

CHAPTER 3

APPLICATION 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 vegetable crop 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. 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.

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.

TYPES OF SPRAYERS

When selecting a sprayer, be certain that it will deliver the proper rate of pesticide uniformly over the target area. Most pesticide applications in vegetable crops are done with a hydraulic sprayer at either high or low pressures.



Hydraulic Sprayers

Water is most often used with hydraulic spraying equipment as the means of carrying pesticide to the target area. 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 one or more nozzles onto the target area.

Low-pressure Sprayers

Low-pressure sprayers normally 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.

Low-pressure sprayers do not deliver sufficient volume to penetrate dense foliage. They are most useful in distributing dilute pesticide over large areas.

High-pressure Sprayers

High-pressure sprayers deliver large volumes at high pressure. They are similar to low-pressure sprayers but deliver up to 50 gallons of spray per minute at pressures up to 800 psi. A boom delivers 200 to 600 gallons per acre.

High-pressure sprayers provide thorough coverage and can penetrate dense foliage, but they can produce large numbers of small spray droplets that can drift. These sprayers can provide low-pressure flow when fitted with proper pressure regulators.

PARTS OF A SPRAYER

To properly select, maintain, and operate your sprayer, you need to know its parts. The major components of a sprayer are tank, pump, agitator, flow control, and nozzles.



Sprayer tank, wand, pump and gauge.

Tanks

Suitable materials for spray tanks include stainless steel, polyethylene plastic, and fiberglass. Spray tanks made of aluminum, galvanized steel, and stainless steel are easily corroded by some pesticides and liquid fertilizers. The tank 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 pesticide 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.

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.

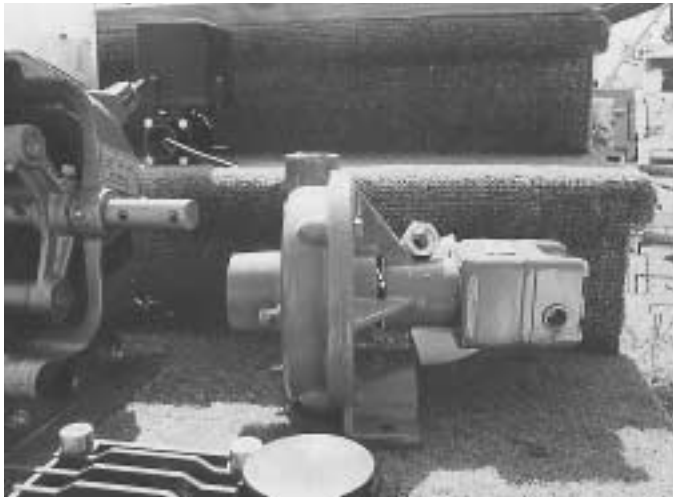
A mechanical agitator consists of a shaft with paddles and is located near the bottom of the tank. The shaft is driven by an electric motor or some other device powered by the tractor. This system is more costly than jet agitation. Mechanical agitators should operate at 100 to 200 rpm. Foaming will result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

Pumps

The pump 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.

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

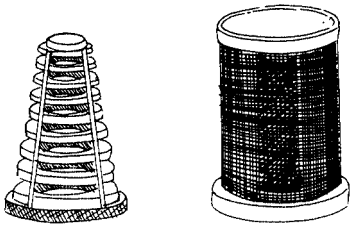
Pesticide sprayers commonly use roller, piston, diaphragm, and centrifugal pumps. Each has unique characteristics that make it well adapted for particular situations. Choose a pump that best fits your pesticide application program.



Centrifugal pump.

Strainers

Proper filtering of the spray mixture not only protects the working parts of the spray system but also avoids mis-application 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 size is determined by the number of openings per linear inch; a high strainer size number indicates smaller openings. Strainers need to be checked for clogs and rinsed frequently.



Strainers.

Hoses

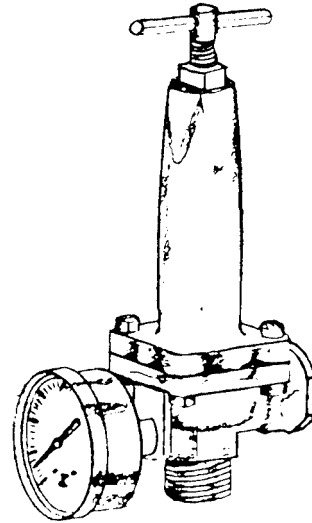
Use synthetic rubber or plastic hoses that have a burst strength greater than peak operating pressures, resist oil and solvents present in pesticides, and are weather resistant.

Sprayer lines must be properly sized for the system. The suction line, often the cause of pressure problems, must be airtight, non-collapsible, and 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 excess spray material back to the tank.

There are two types of pressure regulators – simple relief valves and pressure unloaders. Relief valves are simple bypass valves that require the pump and engine to keep working just as though you were spraying. Pressure 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.

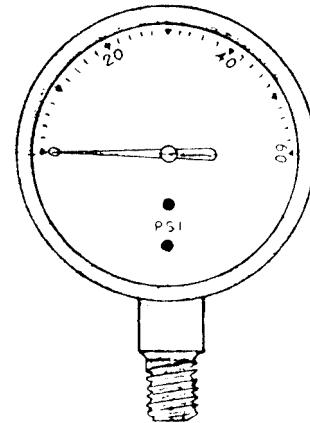


Pressure regulator.

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

Pressure Gauge

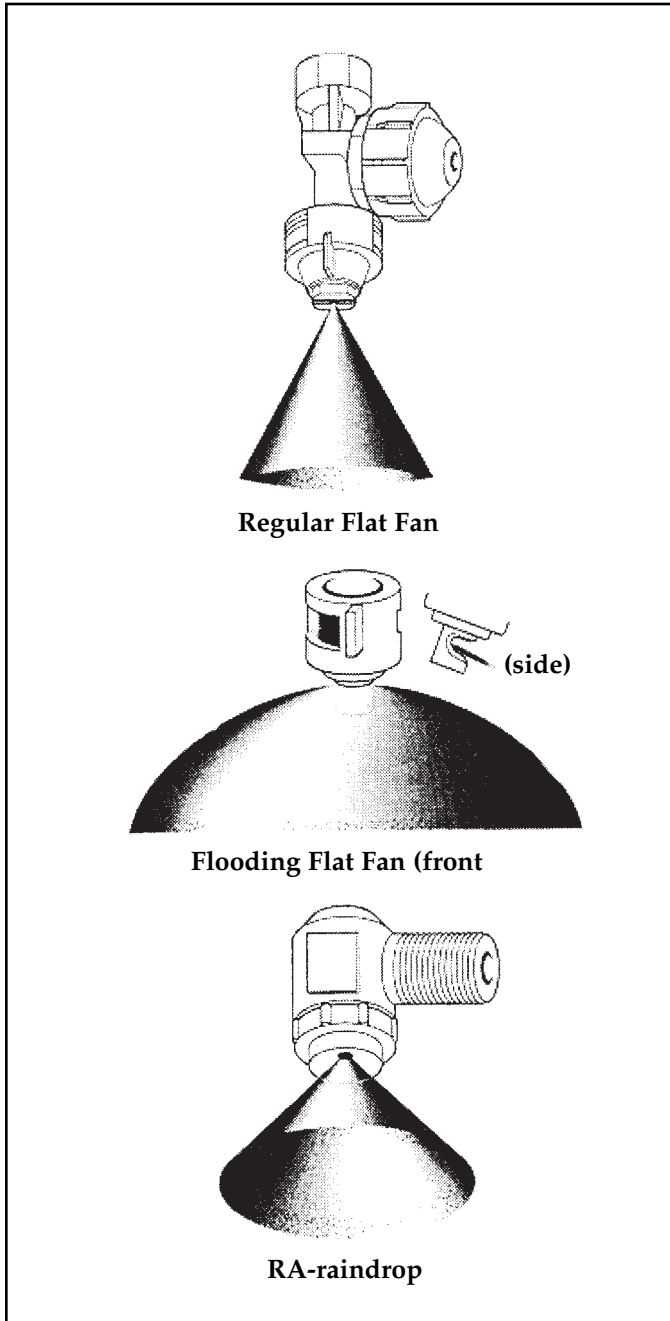
A pressure gauge is essential to every sprayer system to correctly indicate the pressure at the nozzle. Pressure directly affects the application rate and spray distribution. Pressure gauges often wear out because they become clogged with solid particles of spray material. A glycerine-loaded diaphragm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



Pressure gauge.

Nozzles

Nozzles are important to control 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 a specific type of application. Regular flat-fan, flood, and whirl chamber nozzles are preferred for weed control. For minimum drift, flood and raindrop nozzles are preferred because they produce large droplets.



Types of nozzles.

Regular Flat-fan Nozzle

Regular flat-fan nozzles are designed for broadcast applications and are sometimes used on high-clearance and pickup sprayers. They are typically used for foliar

applications and require a 30 to 50 percent pattern overlap to obtain uniform coverage. Flat-fan nozzles are recommended for herbicides and insecticides where foliage penetration and complete coverage are not necessary.

Regular flat-fan nozzles produce a narrow oval pattern and medium droplets at pressures of 15 to 20 psi; drift potential increases at pressures above 30 psi.

Flooding Flat-fan Nozzle

Flooding flat-fans are the most commonly used nozzles. They produce a wide-angle pattern that varies with pressure. At high pressure, the pattern is heavier in the center and tapers off toward the edges; at low pressures, they produce a uniform pattern.

Pressure also affects droplet size. Flooding flat-fan nozzles produce large spray droplets at low pressure and small droplets at high pressure. To control drift, flooding nozzles should be operated at between 8 and 25 psi.

Hollow-cone whirl chamber nozzle

The hollow-cone nozzle is used primarily to penetrate foliage for effective pest control when drift is not a concern. These nozzles produce small droplets at pressures of 40 to 80 psi that penetrate plant canopies and cover the undersides of leaves more effectively than spray from other nozzles.

Whirl chamber nozzles have two pieces. The first part is the whirl chamber, which squirts the material as it moves through the second piece, a disk. This results in a circular hollow-cone spray pattern.

Raindrop Nozzle

Raindrop nozzles are designed to reduce drift. This nozzle produces large droplets in a hollow-cone pattern when operated between 20 and 50 psi. The large droplets aid in drift control but may result in poor coverage by some foliar pesticides.

Nozzles are available in a variety of materials. Brass nozzles are inexpensive but wear rapidly. Stainless steel, nylon, and other plastic nozzles are wear resistant when used with corrosive or abrasive materials. Nozzles made of hardened stainless steel are the most wear resistant and expensive.

OPERATION AND MAINTENANCE OF SPRAYERS

Proper operation and maintenance of spray equipment will lead to safe and effective pest control, significantly reduce repair costs, and 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. Functioning check valves prevent dripping when flow to the nozzle drops below a specific pressure. Measure the distance between the nozzle tip and the target, and adjust the boom accordingly. In broadcast applications, nozzle height affects the uniformity of the spray pattern.

Fill the tank with water that does not have silt or sand in it. Keep the tank level when filling, to make sure the quantity in the tank is correctly indicated.

Calibrate the sprayer before using. (Calibration is discussed in Chapter 4 of this manual.)

During Spraying

Frequently check the pressure gauge to make sure the sprayer is operating at the same pressure and speed used during calibration. Operate the sprayer at speeds appropriate for the conditions. Bouncing and swaying booms can cause application rates to vary. Periodically check hoses and fittings for leaks, and check nozzles for unusual patterns. If you must make emergency repairs or adjustments in the field, wear the protective clothing listed on the pesticide label as well as chemical-proof gloves.

After Spraying

Always flush the spray system with water after each use. 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 APPLICATIONS

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 types of 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 many widths. 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 disk 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.

FIELD OPERATIONS

Pest control with pesticides relies on uniform application of the correct amount of product at the most efficient time. Clogged or worn nozzles, overlapping, and deviations in swath width can double applications or create skips in the treated area.

Dripping nozzles can cause crop damage during turns or when the sprayer is stopped for any reason. Use a positive shutoff, such as a high-capacity diaphragm check valve, to avoid dripping nozzles. Hydraulic and air-activated shutoff systems are more reliable but much more expensive.

GLOBAL POSITIONING SYSTEM (GPS) AND GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Global positioning system (GPS) and geographical information system (GIS) technology has helped increase the accuracy of pesticide applications. This technology combines a tracking and guidance system with precise field mapping. Global positioning systems are based on the triangulation of worldwide satellite signals to determine exact field location. Geographic information systems are computer systems that interpret, manipulate, and display GPS information about a specific location. For example, a grower using a global positioning system can record the exact location of weedbeds in a field. A geographic information system can interpret this information and produce a map of the weed bed locations. This map can be used to apply pesticides directly to the weed beds the following year.

Geographic information systems can also be linked directly to application equipment and used to turn spray nozzles on and off. This results in pesticide applications only where necessary. Global positioning and geographical information systems are most frequently used with herbicide and fungicide applications.

**CHAPTER
3**

Review Questions

Chapter 3: Application Equipment

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

- Which of the following methods of application mixes the pesticide into the soil?
 - Soil treatment
 - Soil application
 - Soil fumigation
 - Soil incorporation
- What are some of the factors that influence the choice of pesticide application method?
- What is one reason to use a directed-spray pesticide application?
 - To minimize contact with beneficial insects.
 - To get an evenly distributed application.
 - To avoid flashback.
 - All of the above.
- Pesticides can corrode certain materials from which spray tanks are made.
 - True
 - False
- A spray tank should have:
 - An opening for filling.
 - A shutoff before the pump.
 - A drain plug at the lowest point.
 - All of the above.
- To compensate for pump wear, pump flow capacity should _____ the largest flow required by the nozzles and hydraulic agitation.
 - Be less than
 - Be equal to
 - Be greater than
 - Not affect
- All spray pumps are resistant to the corrosive effects of pesticides.
 - True
 - False
- Which of the following formulations requires the most agitation?
 - Wettable powders
 - Solutions
 - Emulsions
 - Liquids
- Hydraulic agitation is accomplished by a shaft with paddles in the spray tank.
 - True
 - False
- With paddle agitation, foaming can result if the shaft motor is operated:
 - Too slow.
 - Too fast.
 - Too long.
 - Too little.

11. With hydraulic agitation, foaming can result if the jet is:
- Not operating.
 - Above the liquid level in the tank.
 - Below the liquid level in the tank.
 - All of the above.
12. As liquid moves from the spray tank to the nozzle, the strainer mesh should:
- Remain the same.
 - Become larger.
 - Become smaller.
 - Not matter.
13. Strainers within the spray system are cleaned automatically by the movement of the spray solution.
- True
 - False
14. The burst strength of spray system hoses should be greater than the:
- Peak operating pressure.
 - Volume of spray delivered.
 - Length of the hose.
 - Temperature during the application.
15. What does the pressure regulator do?
16. Relief valves and pressure unloaders are two types of:
- Pressure gauges.
 - Nozzles.
 - Pressure regulators.
 - Hose fittings.
17. Nozzle types are specific to the types of applications.
- True
 - False
18. Low-pressure sprayers and high-pressure sprayers are most efficient if they have the same type of pump.
- True
 - False
19. Low-pressure sprayers are very useful for:
- Penetrating dense foliage.
 - Delivering dilute pesticide over large areas.
 - Spot treatment.
 - All of the above.
20. High-pressure sprayers can:
- Provide high volume at high pressure.
 - Penetrate dense foliage.
 - Increase spray drift.
 - All of the above.
21. What are the first two tasks when readying sprayers for the new season?
22. If a sprayer breaks down, it is **not** necessary to wear personal protective equipment while doing repairs.
- True
 - False
23. After the inside of the spray tank has been rinsed with water, the water should be:
- Sprayed on any site as long as it has plant material growing on it.
 - Sprayed on any bare soil.
 - Sprayed on a site that appears on the pesticide label.
 - Stored.

24. Granular applicators are designed primarily for:
- A. Foliar application.
 - B. Soil application.
 - C. Spot application.
 - D. Basal application.
25. How can global positioning systems and geographical information systems aid a pesticide applicator?