CHAPTER 3

APPLICATION METHODS AND EQUIPMENT

LEARNING OBJECTIVES

After completely studying this chapter, you should:

- Know the various pesticide application methods and the factors that influence your choice of the appropriate method.
- Know special application methods that are used for forestry and roadside right-of-way weed control and when and how they are applied.
- Know the various sprayer components, how they operate, and what the desirable features are.
- Know the various sprayer types, how they operate, and what the desirable features are.
- Understand proper operation and maintenance of sprayers, before, during, and after spraying.
- Know the various types of granular applicators and application methods, when they are applied, and what they consist of.

METHODS OF APPLICATION

The method you choose to apply a pesticide will depend on the nature and habits of the target pest, the site, the pesticide, available application equipment, and the cost and efficiency of alternative methods. Your choice is often predetermined by one or more of these factors. Some common application methods are described below.

Broadcast application is the uniform application of a pesticide to an entire area.

A **directed-spray application** targets pests in a specific area in an effort to minimize pesticide contact with the crop or beneficial insects.

Foliar application directs pesticide to the leafy portions of a plant.

Spot treatment is application of a pesticide to small, discrete areas.

Soil application places pesticide directly on or in the soil rather than on a growing plant.

Figure 3.1. Soil application of dry materials.

Soil incorporation is the use of tillage equipment to mix the pesticide with the soil.

Soil injection is application of a pesticide beneath the soil surface.

Special Application Methods

Some special application methods are used for forestry and roadside right-of-way weed control. They are described below.

With **foliage stem sprays,** the pesticide solution is sprayed on the leaves alone or leaves and stems. Foliage stem sprays can be applied from the time the leaves are fully expanded until they begin to turn color in the fall.

Some herbicides, however, should be applied only in late summer or early fall. Do not treat plants that are under moisture or heat stress. Take care to avoid drift to nearby sensitive vegetation.

Figure 3.2. Foliage stem sprays can be applied from the time the leaves are fully expanded until they begin to turn color in the fall (David Kidd, Univ. of Calif., Davis).

Basal sprays are directed at the lower 18 inches of stems and trunks that are less than 6 inches in diameter. Thoroughly wet the basal area until runoff at the ground line is noticeable. A few herbicides are applied in a single, narrow band or stream to the basal region of brush. Basal treatments are usually effective on canes and thickets as well as trees. Applications to control brush can be made anytime, including the winter months, except when snow or water prevents spraying to the ground line. Basal treatments can be more labor intensive than foliar sprays but are useful in selectively removing undesirable species from stands of desirable trees.

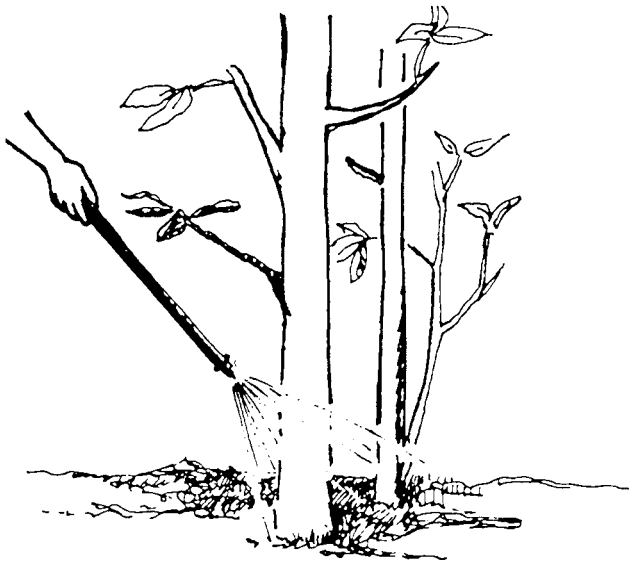

Figure 3.3. Basal sprays are directed at the lower 18 inches of stems and trunks that are less than 6 inches in diameter.

Cut-stump treatments for brush control are made to the freshly cut stump surfaces. Treat stump surfaces within 2 or 3 hours after cutting—drying of the cut surface reduces control. Generally, the cut stump, trunk, and exposed roots are treated with the herbicide solution. Cut-surface treatments are recommended when trees are 4 inches or more in diameter and are usually more effective than basal bark sprays on plants this size or larger.

Figure 3.4. Cut-stump treatments are recommended when trees are 4 inches or more in diameter and are usually more effective than basal bark sprays on plants this size or larger (David Kidd, Univ. of Calif., Davis).

Frill and hatchet injection methods cut the bark around the base of the trunk; herbicide is either applied as a separate step or injected simultaneously into the cut area. The cut-stump, frill, and injection methods are very effective treatments on nearly all brush and tree species. However, ***flashback*** can be a problem with some herbicides applied directly into the tree—the injected herbicide moves through root grafts to other untreated adjacent

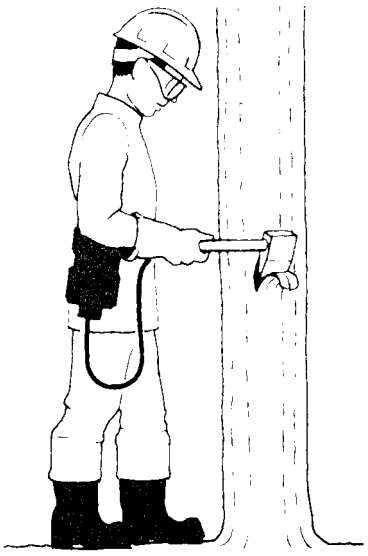

Figure 3.5. The hatchet injector allows the herbicide to be simultaneously injected into the cut area (David Kidd, Univ. of Calif., Davis).

trees and kills them. Read the pesticide label carefully before injecting or frilling trees. Treatment can be made at any time of the year. Deep snow may impede operations, however, and applications made during periods of heavy sap flow in the spring may not be effective. Thickets of brush or species with many stems cannot be easily controlled with these methods.

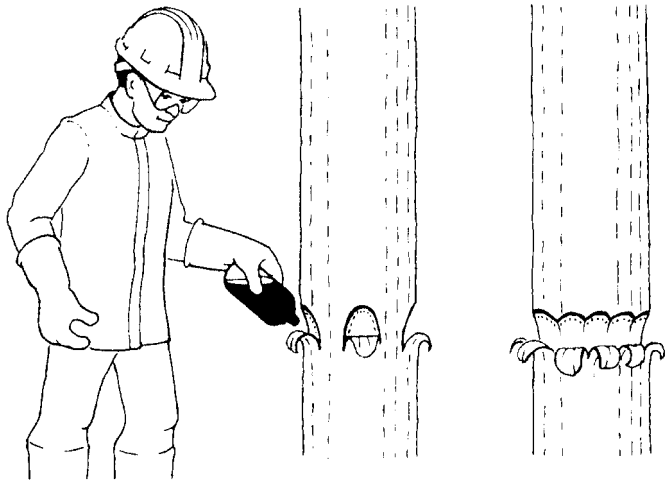

Figure 3.6. Frill cuts involve making downward angled ax or hatchet cuts in a continuous single line of overlapping cuts completely around the tree trunk. The chips are left in place to form a catch basin for the herbicide squirted into the wounds (David Kidd, Univ. of Calif., Davis).

The terms "foliage stem sprays," "basal spray," and "cut-stump treatment" are used above to define weed control application. However, the same terms may also be used for insecticide or fungicide application to Christmas trees. Always be aware of the intent and the type of pesticide being used before making an application.

COMPONENTS OF SPRAYERS

You must be thoroughly familiar with a sprayer's components to properly select, maintain, and operate the sprayer. The major components of a sprayer are the tank, pump, flow control, and nozzles. Other important components are strainers, pressure gauges, hoses, and fittings.

Tanks

Suitable materials for spray tanks include stainless steel, polyethylene plastic, and fiberglass. Some pesticides corrode aluminum, galvanized, and steel tanks. The cover should form a watertight seal when closed to minimize spills. All tanks should have a drain plug at their lowest point and shut-off valves so that any liquid in the tank can be held without leaking if the pump, strainers, or other parts of the system need to be serviced.

Tank capacity markings must be accurate so that you can add the correct amount of water. A clear plastic tube (sight gauge) is mounted on metal tanks.

Agitators

Agitation is required to combine the components of the spray mixture uniformly and, for some formulations, to keep the material in suspension. If agitation is inadequate, the application rate of the pesticide may vary as the tank is emptied. The two common types of agitation are hydraulic and mechanical.

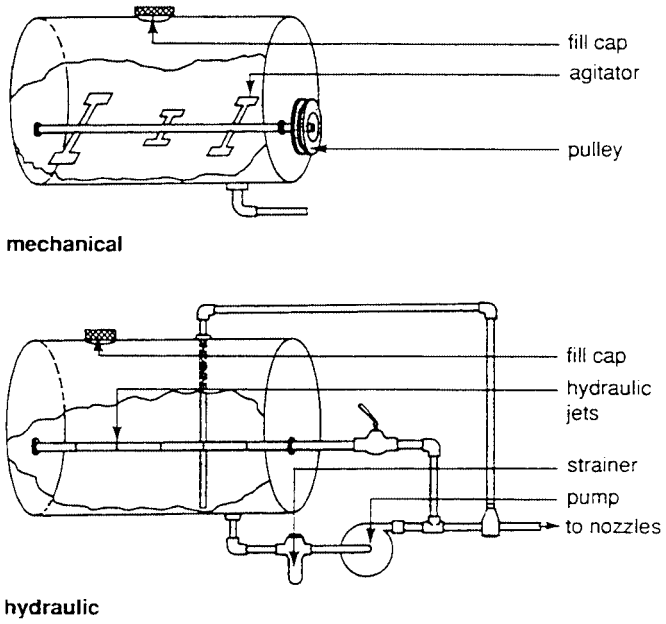

Figure 3.7. Two types of agitators in sprayer tanks (mechanical and hydraulic).

Hydraulic or jet agitation discharges the spray mixture at a high velocity into the tank. Liquid for agitation should come from the discharge side of the pump and not the bypass line of the pressure-regulating valve.

The quantity of flow required for agitation depends on the chemical used. Little agitation is needed for solutions and emulsions, but intense agitation is required for wettable powders. For jet agitators, a flow of 6 gallons per minute for each 100 gallons of tank capacity is adequate. The jet should be submerged to prevent foaming. Wettable powder suspensions can wear the inside of the tank if the jet stream passes through less than 12 inches of liquid before hitting the tank wall.

A **mechanical agitator** consists of a shaft with paddles and is located near the bottom of the tank. The shaft is driven by an electric motor or some other device powered by the tractor. This system is more costly than jet agitation. Mechanical agitators should operate at 100 to 200 rpm. Foaming will result at higher speeds.

Pumps

The heart of the spraying system is the pump. It must deliver the necessary flow to all nozzles at the desired pressure to ensure uniform distribution. Pump flow capacity should be 20 percent greater than the largest flow required by the nozzles and hydraulic agitation to compensate for pump wear.

When selecting a pump, consider resistance to corrosive damage from pesticides, ease of priming, and power source available. The materials in the pump housing and seals should be resistant to chemicals, including organic solvents.

Pesticide sprayers commonly use roller, piston, diaphragm, and centrifugal pumps. Each has unique characteristics that make it well adapted for particular situations. Choose a pump that best fits your pesticide application program.

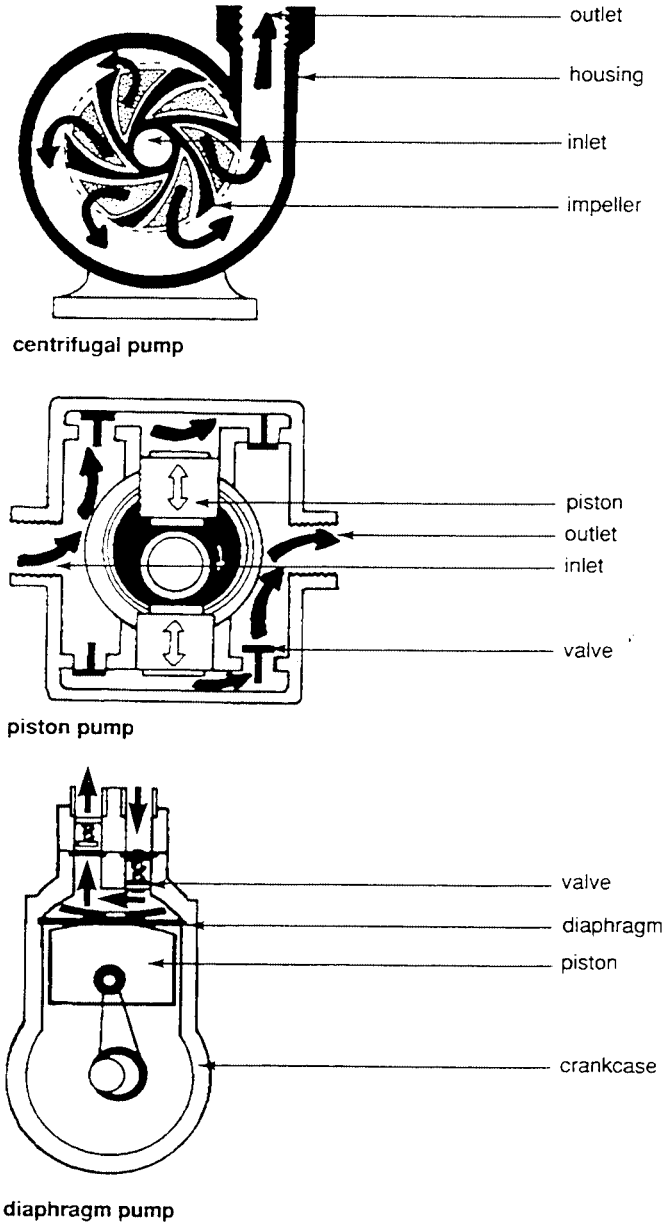

Figure 3.8. Three types of pumps.

Strainers

Proper filtering of the spray mixture not only protects the working parts of the spraying system but also avoids misapplication due to nozzle tip clogging. Three types of strainers commonly used on sprayers are tank filler strainers, line strainers, and nozzle strainers. As the mixture moves through the system, strainer openings should be progressively smaller. Strainer mesh is described by the number of openings per linear inch; a high number indicates small openings. Strainers need to be checked for clogs and rinsed frequently.

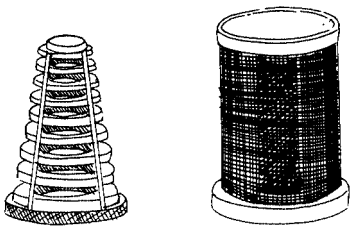

Figure 3.9. Strainers.

Hoses

Use synthetic rubber or plastic hoses that have a burst strength greater than peak operating pressures, resist oil and solvents present in pesticides, and are weather-resistant.

Sprayer lines must be properly sized for the system. The suction line, often the cause of pressure problems, must be airtight, non-collapsible, as short as possible, and have an inside diameter as large as the pump intake.

Pressure Regulators

A pressure regulator is one of the most important parts of a sprayer. It controls the pressure and therefore the quantity of spray material delivered by the nozzles. It protects pump seals, hoses, and other sprayer parts from damage due to excessive pressure, and it bypasses the excess spray material back to the tank.

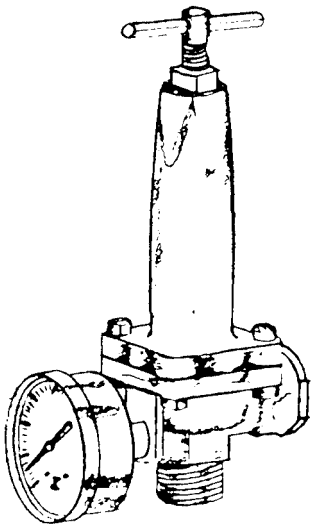

Figure 3.10. Pressure regulator.

There are two types of pressure regulators—simple relief valves and pressure unloaders. The relief valves are simple bypass valves that require the pump and engine to keep working just as though one were spraying. The unloaders maintain working pressure on the discharge

end of the system but move the overflow back into the tank at lower pressure, thus reducing strain on the engine and the pump.

Be certain that the flow capacity of the pressure regulator matches that of the pump being used.

Pressure Gauge

A pressure gauge must be a part of every sprayer system to correctly indicate the pressure at the nozzle. Pressure directly affects the application rate and spray distribution. Pressure gauges often wear out because they become clogged with solid particles of spray material. A glycerine-loaded diaphragm gauge is more expensive but will last indefinitely.

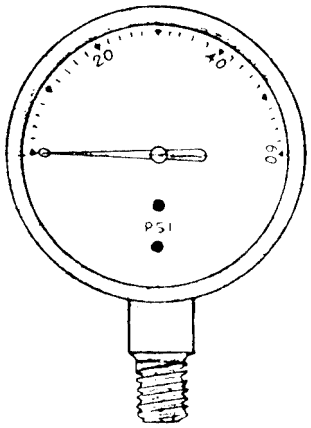

Figure 3.11. Pressure gauge.

Nozzles

Nozzles are important in controlling the volume of pesticide applied, the uniformity of application, the completeness of coverage, and the degree of drift. Many types of nozzles are available, each one designed for specific applications. Regular flat-fan, flood, and whirl chamber nozzles are preferred for weed control. For minimum drift, flood, whirl chamber, and raindrop nozzles are preferable because they produce large droplets.

SPRAYERS

The primary function of any sprayer is to deliver the proper rate of chemical uniformly over the target area. When selecting a sprayer, be certain that its components will withstand the deteriorating effects, if any, of the chemical formulations you use. Also consider durability, cost, and convenience in filling, operating, and cleaning.

Hydraulic Sprayers

Water is most often used as the means of carrying pesticide to the target area with hydraulic spraying equipment. The pesticide is mixed with enough water to obtain the desired application rate at a specific pressure and travel speed. The spray mixture flows through the spraying system under pressure and is released through a nozzle onto the target area.

Low-pressure Sprayers

Low-pressure sprayers are normally designed to deliver low to moderate volumes at low pressure—15 to 100 pounds of pressure per square inch (psi). The spray mixture is applied through a boom equipped with nozzles. The boom usually is mounted on a tractor, truck, or trailer, or the nozzle(s) can be attached to a hand-held boom.

Roller-type pumps are often used on small tank sprayers (50 to 200 gallons), but sprayers with large tanks (200 to 1,000 gallons) usually have centrifugal pumps. Low-pressure sprayers do not deliver sufficient volume to penetrate dense foliage because of low operating pressure. They are most useful in distributing dilute pesticide over large areas.

High-pressure Sprayers

High-pressure sprayers are designed to deliver large volumes at high pressure. They are similar to low-pressure sprayers except that they have piston pumps that deliver up to 50 gallons of spray per minute at pressures up to 800 psi. A boom or handgun delivers 200 to 600 gallons per acre.

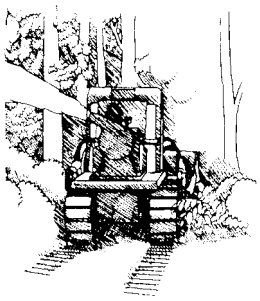

Figure 3.12. High-volume foliage spray.

High-pressure sprayers provide thorough coverage and can penetrate dense foliage; however, these sprayers produce large numbers of small spray droplets which can drift. These sprayers can provide low-pressure flow when the proper pressure regulators are used.

Backpack Sprayers

Backpack sprayers are useful in situations where small areas or widely dispersed individuals require treatment. They are well suited for treating individual brush plants and for basal and cut-surface applications. Tanks usually hold 3 to 5 gallons. The sprayers can be fitted with a single nozzle or with a boom with up to three nozzles. Some are filled to about three-quarters of the tank capacity with liquid and then air is pumped into the remaining space. Initial pressure is 30 to 60 psi, but it drops continuously as the spray is applied unless a special pressure regulator is used.

Other backpack sprayers have a lever that is pumped during the spraying operation to activate a plunger or diaphragm pump. They have a small air chamber to reduce the surging of the spray mixture as the lever is pumped. The boom can be equipped with a pressure gauge so that a nearly constant pressure can be maintained while spraying.

Figure 3.13. Backpack sprayer.

Miscellaneous Equipment

Tree injectors. Tree injectors offer a precise way of introducing a pesticide (most often a herbicide) into the trunks of well developed brush or trees. The number of cuts and the amount of chemical solution delivered in each blow will depend on the species, trunk diameter, and product being used. Cuts are made at a 60 degree angle with the ground around the circumference of the tree. The cuts must penetrate the bark and reach the sapwood or inconsistent control will result. Tree injectors are feasible in areas where fewer than 500 trees per acre need to be removed or treated.

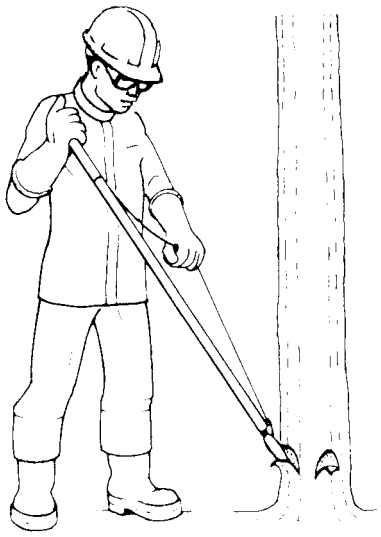

Figure 3.14. The tree injector offers a precise way of introducing pesticide into the trunks of well developed brush or trees.

Spot guns. Adjustable, industry-quality spot guns are recommended to apply several forestry herbicides to the soil at the base of undesired brush and small trees. Their capacity is adjustable from 2 to 20 milliliters per squeeze of the trigger. Frequently, undiluted pesticide is applied, so special care must be taken to assure operator safety.

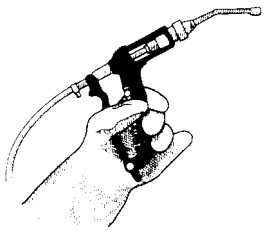

Figure 3.15. Low-volume spot gun.

OPERATION AND MAINTENANCE OF SPRAYERS

Proper operation and maintenance of spray equipment are essential for safe and effective pest control, will significantly reduce repair costs, and will prolong the life of the sprayer.

Before Spraying

At the beginning of each spraying season, fill the tank with water and pressurize the system to be sure all the parts are working and there are no drips or leaks. All nozzles should be of the same type, size, and fan angle. If using nozzle strainers, make sure the check valves are working properly. They function to prevent dripping when flow to the nozzle drops below a certain pressure. Measure the distance between the nozzle tip and the target and adjust the boom accordingly. Nozzle height is very important in broadcast application because it affects uniformity of the spray pattern.

Keep the tank level during filling so that the quantity in the tank is correctly indicated. The sprayer must now be calibrated. Calibration is described in the next chapter.

During Spraying

Frequently check the pressure gauge and tachometer while spraying, making sure that the sprayer is operating at the same pressure and speed used when it was calibrated. Speeds should be reasonable so that sprayer booms are not bouncing or swaying excessively. Periodically check hoses and fittings for leaks and nozzles for unusual patterns. If you must make emergency repairs or adjustments in the field, wear all protective clothing listed on the label as well as chemical-proof gloves.

After Spraying

Always flush the spray system with water after each use and apply this rinse water to sites for which the pesticide is labeled. Clean the inside and outside of the sprayer thoroughly before switching to another pesticide and before doing any maintenance or repair work. All parts exposed to a pesticide will normally have some residue, including sprayer pumps, tanks, hoses, and boom ends.

GRANULAR APPLICATORS

Granular applicators are designed primarily for soil applications and are available in various styles and sizes. Drop-through spreaders and rotary spreaders are the most common. Shaker cans and hand distribution of pellet or gridball formulations may also be used on occasion.

Figure 3.16. Granular spreaders are designed primarily for soil applications.

Granular applicators normally consist of a hopper for the pesticide, a mechanical-type agitator at the base of the hopper to provide efficient and continuous feeding, and some type of metering device, usually a slit-type gate, to regulate the flow of the granules.

Drop-through Spreaders

Drop-through spreaders are available in widths from 1½ to 3 feet or more. An adjustable sliding gate opens holes in the bottom of the hopper and the granules flow out by gravity feed. Normally, a revolving agitator is activated when the spreader is in motion to assure uniform dispensing.

Rotary Spreaders

Rotary spreaders distribute the granules to the front and sides of the spreader, usually by means of a spinning disc or fan. Heavy granules are thrown farther than lighter ones. A 6- to 8-foot swath width is common. Both power- and hand-driven rotary spreaders are available. The former are generally best suited for use in forests.

CHAPTER 3

Review Questions

Chapter 3: Application Methods and Equipment

Write the answers to the following questions and then check your answers with those in the back of the manual.

1. Which of the following methods of application mixes the pesticide into the soil using tillage equipment?
   A. Soil treatment
   B. Soil application
   C. Soil fumigation
   D. Soil incorporation

2. What are some of the factors that influence the choice of pesticide application method?

3. Flashback can occur with which of the following pesticide application methods?
   A. Directed spray
   B. Foliar application
   C. Hatchet injection
   D. Soil incorporation

4. What is one reason to use a directed-spray pesticide application?
   A. To minimize contact with beneficial insects.
   B. To get an evenly distributed application.
   C. To avoid flashback.
   D. All of the above.

5. Cut-stump pesticide treatments are most effective when applied:
   A. Within hours after cutting.
   B. Within days after cutting.
   C. Within weeks after cutting.
   D. Within months after cutting.

6. Pesticides can corrode certain materials from which spray tanks are made.
   A. True
   B. False

7. A spray tank should have:

   A. An opening for filling.

   B. A shut-off before the pump.

   C. A drain plug at the lowest point.

   D. All of the above.

8. To compensate for pump wear, pump flow capacity should _____ the largest flow required by the nozzles and hydraulic agitation.

   A. Be less than

   B. Be equal to

   C. Be greater than

   D. Not affect

9. All spray pumps are resistant to the corrosive effects of pesticides.

   A. True

   B. False

10. Which of the following formulations requires the most agitation?

    A. Wettable powders

    B. Solutions

    C. Emulsions

    D. Liquids

11. Hydraulic agitation is accomplished by a shaft with paddles in the spray tank.

    A. True

    B. False

12. With paddle agitation, foaming can result if the shaft motor is operated:

    A. Too slow.

    B. Too fast.

    C. Too long.

    D. Too little.

13. With hydraulic agitation, foaming can result if the jet is:

    A. Not operating.

    B. Above the liquid level in the tank.

    C. Below the liquid level in the tank.

    D. All of the above.

14. As liquid moves from the spray tank to the nozzle, the strainer mesh should:

    A. Remain the same.

    B. Become larger.

    C. Become smaller.

    D. Not matter.

15. Strainers within the spray system are cleaned automatically by the movement of the spray solution.

    A. True

    B. False

16. The burst strength of spray system hoses should be greater than the:

    A. Peak operating pressure.

    B. Volume of spray delivered.

    C. Length of the hose.

    D. Temperature during the application.

17. What does the pressure regulator do?

18. Relief valves and pressure unloaders are two types of:

    A. Pressure gauges.

    B. Nozzles.

    C. Pressure regulators.

    D. Hose fittings.

19. Nozzle types are specific to the types of applications.

    A. True

    B. False

20. Low-pressure sprayers and high-pressure sprayers are most efficient if they have the same type of pump.

    A. True

    B. False

21. Low-pressure sprayers are very useful for:

A. Penetrating dense foliage.
B. Delivering dilute pesticide over large areas.
C. Spot treatment.
D. All of the above.

22. High-pressure sprayers can:

A. Provide high volume at high pressure.
B. Penetrate dense foliage.
C. Increase spray drift.
D. All of the above.

23. It is hardest to maintain uniform pressure when using a:

A. Backpack sprayer.
B. High-pressure sprayer.
C. Low-pressure sprayer.
D. Hydraulic sprayer.

24. Tree injectors are most often used with:

A. Insecticides.
B. Fungicides.
C. Herbicides.
D. Rodenticides.

25. Tree injectors treat several trees at the same time.

A. True
B. False

26. Spotguns are used to spray herbicide on the soil at the base of undesirable brush .

A. True
B. False

27. What are the first two tasks when readying sprayers for the new season?

28. If a sprayer breaks down, it is not necessary to wear personal protective equipment while doing repairs.

A. True
B. False

29. After the inside of the spray tank has been rinsed with water, the water should be:

A. Sprayed on any site as long as it has plant material growing on it.
B. Sprayed on any bare soil.
C. Sprayed on a site that appears on the pesticide label.
D. Stored.

30. Granular applicators are designed primarily for:

A. Foliar application.
B. Soil application.
C. Spot application.
D. Basal application.