

Additional Information for Industrial, Institutional, Structural and Health-Related Pest Control

Category 7 & 8

PREFACE

Federal regulations establish general and specific standards that you must meet before you can use certain pesticides. This guide contains basic information to help you meet the specific standards for applicators who are engaged in industrial, institutional, structural and health-related pest control. This guide will give you additional information about:

- pest control and pesticides
- using pesticides safely
- recognizing and controlling common pests

USING PESTICIDES SAFELY

The pesticide applicator should be thoroughly trained in the uses and hazards of the materials they is using. The applicator is responsible for preventing adverse effects to the public, to pets and domestic animals, to property, to the environment, and to themselves and other applicators. In addition, the application must achieve effective results on the pest problem being treated.

Label Information

By definition, the label is the information printed on or attached to the pesticide container. Labeling includes the label and all other written, printed or graphic material accompanying the pesticide. It is a violation of federal law to use pesticides in a manner inconsistent with labeling.

The importance of reading the label cannot be over stressed. The information that appears on the label represents some of the most expensive literature available. The research and development that lead to the wording on a label frequently costs millions of dollars and takes many years to complete. The information on the label, therefore, is the best literature available on the safe and proper use of the chemical. The most important few minutes in pest control is the time spent reading the label.

Some information appears on the labels of insecticides used by pest control operators that is rather specific to the industry. This information is extremely important since the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) states it is illegal to use any pesticide in a manner inconsistent with its labeling. A specific example where this information is important to the pest control industry involves the use of pesticides in foodhandling establishments. You may only use those insecticide formulations which bear directions on their labels for use in food handling establishments. Typical labels have wording such as "Food Areas: limited to crack and crevice treatment only... application of this product in the food areas of food-handling establishments other than as a crack and crevice treatment is not permitted." Some important definitions of terms that appear in labeling with respect to use in food-handling areas are as follows:

Definitions of Terms Found on the Label

Tank mixing. Many labels will permit tank mixing with other pesticides, unless the other pesticide label prohibits the mixing. Some pesticides will explicitly prohibit mixing certain pesticides. The applicator must be aware of such label directions.

Treatment Sites. Many labels will list sites/areas that the pesticide can be applied. The applicator must be aware of these areas and the areas not listed. For example, if apartments or apartment buildings are not listed on the label, the product cannot be used in apartments.

Food-handling establishments. An area or place other than a private residence in which food is held, processed, prepared, and/or served. ("Held" includes displayed for sale as well as stored). Some places "other than a private residence" include: restaurants, lunchrooms, caterers, cafeterias, bars and taverns, private clubs, military messes,

officers and NCO clubs, food contractors in plants and office buildings, mobile caterers, airlines, ships, drug stores, confectionery stores, dairy products stores, bakery product stores, drive-in movies, school lunch rooms, colleges and universities, hospitals, homes for aged, orphans and handicapped, federal and state prisons and jails. Private residences are excluded; however, you should be alert for any possible changes in the future that might place private residences under this definition.

Non-food Areas. These include garbage rooms, lavatories, floor drains (to sewers), entries and vestibules, offices, locker rooms, machine rooms, boiler rooms, garages, mop closets and storage (after canning or bottling).

Food Areas. These include areas for receiving, serving, storage, packaging (canning, bottling, wrapping, boxing), preparing (cleaning, slicing, cooking, grinding), edible waste storage and enclosed processing systems (oils, dairies, edible oils, syrups).

Residual Insecticides. These include products applied to obtain insecticidal effects lasting several hours or longer and which are applied as general, spot or crack and crevice treatments. Residuals include insecticides that remain on the treated surface for days. These usually provide insecticidal effects lasting several hours or longer and are, therefore, considered residual by the EPA.

There are three types of residual applications recognized by the EPA: general, spot and crack and crevice. Each may be used in certain areas if specified on the label and are defined as follows:

General. This is application to broad expanses of surfaces such as walls, floors, and ceilings or as an outside treatment. This is permitted only in areas using only those insecticides so labeled.

Spot. This is application to limited areas on which insects are likely to occur and will not ordinarily be contacted by workers. These areas may occur on floors, walls and bases or undersides of equipment. For this purpose, a "spot" will not exceed two square feet. In order for spot treatments to be justified, there must be a surface on which insects are likely to occur. A "spot" may be round or long and narrow. This indicates that a considerable area could be treated but in practice the area must be limited to places where insects are present or are likely to occur.

Crack and Crevice. This is application of small amounts of insecticides into cracks and crevices in which insects hide or through which they may enter a building. Such openings commonly occur at expansion joints, between different elements of construction, and between equipment and floors. These openings may lead to voids such as hollow walls, equipment legs and bases, conduits, motor housing, junction or switch boxes. The crack and crevice treatment includes the use of sprays, dusts, or baits. It does not permit treatment of surfaces. In some cases, a pin-stream spray may be an acceptable application method but a better approach may be to make application with an insertion tube directly into cracks and crevices.

Directions for Use. The directions for use on a pesticide label include the site of application (crop, animal or surface) and the type of pests (insects, rodents, etc.) on which the product may be used. Methods of application and recommended dosage rates are also given. The label will normally give the concentration at which the pesticide is to be used. Dosage rates for pesticides used in general pest control are given as a certain percent concentration spray such as 1/2 percent or 1 percent spray. The labeled products used for pest control provide dilution information to aid you in accurately preparing the volume of spray you need at label recommended strength. It is illegal to increase the concentration of any pesticide over the maximum application rate shown on the labeling. Also it is a conflict of usage to change the method, time of application, or other conditions of use shown on the label (to reduce the concentration below labeled rates is also considered a conflict of usage unless prior written approval is given by the State Board of Agriculture). It is extremely important to note those areas listed on the label where the pesticide can be used. Specifically, pesticide labels will indicate either indoor or outdoor use.

- **Void treatment** is the application of insecticide into an empty space inside a wall or ceiling, behind a kickplate, inside a table leg, or in any other void. The application is usually done through an injector tip. Insecticide residues are out of the reach of people, and inside prime harborage sites for cockroaches, ants, and other pests.

- **Spot treatment** is the application of an insecticide residue to a limited area, not to exceed two-square feet. These areas may occur on floors, walls, and the undersides of equipment.
- **Baiting** is the placement of insecticide baits, which are enclosed inside bait stations or else applied into cracks, crevices, and voids.
 - Insect bait stations are available to control both cockroaches and ants. Their advantages are that the insecticide is enclosed inside a plastic or metal station, the bait remains effective for periods, and they are very easy to apply. Disadvantages are that they are often visible and may become harborage for pests if not removed after the bait has been consumed (or has deteriorated). Bait stations are typically placed inside cabinets, equipment, and other infested sites.
 - Pastes, gels, and other injectable baits may be packaged inside tubes or syringes that you squeeze to apply, or designed to be applied by various types of bait "guns" or with a small spatula or putty knife. To control German cockroaches, for example, you would place spots or beads of bait in or near dark, protected harborages or aggregation sites, concentrating on edges, corners, cracks and crevices.
- **Space treatment** is the application of a fine aerosol mist of insecticide. The term covers "fogging," "directed" space treatments, and sometimes "flushing" to chase pests from their hiding places. The mist of insecticide is applied with pressurized aerosols or "foggers." For space treatments, you will need to clear the room and surrounding areas beforehand and ventilate the room before allowing people and pets to return.

USING PESTICIDES SAFELY

Do not release pesticides into soil, air or water except where you intend to do as a safe and approved part of your work. Pesticides put in the wrong place, or on the wrong plant, or where the wrong animal can contact or consume them, are pollutants and are cause for concern.

Use special care in sensitive areas such as food handling establishments and where children, elderly people or ill people are located. Pets and their eating places must also be kept in mind. Pesticides used in or around such areas should be the safest ones available which are effective, and they should be applied so that contamination does not occur.

SOME GENERAL INSECT PESTS

Ants

Ants are social insects that live in colonies located in and around homes and other structures. Ants enter buildings seeking sweet or fatty substances in kitchens, pantries, store rooms or warehouses. They may also be pest in lawns or gardens.

Ants have "elbowed" antennae and the body regions are distinctly defined by narrow constrictions. All ants have chewing mouthparts. Ants range in size from less than $\frac{1}{16}$ inch long up to $\frac{1}{2}$ inch long. The stages in the life cycle of an ant are : egg, larva, pupa, and adult. During the year, ant colonies produce winged individuals. These are often mistaken for termites. Ants have three distinct castes: the queen, the male and the worker.

Carpenter ants are variable in size, measuring up to $\frac{1}{2}$ inch long. They range in color from red to black, and may be either winged or wingless. Carpenter ants build nests in hollow trees, logs, telephone poles, posts, porch pillars, and

other wood used in homes. A small pile of coarse sawdust beneath wood that has a higher than normal moisture content is a common sign of infestation. Carpenter ants do not eat wood but simply hollow it out to form nests. Still, they can weaken structures, and workers may be seen in homes foraging for food.

Most other ants build their nests in soil. Those that invade buildings usually nest near foundations, in the lawn, or under concrete slabs.

Control both carpenter ants and other indoor or outdoor nesting ants by direct treatment of the nest. Locate the openings of carpenter ants nests and blow insecticide dust into the nesting area. Control other ant species with sprays, dusts, baits, or granular formulations directed at nest entrance and surrounding area.

If you cannot locate the nest site, apply an insecticide where the ants gain entry or hide along foundations walls, at doorway, window sills, baseboards, behind built-in cabinets, under furniture, or behind the refrigerator and other heavy appliances.

Bees and Wasps

Bees and wasps are nuisances and may be dangerous to some people because of the female's ability to sting. Bees and wasps have body structures similar to ants. All have four wings, with the front wings longer than the hind wings. Wasps have chewing mouthparts while bees have distinctively striped yellow and black bodies. They may range in size from less than ½ inch to more than 1½ inches long. These insects all have similar life cycles including egg, larva, pupa, and adult stages.

Bees such as honey bee, bumblebee and carpenter bee are pests in and around buildings. Structural damage results from the nest-building activities of carpenter bees.

Honeybees may building nests in walls, chimneys and attics. Their combs may melt and allow honey to seep through walls. In addition, the combs may be infested by other insects. Bumblebees build their nests in the ground, in straw, or in buildings.

Carpenter bees drill ½ inch holes into exposed wood. The holes make a 90 degree turn below the surface and run with the grain of the wood for a distance of up to 12 inches.

Bumblebees and carpenter bees look very much alike. However, bumblebees have yellow hair on the top of the abdomen, while carpenter bees have a solid, shiny black abdomen.

Control bees by directing insecticides at the nest. It is wise to wear clothing to protect against stings when treating nests of honeybees and bumblebees.

Occasional Invaders

The term "occasional invaders" includes those pests which occur in buildings at some stage of their life cycle, but which do not usually complete their entire life cycle within the building.

The clover mite is an annoying household pest, especially in housing developments where turfgrasses are newly established and there is a heavy growth close to foundation walls. This tiny (smaller than a pinhead), reddish brown mite may occur in large numbers. It is frequently first noticed around windows but may later spread throughout the entire structure. This pest does not bite people and does no damage other than to leave a red stain when crushed. It feeds on grasses, clovers, and some other plants in lawns. The clover mite is most abundant in homes during fall and spring months, when it enters buildings in search of protection from unfavorable weather. Life stages of a clover mite are: egg (bright red and laid in foundation cracks and other protected places), larva, nymph and adult.

Clover mites are difficult to control. Methods that keep the mites from getting indoors give the best results. These

methods include: establishing a plant-free strip 18 to 24 inches wide along foundation walls and directing pesticide sprays at the strip and walls. If a plant-free strip cannot be established, spray the foundation walls and the adjacent 10-foot strip of grass with a residual insecticide.

Millipedes are gray or brown cylindrical worm-like arthropods, ½ to 1½ inches long. They have two pairs of short legs on each body segment. Millipedes curl up when disturbed. They are common on the forest floor, in compost piles, and heavily mulched areas.

The stages in the life cycle of a millipede are: egg, nymph and adult.

When millipedes leave their natural habitat, they crawl over lawns and sidewalks and may invade buildings in large numbers. They cause no damage. Prevent invasion by removing leaves and compost around buildings and by sealing cracks in foundation walls and around doors, basement windows, crawl spaces, and vents.

Spraying a 10-foot wide strip around the foundation is helpful in control. Repeat applications may be necessary during periods of heavy migration.

Silverfish and firebrats are wingless insects. The adults are about ½ inch long. They have three long “bristletails” at the ends of their bodies.

The stages in the life cycles of silverfish and firebrats are: egg, nymph and adult, which continues to molt throughout its life span.

These pests feed on stored foods, paper and almost anything containing proteins or carbohydrates. Directed sprays applied to cracks and crevices that serve as hiding and resting places are most frequently used for control ; dusts and baits may also be used.

Booklice (psocids) are very small (1/20 to 1/10 inch), light-colored insects that may be found indoors and out. Indoors they frequent damp places around stored goods and books and in crawl places. They feed on molds and fungi. They do no damage as are pests only by being present, often in tremendous numbers.

The stages in the life cycle of the book louse are: egg, nymph and adult. Booklice can be serious pests for manufacturers of food products and containers. Control booklice by removing moisture and food sources. Directed sprays and aerosols are effective in control.

Fabric Pests

Carpet beetles and clothes moths attack a variety of woolen products, furs, feathers, and hair. Infestations are common in boxes of old clothing, overstuffed furniture, woolen coats, and piano felt. The larval stages cause the damage. The presence of adults in an area may be the first sign of an infestation.

The stages in the life cycles of beetles and moths are: egg, larva, pupa and adult.

The black carpet beetle is the most widespread and damaging of the carpet beetles. Adults are shiny black and about 1/8 inch long. Larvae are up to ½ inch in length, yellow brown, carrot or cigar shaped, and have a long brush of tail bristle.

Other carpet beetles are oval, about 1/8 inch long, and brightly colored in various patterns of white, brown, yellow and orange. Larvae are about 1/4 inch long, light brown to black, fuzzy and slow-moving.

The webbing clothes moth adult is buff-colored with reddish hairs on the top of its head. The casemaking clothes moth is light brown and has three dark spots on each wing. The larvae of the webbing clothes moth usually spins feeding tunnels of silk as it moves over its food source. The casemaking clothes moth larva carries with it a small silken case that it spins around itself. To this case are attached the bits of fibers upon which the larvae is feeding. It attaches the case to walls or ceilings when it enters the pupal stage.

Prevention is a very important part of fabric pest control. This can be done by cleaning fabrics correctly and storing them in tight containers with moth crystals. Control infestation by treating all infested areas with directed sprays.

WOOD-DESTROYING PESTS

Termites

The stages in the life cycle of a termite are: egg, nymph and adult.

Termites are social insects having colonies in which there is a division of labor between different types of individuals. Nearly all species have reproductive and soldier castes, and many have a worker caste. If a worker caste is lacking, the nymphs handle the nest building and food gathering activities. The workers are responsible for damage done to wooden structures. Within the reproductive caste are the winged primary reproductives which emerge from the colony during the warmer months of the year to disperse and form new colonies.

Subterranean termites are so named because the colony is usually located below ground with the workers attacking wood above ground.

The white, softbodied workers eat the soft grain of wood, leaving a thin shell outside and the lignous portion in layers. Subterranean termites use bits of soil and excrement to build shelter tubes and to close up breaks in the surface of infested wood.

If 'swarmer' (reproductive) termites have not been seen, the presence of a colony can be determined by probing wood near the foundation or soil or by observing earthen "shelter tubes" on foundation walls or wood. These are the only termites commonly found in Kentucky.

Termites must have wood for food and usually need soil for moisture. Wood in contact with soil is ideal for termite development. Termites occasionally become established without soil contact when a leaky roof or pipe provides moisture. Infestations may become established under concrete slabs, garage floors, patios, and dirt filled porches. Termites may then enter the building through structural wood or foundation walls adjacent to the slab. In houses built partly or completely on slabs, termites enter through expansion joists, cracks, and utility openings.

Breaking the connection between wood and the soil is essential in termite control. This may be done with either a chemical or mechanical barrier.

Soil on both sides of exposed foundation walls and soil surrounding supporting piers should be drenched down to the footing with an approved residual insecticide. Apply the insecticide by trenching and back filling or a combination of trenching and rodding.

For outside basement walls (where the footing is deep) dig a V-shaped trench against the wall. It should be deep enough to insure penetration to the footing. After trenching, use a perforated hollow rod to inject insecticide to the footing of the basement wall. When treating concrete block or brick foundation walls, drill them above the grade line and flood all voids with insecticide.

To treat the slab-constructed buildings, saturate the soil beneath the slab. Inject insecticide either through holes drilled in the slab or by drilling and rodding horizontally under the slab. Either method must be done carefully since things as heat pipes and vapor barriers may be located under the slab. Soil treatment prior to pouring the slab is the best method of prevention.

Treat filled porches by: drilling the slab from the top; drilling the porch foundation horizontally at each end next to the building and injecting the chemical by rodding; or by making openings in the foundation wall, excavating the porch fill immediately under the slab, and drenching the soil with insecticide.

Powderpost Beetles

There are several kinds of powderpost beetles. The most common are Lyctid powder-post beetles and Anobiid powder-post beetles. The adults are small (about 1/3 inch long) and usually reddish-brown to nearly black.

The stages in the life cycle of powderpost beetles are: egg, larva, pupa and adult.

Small “shot hole” exit openings in wooden surfaces are a sign of infestation. Slight jarring of the wood causes a fine powder to sift from these holes. When the wood is cut or broken, the interior reveals galleries filled with a finely-packed powder which is produced by the feeding of grub-like larvae. Joists, subflooring hardwood flooring, sills, plates, and interior trim are the parts of buildings most frequently attacked. Furniture and other wood products also may be damaged.

To prevent infestation or to control existing infestation, wet all surfaces thoroughly with insecticide. Furniture and other movable objects may be fumigated in special chambers.

Longhorned beetles are large (1/2 to 3 inches long) and brightly colored. They have long, thin antennae which may be longer than the body. Eggs are usually laid on unseasoned, rough-sawed timbers or logs. The larvae, called round-headed borers, feed in the wood. They bore large, oval holes as they move through the wood.

The stages in the life cycle of the long-horned beetle are: egg, larva, pupa, and adult.

The only species that requires control in structures is the old-house borer. The adult is about 3/4 inch long, grayish-brown to black, and has two white patches on the wingcovers. Its galleries have distinctive ripples on the interior surface. The old-house borer usually damages only pine sapwood.

For control of Old House Borer, infested timbers must be drilled and pressure-treated to force the insecticide throughout the gallery system. Fumigation under a tarpaulin may sometimes be required.

Severe wood decay occurs only in wood with a moisture content greater than 20 percent. Most wood-rotting fungi grow only on wood which is subject to wetting by rain, roof leaks, plumbing leaks, condensation, or contact with moist soil. Two rare species, however, can conduct water directly to wood.

Fungi take their food from the wood as they grow and reduce the strength of wood, often making it brown and crumbly or white and stringy. Discoloration and powdery mold growth below the surface of wood should not be confused with decay although it indicates the surface of the wood has had greater than 20% moisture at one time. The moisture content of the wood may be measured with a moisture meter to accurately determine the need for control.

Fungicides will not stop wood decay once it has started, though they sometimes slow its progress. The key to complete control of wood decay is to eliminate the source of moisture. This may be done through proper drainage, breaking contact between wood and soil, proper ventilation, the use of vapor barriers, and waterproofing foundations. In some situations, pressure-treating lumber with preservative chemicals may prevent attack by wood-destroying fungi.

STORED PRODUCT PESTS

Most food products may be attacked by insects commonly referred to as ‘pantry pests’. They eat or contaminate the products and may make them unfit for human consumption. They often leave the infested products and move about inside structures.

To eliminate infestations, find and destroy infested materials and treat the area where they are stored. Infested materials can be treated with cold or heat or be fumigated. Thorough cleaning is essential to remove spilled food to prevent re-infestation. The stages in the life cycles of the stored products pests discussed below are: egg, larva, pupa and adult.

The confused and red flour beetles, the sawtoothed grain beetle, and the cigarette and drugstore beetles are small, reddish-brown insects usually less than 1/8 inch long. Their larvae are small and yellowish-white with brown heads. The adults often crawl over infested material and adjacent surfaces. Larvae and adults will be found in the infested material.

Cabinet beetle adults have various colored patches of scales on their backs and are 1/8 inch long. The larvae are fuzzy, light brown to black, and about 1/4 inch long. The larval stages do most of the damage. Adults feed mainly on flower pollen outdoors but may feed on stored food products.

The Indian meal moth is a small moth with a wingspread of about 1/2 inch. Its forewings have a "purplish" color on the outer two-thirds and are whitish gray near the body. The pinkish-white caterpillars cover the materials on which they feed with loose webbing. The adults fly about near the site of the infestation. The larvae may also leave their food and crawl over adjacent surfaces. This is the most common moth which attacks stored food products.

The Angoumois grain moth is a tiny moth similar in size and color to the clothes moth. The hind wing of the Angoumois grain moth has a finger-like projection, and this moth may be seen flying about in the daytime, whereas clothes moths avoid light. The larvae develop within whole kernels of grain.

The granary and rice weevils primarily attack stored whole grain. Adults are reddish-brown to black, about 1/8 inch long, and have pronounced snouts. Their larvae are small, white, legless grubs that feed and develop inside individual kernels of grain.

VERTEBRATES

Bats are night-flying mammals. They have leathery, membranous wings. They roost in attics, hollow walls, chimneys, caves, barns, hollow trees and other similar places. In addition to the general nuisance and odors associated with bat infestations, they also harbor ectoparasites that may attack man, and they are subject to rabies. Bats can best be controlled by closing all openings which they may enter structures to roost. After using repellents and carefully observing bats leaving roosting areas, you can locate and close entrance openings.

Skunks create nauseating odors, damage lawns, harbor ectoparasites, and are subject to rabies. They may enter buildings. Entrances should be closed when skunk is outside or it may be baited to a trap outside the building for removal to a remote site.

Squirrels of various species may enter buildings and be a nuisance or do damage to the structure. They may bite when cornered. They carry ectoparasites. Squirrels can be controlled by closing openings, by using repellents or by using live traps to remove them to remote areas. Where it is permitted, squirrels may be shot.

Moles burrow underground and rarely come above ground. Their burrows deface lawns and they may damage roots of ornamental plants as they search for earthworms and insects. Moles can be controlled by controlling the insects and earthworms they use for food. Traps specifically designed for mole control may be useful in some situations.

Snakes may find their way into and around buildings. Most of them are not poisonous but may frighten people and may bite when disturbed. Good rodent control, which reduces the snake food supply, and removal of hiding areas will usually force snakes out of an area. Keep snakes from getting inside structures by closing all points of entry.

WEEDS

Weeds around structures may need control because they create a fire hazard, they harbor insects or rodents, and they shorten the life of metal fences and buildings.

Non-selective vegetation control (bare ground) residual, broad-spectrum herbicides used to kill all plant growth and prevent new growth for a season or more. This method is used where reduction of fire hazard is important.

Short-term vegetation control-herbicides are used at rates that give a good knockdown of existing vegetation and retard the regrowth. Short-term vegetation control is used where bare ground is not necessary.

Selective weeding — control of certain plants without permanent injury.

Chemical trimming and pruning — use of contact herbicides to give narrow bands of controlled weeds around desirable plants or buildings. Often used to give mowing strip around trees or under guard rails

Mechanical or cultural control — use of hoes, blades, fertilization, landscaping, competitive planting, or other non-chemical methods to control unwanted vegetation.

Herbicides can be applied as re-emergence or post emergence treatments. A herbicide can affect plants by:

- killing the plant or plant parts that it contacts
- killing when the herbicide is absorbed by foliage and transported throughout the plant, or
- killing when roots absorb the herbicide dissolved in soil moisture and translocated throughout the plant (may last a season or more in the soil but requires rain, irrigation, or mechanical incorporation-discing-for activation in the soil).

Factors affecting herbicide performance:

Type of weed - All herbicides are selective to some extent and will fail to kill some types of plants. Some herbicides will work better on grasses and some will work better on broadleaf plants. Perennial weeds can often grow back from their extensive root systems and will require multiple treatments or special techniques and herbicides. Brush control may be particularly difficult but can be done in the following ways:

- Foliage absorbed - usually applied in the summer.
- Basal stem - applied to soil around stems or clumps in the late winter or early summer.
- Stump treatment - applications of herbicides to freshly cut stump.
- Dormant cane treatment - application of fuel oil during winter.
- Type of soil - sand or other soil low in clay and organic matter will not absorb the herbicide as much, so lower amounts will give equivalent results. Leaching will be more of a problem. Soils high in clay or o.m. will absorb some of the herbicide. More herbicide and more rainfall is usually necessary for effective control.
- Rainfall - too much rain soon after a contact herbicide is applied can nullify its effectiveness, but the same amount of rain might facilitate the action of a root-absorbed herbicide. Rainfall may also wash herbicides away from the target plants, injuring non-target plants and animals.
- Growth state of plant - foliage absorbed herbicides will usually work only when the plant is actively growing. Re-emergence herbicides must be applied before the weeds have emerged. Where selective herbicides are used, it is important that the non-target plants be healthy.
- Sunlight - some herbicides can be nullified if they remain on the soil surface too long before a rain washes them in.

Choose equipment for the type of herbicide treatment desired. The pump will usually have a high volume (10 g.p.m. or more) but low pressure (50-100 lbs psi). Nozzles will usually be selected to give uniform coverage with large droplets to minimize drift. Mechanical agitation in the tank is required if wettable powders will be used.