of plant pests into or through the United States. A definition for plant pests was included in the Act and expanded to cover diseases, mollusks, viruses, and nematodes, as well as insects.

Authorization was given to the inspector to take emergency action to seize, treat, or destroy articles or products with respect to plant pests new to or not known to be widely prevalent in the United States. It provided that the least drastic actions be taken to prevent the spread of plant pests—destruction, exportation, or return to point of origin. Provision also was made to compensate the owner for losses due to disposal of products, articles, means of conveyance, or pests, provided he/she established in court that the disposal was unauthorized by either the Federal Plant Pest Act or the Plant Quarantine Act.

The Federal Plant Pest Act also authorized inspection without a warrant of persons and means of conveyance moving interstate on probable cause of threat of spread of a plant pest. The Act also included provisions for entry of premises with a warrant to make any inspections and seizures necessary under the Act. Violation of regulations is covered by this Act, as well as violations of the Act itself, and a penalty is authorized for types of violations.

3. Organic Act (September 21, 1944). The original Organic Act of 1944 was enacted to give the Secretary of Agriculture authority to cooperate with farmers' associations and individuals, as well as states or political subdivisions thereof, and Mexico, in operations to control or eradicate the Japanese beetle, sweet potato weevil, Mexican fruit fly, gypsy moth, browntail moth, corn borer, pink bollworm, and thurberia weevil, as well as citrus canker, Dutch elm disease, phony peach and peach mosaic, and cereal rust.

In addition, the Act gave the Secretary authority to inspect and certify domestic plants and plant products as meeting foreign sanitary requirements. Previously, this authority had been granted annually by successive appropriation acts. The Act was amended in 1949 to include citrus blackfly, whitefringed beetle, and Hall scale. In 1957 it was further amended by including imported fire ant, soybean cyst nematode, and witchweed.

An important part of the 1957 amendment adds to the existing law the words "insect pests, plant diseases, and nematodes, such as..." This language, according to legislative history, was intended to have the effect of permitting the Department of Agriculture to undertake eradication or control campaigns against insect pests of the same description as those listed in the section without requiring an amendment of the Act to provide for each. The Act, when promulgated in 1944, gave the Secretary the authority to certify plants and plant products for export. Prior to the Act, the Department charged for such certification. However, since the 1944 Act did not require the collection of fees, this was suspended on July 1, 1945.

4. The Federal Noxious Weed Act (1974). This Act "provides for the control and eradication of noxious weeds and the regulation of the movement in interstate or foreign commerce of noxious weeds and potential carriers thereof, and for other purposes. No person shall knowingly mail, ship, offer for shipment, offer for entry, import, receive for transportation, carry, or otherwise transport or move, or allow to be moved, by mail or otherwise any noxious weed unless such movement is authorized under general or specific permit from the Secretary of Agriculture." The Act also provides for power of temporary quarantine and restriction or prohibition of interstate movement of any products and articles capable of carrying noxious weeds whenever the Secretary has reason to believe an infestation of noxious weeds exists in any state, territory, or district.

Refer to the Iowa Core Manual for further information on current laws and regulations.

Pests

Japanese Beetle. The Japanese beetle (*Popillia japonica*) is presently found in Iowa. Although in recent years it has been detected in several eastern counties, at this time there is only one established population just north of Le Claire in Scott County.

Description: Japanese beetles are a little less than 1.3 cm (1/2 inch) long and are shiny, metallic green. The adults have coppery brown wings and six small patches of white hairs along the sides and back of the body under the edges of the wings. The immature form is a white grub that is similar to our native white grub but is usually smaller—only about 2.5 cm (1 inch) long. It lies in the soil in a curled or C-shaped position.

Life Cycle: Adult beetles first appear in early to mid July in Iowa. They fly only in the daytime and are extremely active for only 4 to 6 weeks. Female beetles burrow about 7.6 cm (3 inches) into the ground, usually turf, and lay eggs. The eggs hatch in August, and the small grubs feed on plant roots. The grubs are almost full grown by late fall and burrow about 10 to 20.3 cm (4 to 8 inches) below the soil surface where they overwinter in an earthen cell. During the following spring, the grubs move upward to the roots, pupate, and emerge as adults in June.

Damage: Grubs feed on roots, particularly of grasses. Beetles feed on the foliage of more than 275 different plants. They often congregate on flowers or fruits of plants exposed to bright sunlight. Beetles can cause extensive damage to the leaves of plants by skeletonizing them.

Natural Controls: Weather, disease, and parasites often help reduce Japanese beetle populations. Extremely dry weather destroys many eggs. Wet summers, however, are favorable for egg and grub development.

Gypsy Moth. The gypsy moth (*Lymantria dispar*) is a serious pest of trees in the northeastern United States. Male moths have frequently been detected in pheromone traps in Iowa since the early 1970s, but no known established population of this pest exists in Iowa.

Description: Female moths are white with black wing markings and do not fly. Males have dark brown forewings and a 3.81 cm (1½-inch) wingspread. Males are strong fliers. Larvae are large and hairy and display pairs of red and blue dots on their backs.

Life Cycle: The gypsy moth overwinters as eggs attached to leaves, stones, rocks, or shaded objects. These eggs hatch into larvae in mid to late May. By the end of June, the larvae pupate, and the adult moths emerge in 10 to 14 days.

Damage: Only the larval stage is destructive. The larvae feed on leaves of forest, shade, and fruit trees, and on ornamentals. Single defoliations may kill conifers, but hardwoods can sustain several years of defoliation before being killed. Where established populations of the gypsy moth occur, large numbers of larvae may strip all the leaves from a tree.

Pine Shoot Beetle. The pine shoot beetle (*Tomicus piniperda*) is not presently found in Iowa. The beetle is a pest of foreign origin that has been detected around the Great Lakes' area. It may have entered the United States through one or more of the Great Lakes' ports. Presently, it has been detected in Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York.

Description: Adults of *T. piniperda* are cylindrical, 3 to 5 mm (0.12 to 0.2 inch) long, with a shiny black head and smooth prothorax. The wing covers vary from reddish-brown to black. The antennal funicle has six segments. Larvae are legless, slightly curved grubs. The larvae can reach 5 mm (0.2 inch) in length when fully grown and have a brown head and white body.

Life Cycle: Pine shoot beetles usually complete only one life cycle per year. They overwinter as adults in small niches cut into the bark at the base of host trees. The adult beetles emerge in April when temperatures reach approximately 54° F and colonize cut pine stumps, logs, or the trunks of weakened trees. The beetles mate and the females lay eggs in vertical gallery systems that they bore between the inner bark and outer sapwood of a tree. Egg galleries are 10.2 to 25.4 cm (4 to 10 inches) in length. The larvae feed under the bark from April to June forming separate feeding galleries 3.8 to 8.9 cm (1.5 to 3.5 inches) long that radiate outward from the egg gallery. The larvae pupate at the end of their galleries, and transform into adults. These adults tunnel through the outer bark from July to September creating 2-mm (0.08 inch) wide exit holes, and fly to new pine shoots in the crown of living host trees of any size to feed. The beetles tunnel into the center of the shoot, hollowing 2.5 to 10.2 cm (1 to 4 inches) of wood. During this feeding, each adult may destroy 3 to 6 shoots. Damaged shoots droop, turn yellow and then red, and eventually fall to the ground. With the colder temperatures of fall the adult beetles seek overwintering sites at the base of host trees.

Damage: The shoot feeding stage is the most destructive stage of the life cycle. When shoot feeding is severe, tree height and girth may be reduced. In the United States the pine shoot beetle has been, thus far, primarily a pest of Christmas tree plantations and tree nurseries. Regulatory problems associated with quarantine have been more problematic for such operations than has been the beetle damage. Beetles prefer Scotch pine but also will feed on Eastern white pine, mugo pine, and Austrian pine. Spruce and fir trees also can be affected.

Soybean Cyst Nematode. The soybean cyst nematode (*Heterodera glycines*) is a destructive pest to roots of soybeans, lespedeza, and other crops. It is present in more than two-thirds of Iowa counties.

Description: Nematodes are small, plant-parasitic roundworms. Their life cycle is similar to that of insects, with an egg, larval, and adult stage. Both larvae and adults are light colored and barely visible with the naked eye.

Life Cycle: Larvae hatch from eggs and burrow into roots of the host plant. While feeding on roots, they inject digestive chemicals into them causing stunted or yellow plants. Larvae mature in roots. Adult males leave the roots and live in the soil, but females remain in the roots. As a female feeds, her body swells and eventually splits the root. After mating, the female lays some eggs but eventually dies with many eggs still within her body. The carcass darkens from yellow to brown and becomes a cyst. It remains viable for years and is resistant to decay. Cysts are easily spread in soil that clings to roots, crops, machinery, and containers.

Damage: Damaged plants may become yellow and stunted. A severe infestation can destroy a crop.

Barberry. Barberry (*Berberis* L.) is a woody shrub that is widely distributed through much of the world. Several species are either native or naturalized in North America; some were probably brought here from Europe by early settlers. Barberry was widely planted as a hedge and ornamental shrub as early as the late 17th century. The berries are eaten by birds, which results in extensive dispersal of the plant. Barberry is now found throughout the northern United States.

Description: Barberry is considered undesirable because it is the alternate host for *Puccinia graminis*, a fungus-causing stem rust that is a very destructive disease of small grains. Common barberry, *Berberis vulgaris* L., is an introduced species and is the most important one in this regard, but native species *B. canadensis* and *B. fendleri* also are susceptible to the fungus.

Life Cycle: Barberry is required for the fungus to undergo the sexual reproductive phases of its life cycle. The overwintering spores are produced on the leaves and stems of small grains; these spores in turn produce another spore type that infects barberry. On barberry, fertilization of the fungus takes place and yet another spore type is produced that infects small grains. Barberry not only acts as a source of the disease for small grain crops but also provides a means for rapid development of new races of the fungus, making resistance breeding more difficult.

Damage: The significance of barberry is greatest in the states where wheat is a major crop. Wheat acreage in Iowa has dropped significantly; subsequently, the importance of barberry has been reduced. Because wheat production in Iowa is now limited to certain areas, it may be practical to eradicate barberry bushes within a mile or so of wheat fields. Bushes that are farther away will contribute little to infection of these fields.

Factors influencing pest spread

Pest introduction

During the late 1800s, a number of disastrous pest introductions into the United States dramatized the need for regulatory action. Prior to this time, the introduction and spread of pests was regarded as unavoidable. However, as scientific knowledge advanced, we have found that many organisms that are of no serious consequence in their native habitat can become serious pests when introduced into new areas. Cultural or environmental conditions, the presence of diseases, natural predators, parasites, and other factors may keep an organism at levels where no significant damage occurs. However, when that organism is introduced into a new habitat where natural controls are not present, it may become a pest. The possibilities of introduction of pests into new areas have been enhanced considerably due to increased amounts of host material and improved transportation.

Pest spread

In discussing pest spread, it is important to distinguish between natural spread and artificial spread. Natural spread is the movement the pest can make without human assistance. Artificial spread is the unnatural movement of a pest by humans. The introduction of 80 pairs of starlings into New York in 1890 is an instance of artificial spread as the birds cannot cross large bodies of water on their own. However, the complete invasion of the country by starlings, starting around World War II, was accomplished by the birds' natural movements to occupy this new ecological niche.

For most pests, the major avenue of long-distance spread, and certainly intercontinental movement, is associated with human movement. Prevention of artificial spread is one objective of pest regulatory programs.

The introduction of an organism into a new area does not ensure its establishment. To become established, a pest organism must:

- move into a favorable environment where an appropriate host or food source is available during a specific season;
- arrive in a location where alternate hosts occur in the proper sequence, if necessary, for the survival of that species; and
- be physiologically sound and in numbers sufficient to allow for natural attrition from environmental factors, thus permitting reproduction.

If every entry of a pest were to establish an infestation, regulations and quarantines on the movement of materials would be impractical because it would be impossible to intercept every infested lot of material. Regulatory programs attempt to reduce the movement of infested materials to such a low level that the likelihood of establishment of the pest in new areas is minimal.

Population dynamics

To evaluate the potential seriousness of a pest, it is necessary to have considerable information about its environmental requirements. Regulatory programs are generally concerned with controlling the entire population of the pest species.

Major characteristics of pest populations important to consider when regulatory programs are being designed include:

- population densities;
- age distributions;
- reproduction and mortality rates; and
- biotic potential and growth.

Control or eradication programs must consider all life stages at which the organism becomes a pest. It is necessary to know what effect such factors as pesticides, parasites, predators, and host resistance have on all stages of the pest. However effective a factor may be against a given stage of a pest, its long-term value is limited if it does not account for significant decreases between generations. For example, even if a high percentage of the larval stage of a pest is killed by control techniques, the remaining reproductive population may have the potential for significant damage or spread by the next generation of the pest.

Studies of life cycles often can identify critical developmental stages and other factors important in producing population changes. Recognition of these key factors and their influence on pest populations may permit development of controls that have significant impact in reducing the populations. These factors, which normally have an important limiting effect on native pest populations, may include resistance of host material to the pest, the presence of parasites, or specific climatic conditions. The absence of these factors often is responsible for the explosion of a pest population when it is introduced into a new environment.

Principles of control

The strategies for plant and animal pest control depend upon the successful blending of many skills. Rarely does any single method prove successful for a sustained period of time unless supporting measures are soundly conceived. There are four basic strategies for protecting plants and animals from pests:

- prevention of entry;
- eradication of infestation;
- retardation of spread; and
- mitigation of losses.

These strategies are evolutionary in concept; in practice, one strategy is gradually replaced by stronger supporting measures.

Prevention of entry

Agricultural quarantine inspection programs at ports of entry are designed to prevent the introduction and establishment of plant and animal pests and diseases into the United States and its possessions. These inspection activities are accomplished by inspection staffs at major air, sea, border, and offshore ports. Inspectors work in cooperation with other border clearance agencies in the examination of passengers, their bags, and means of conveyance. Cargoes of both agricultural and nonagricultural nature also are inspected. Treatment or other safeguards may be applied to ensure that harmful pests do not cross borders. Certain hazardous agricultural products are prohibited entry when disinfestation means are not available. This depends upon the country of origin and the particular prohibited item. For example, *Bamboo* spp. and seeds from all other countries are prohibited entry into the United States.

Eradication

Once an introduction occurs and if effective tools are available, the immediate objective is complete eradication of the pest. Generally, all means available, including application of pesticides, are made to achieve this objective.

Retardation and mitigation

In cases where the pest has become firmly established and eradication is not feasible, the objectives are different, depending on the pest populations, the damage being experienced, and the likelihood of long-distance spread. Quarantines, inspection, and chemical treatment or other appropriate measures are used to reduce the possibility of long-distance spread. In other areas where pest populations are high and damage is occurring, an integration of control measures may be used. Among these measures are:

- release of parasites and predators;
- release of sterile males;
- removal of hosts;
- use of pesticides; and
- use of resistant varieties.

Methods of control

The success of most regulatory programs depends upon many diverse but related factors among which is adequate pest control. As mentioned above, satisfactory control of a pest population must be maintained at the point of origin so the potential long-distance spread is greatly reduced. Once an introduction occurs, the use of chemical control becomes essential. The implementation of chemical control when pest populations are newly established and not widely distributed is both economically sound and biologically feasible.

The selection of proper methods of control and suitable pesticides is based on many factors:

- pest species, life cycles, method of dispersal, and mode of attack;
- host species and location of infestation;
- method of pesticide application;
- formulation of pesticide;
- mode of pesticide action;
- size and location of areas selected for treatment; and
- effect of pesticide on target and nontarget organisms.

Proper pesticide use

Precautions should be taken to prevent accidental poisoning of livestock during pesticide applications. Avoid drift of pesticide sprays onto livestock and other domestic animals and pets. Do not allow poultry, dairy animals, or meat animals to eat plants or drink water contaminated with pesticides.

Avoiding harmful residues

Residues in excess of the established legal tolerances can be avoided by applying only those pesticides specified for use on the crop or livestock and by following indicated schedules. Do not exceed recommended dosages. Observe the safety restrictions, particularly the required interval between the last application and harvest, feeding, or slaughter.

In storage facilities, apply only those pesticides registered for this purpose. A commodity that comes in contact with floors or walls treated with pesticides not registered for this use may become contaminated. Repeated applications of some fumigants will cause residues to build up in the stored commodities.

Consider the tolerance of a commodity for a pesticide that may modify taste, odor, appearance, ripening rate, viability, or vitality.

Environmental concerns

Regulatory personnel have two basic responsibilities:

- to control regulated pests, and
- to protect nontarget species.

Consideration should always be given to the best methods to control regulated pests with a pesticide while minimizing its effect on nontarget species.

It should be made clear that environmental effects from pesticides are not necessarily deleterious. There are numerous examples of environmental benefits by the careful selection and judicious use of pesticides. In other situations, the use of pesticides can result in neutral or indeterminate impacts on the environment.

The effectiveness of any pest control program depends greatly upon proper planning and sound management of the pesticide application. All treatment areas must be kept as small as possible, and all sensitive areas—water, pastureland, residential areas, etc.—must be avoided. Consideration must always be given to areas adjacent to treatment sites. Continuous monitoring of weather conditions (wind, humidity, precipitation, etc.) should be carried out prior to and during application. Care must be taken to avoid runoff of any pesticide and, where possible, all animals and birds should be excluded from the treated area. All standing bodies of water should be avoided if possible.

Pesticides

Different classes of pesticides exhibit very different chemical properties. These differences are significant in selecting the proper product for a specific application. The insecticidal properties of one compound may make it desirable from a control standpoint. However, some other property may make it environmentally unacceptable.

When choosing a product for a particular situation, all factors involved should be carefully considered from a risk/benefit standpoint.

Most restricted products you will encounter will be either organochlorines, organophosphates, herbicides, or fumigants

Organochlorines

Organochlorines contain the elements chlorine, hydrogen, and carbon. Dieldrin, chlordane, endrin, mirex, toxaphene, and DDT are representatives of this group.

Organochlorines were first recognized for their pesticidal properties in the 1940s. These products have been invaluable as public health and agricultural pesticides. Unfortunately, one of the properties that makes them so valuable as a pesticide can have negative effects on the environment if application is not properly controlled. This property is commonly called "persistence." This means that when applied, these chemicals do not easily break down into less toxic substances. Therefore, they are available to be picked up by nontarget organisms. Accumulation of these chemicals can occur in fatty tissue and build up to toxic levels in animals further along the food chain.

Some insects have become resistant to organochlorines. This has led to a reduction in their use in some areas.

Organochlorines act on the central nervous system in most organisms. They are effective contact and stomach poisons. These compounds are readily absorbed through the skin by humans. Aquatic organisms are extremely sensitive to most organochlorine insecticides. Oxygen uptake at the gills is impeded, and death can result from suffocation. Therefore, in agricultural applications, extreme care should be taken to avoid the contamination of water supplies with organochlorines.

Organophosphates

The organophosphates are derived from phosphoric acid. Representatives of this group are parathion, malathion, and diazinon. All of these compounds have a similar mode of action. They are cholinesterase inhibitors, or nerve poisons. They are effective as contact and stomach poisons.

Organophosphate insecticides began to replace the organochlorine insecticides in the mid 1960s. There are three basic reasons for the transition to organophosphate insecticides:

- They are effective against insects resistant to the organochlorine compounds.
- They are biodegradable and do not contaminate the environment for a long time.

- They have less long-acting effects on nontarget organisms. Organophosphates, although often acutely toxic to mammals, have not presented a serious problem to aquatic life.

The primary danger from organophosphate insecticides is to the applicator. These compounds are readily absorbed through the skin; the vapors are poisonous and should not be inhaled. If ingested, some of these compounds are acutely toxic.

Organophosphates exhibit a wide range of toxicities, from parathion that has an oral LD_{50} of approximately 5 mg/kg to malathion that has an oral LD_{50} of approximately 1,400 mg/kg. Because of the wide range of toxicities of products belonging to this group, each product should be evaluated on its own merit.

Herbicides

Chemical weed killers have been in use since the early 1940s. The development of these products has been responsible, in large part, for the dramatic increases in agricultural production over the last 50 years.

There are many types of herbicides available today. They can be broadly classified as selective and nonselective herbicides. Both selective and nonselective products can be applied to foliage or to the soil.

Examples of selective herbicides are 2,4-D and dicamba. Both of these are effective on broadleaf weeds and are used in corn production. Soybeans are highly susceptible to both. The herbicide 2,4-D is generally referred to as a "phenoxy" or "hormonal" herbicide. Dicamba works as a growth regulator herbicide. Both are translocated throughout the plant.

Contact herbicides are in a separate group of pesticides. Some of these products also are selective on broadleaf weeds. They have a contact, burning action to plant tissue. Paraquat, a nonselective herbicide, is effective on broadleaf weeds and grasses. It is selective because of placement only.

Most of the foliage-applied herbicides are effective on actively growing plants and have no long-term action.

The soil-applied herbicides act mainly on weeds as they germinate and can be active for several months.

Herbicides generally have a low mammalian toxicity and most do not present an immediate hazard to the applicator. One exception to this is Paraquat, which is extremely toxic if inhaled or ingested and for which there is no known antidote.

The greatest danger from using herbicides is the potential economic damage from drift to adjacent cash crops.

Most herbicides are broken down either chemically or biologically in the soil. Foliage-applied herbicides are broken down rapidly, and even persistent soil-applied herbicides disappear within a few months under most conditions. Soils of high organic or clay content can delay breakdown.

Research data gathered in recent years indicates that herbicide residues do not build up to unacceptable levels as a result of repeated annual applications.

Fumigants

Fumigants are gases that kill body cells and tissues. They generally enter an organism through the respiratory tract and, in some cases, can penetrate an insect's body wall.

Fumigants are available in solid, liquid, or gaseous form. They are active in gaseous form. The gases (molecules) penetrate cracks and voids in materials infested by insects.

The utilization of fumigants is limited by:

- flammability—some fumigants must be mixed with nonflammable materials to render them safe for use;
- toxic hazards to applicators—fumigants potentially present a greater danger to applicators than any other pesticides;
- high reactivity—fumigants present a problem of poisonous residues and residual odors in food;
- tendency to corrode metals;
- lack of chemical stability; and
- cost.

All fumigants that are effective pesticides are toxic to humans. Therefore, it is necessary to add warning agents (dyes or odors) to compounds that are naturally colorless or odorless.

No fumigant should ever be used unless it has these warning additives and the applicator is thoroughly familiar with fumigant application.

When taking part in a fumigation activity, do not begin actual fumigation until you are *positive* that the area is secure and adequate measures have been taken to protect nonparticipants.

Special situations

Although it is a violation of FIFRA regulations to use a pesticide in a manner inconsistent with the labeling, there are special emergency provisions. When a new pest is introduced into the country, a pesticide is not likely to be registered to combat it because it will not be specifically mentioned on the label. Section 18 (FIFRA) as amended, provides authority for the EPA administrator to exempt any federal or state agency from any provision of FIFRA if he/she determines an emergency exists. The following are the types of exemptions defined by EPA regulations:

- Specific exemption involves the outbreak of pests and must be requested for in writing by the head of a federal agency or the state governor.
- Quarantine exemption may be issued for federal or state programs to prevent the introduction or spread of a foreign pest on a written request similar to that used in a specific exemption.
- Crises exemption is used in a situation involving an unpredictable pest outbreak where need is so critical as to preclude application for a specific exemption.

Such exemptions may not involve use of any pesticide that has been suspended or canceled for the use in question.

In situations of a highly localized nature, consideration may be given to obtaining registration for "special local needs" through the Iowa Department of Agriculture pursuant to FIFRA Section 24(c).

Self-study worksheet for regulatory pest control

Category 9, Commercial Pesticide Applicator Manual

This worksheet is designed to assist you in preparation for the certification examination in Regulatory Pest Control (Category 9) for commercial pesticide applicators in Iowa. You should first carefully read and study the category manual. Then, test your knowledge by completing the following exercises. The answer to each question on the worksheet can be found in the manual on the page indicated by the number in parentheses following each question, e.g., (p. 6) means that the information needed to answer the question is discussed on page 6 in the manual.

Key words

You should understand these terms. What do they mean?

Plant Quarantine Act (p. 4) ______________________________

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Federal Plant Pest Act (p. 5) ______________________________

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Organic Act (p. 5)______________________________

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Federal Noxious Weed Act (p. 6) ______________________________

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barberry (p. 8) ______________________________

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natural spread (p. 9) ______________________________

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population dynamics (p. 10) ______________________________

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retardation (p. 11) ______

organochlorine (p. 13) ______

General questions

1. What are the purposes of the Federal Plant Pest Act of 1957? (p. 5) ______

2. Describe the damage due to Japanese beetles. (p. 7) ______

3. Why are barberry and soybean cyst nematodes regulated pests? (p. 8) ______

4. What is the difference between natural and artificial spread of a pest? (p. 9) ______

5. What are four principles of pest control? (p. 10) ______

6. What property exhibited by organochlorine pesticides makes them unsuitable for certain types of applications? (p. 13) ______

7. What limits the use of fumigants? (p. 15) ______

Matching exercises

Acts and regulations

1. ______ Plant Quarantine Act (p. 4)
2. ______ Plant Pest Act (p. 5)
3. ______ Organic Act (p. 5)
4. ______ Noxious Weed Act (p. 6)

a. provides for control of Japanese beetle et al.
b. provides for eradication and regulates movement of noxious weeds
c. broad authority to control entry of plants into the United States
d. provides payment for confiscated materials

Pest identification

1. ______ Japanese beetle (p. 6)
2. ______ Gypsy moth (p. 7)
3. ______ Pine shoot beetle (p. 7)
4. ______ Soybean cyst nematode (p. 8)
5. ______ Barberry (p. 8)

a. host for black stem rust
b. larval feeding may reduce tree height
c. spread by soil in crops and containers
d. immature is white and C-shaped
e. larvae are hairy caterpillars

Understanding key concepts

(true or false)

1. ______ The Organic Act of 1944 gave the authority to control cereal rust, corn borer, gypsy moth et al. (p. 5)
2. ______ Japanese beetles are not found in Iowa. (p. 6)
3. ______ Gypsy moth larvae are curled, white, and C-shaped. (p. 7)
4. ______ Adult pine shoot beetles overwinter in the bark of host trees. (p. 7)
5. ______ Soybean cyst nematodes burrow into roots of host plants. (p. 8)
6. ______ Barberry reproduces by seeds and new shoots. (p. 8)
7. ______ Natural spread is the movement of pests by humans. (p. 9)
8. ______ Regulatory programs attempt to eliminate a pest altogether. (p. 10)
9. ______ The first principle of pest control is to prevent entry. (p. 10)
10. ______ Mirex and toxaphene are organophosphate insecticides. (p. 13)
11. ______ Organophosphates generally present serious problems to aquatic life. (p. 13)

Understanding key concepts (continued)

(true or false)

12. _____ 2,4-D and dicamba are selective herbicides. (p. 14)

13. _____ Fumigants are generally stable and only slightly flammable. (p. 15)

Sample exam question

Barberry is a regulated pest because (p. 8)

a. it is extremely poisonous to livestock
b. it is a primary host for Japanese beetles
c. it causes competitive displacement of shrubby perennials
d. it is aesthetically unpleasant
e. it is an alternate host for black stem rust of wheat

Before Using Any Pesticide

STOP

READ THE LABEL

All pesticides can be harmful to health and environment if misused.

Read the label carefully and use only as directed.