CHAPTER 3

APPLICATION EQUIPMENT

LEARNING OBJECTIVES

After completely studying this chapter, you should:

- Know the various sprayer types and components, how they operate and what the desirable features are.
- Know special application methods that are used for fruit crop weed control and when and how they are used.
- Understand proper operation and maintenance of sprayers before, during and after spraying.

TYPES OF SPRAYERS

Spraying in fruit crop production is usually to the foliage or the ground. Foliar applications are used for disease, insect or mite control, nutrition, growth regulation and chemical thinning; ground applications are for nematode and weed control. When selecting a sprayer, be certain that it is appropriately matched to the chosen objective and will deliver the proper rate of pesticide uniformly over the target area. Most sprayers used in Michigan for pesticide applications in fruit crops use water or air as the carrier.

FOLIAR APPLICATIONS

Air-blast and Air-assisted Sprayers

Sprayers used for foliage application in tree fruit commonly use water as a diluent and air as the carrier for the chemical. **Air-blast sprayers** contain a fan that can produce a high volume of airflow. Nozzles operating under low pressure deliver spray droplets directly into the high-speed airstream. The air blast shatters the drops of pesticide into fine droplets and transports them to the target. The air blast is generally directed to one or both sides as the sprayer moves forward. Make sure to match the sprayer capability to the tree size. For example, applications to large trees will require a sprayer with large air-volume capacities. Air-blast sprayers provide good penetration and coverage, but the fine spray is very susceptible to drift and may be difficult to confine to target areas. To reduce drift, applications should be made when there is little to no wind.

Airblast sprayer

Tower sprayers are also used to spray orchard trees. These sprayers are constructed to deliver air and spray material close to the top of the tree. This practice gives better spray deposition and coverage than traditional air-blast sprayers, which attempt to blow the spray up into the treetops from the ground.

Low-volume spraying

Reducing the amount of water applied per acre results in low-volume spraying. For example, a low-volume application would be a reduction from 350 gallons of water per acre to 20 to 100 gallons of water. Manufacturers recommend the optimal range of water per acre for the best results from their equipment. Keep in mind

that tree size, number of trees per acre and nozzles also influence how many gallons of water are needed to provide adequate coverage.

Advantages of low-volume spraying include:

- Reduced runoff.
- Reduced use of pesticide and water.

Disadvantages of low-volume spraying include:

- The importance of maintaining a constant ground speed.
- The need to take extra care when calibrating equipment.
- More noticeable application errors because of the decrease in total gallonage applied.

GROUND APPLICATIONS

In fruit crop production, ground applications are typically used to apply herbicides to control weeds. Herbicides may be applied using hydraulic sprayers, which use water and pressure to carry the chemical to the target. 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 that normally deliver low to moderate volumes at 15 to 100 pounds of pressure per square inch (psi) are typically used for herbicide applications. The spray mixture is applied through a boom equipped with nozzles. The boom usually is mounted on a tractor, truck or trailer; the nozzle(s) can also be attached to a hand-held boom.

Granular applications

Some herbicides used in fruit crop production may be applied with a granular applicator. 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. Granular applicators normally consist of a hopper for the pesticide, a mechanical 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 have an adjustable sliding gate that opens holes in the bottom of the hopper — 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 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. Both power- and hand-driven rotary spreaders are available. With any granular application, uniform distribution of the granules is important, and applications should only be made only when there is little or no wind.

PARTS OF A SPRAYER

To properly select, maintain and operate your sprayer, you need to be familiar with its components. The major parts 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 and galvanized steel are easily corroded by some pesticides and liquid fertilizers. To minimize spills, the tank cover should form a watertight seal when closed. 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 (jet) 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. Agitation using a hydraulic jet is commonly called jet agitation. 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.

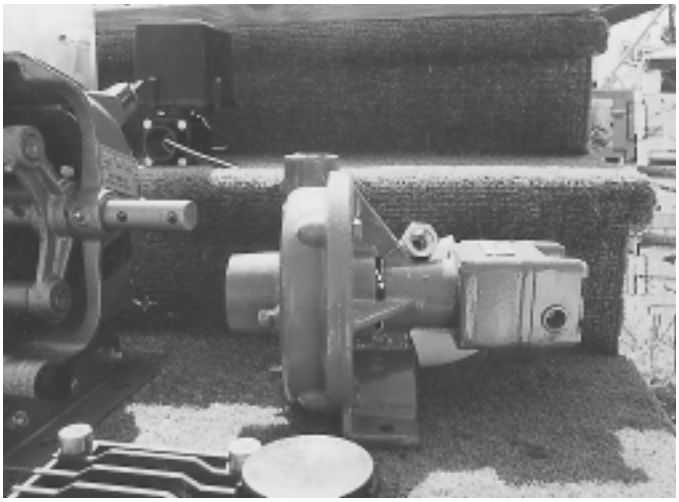
A mechanical agitator consists of a shaft with paddles and is located near the bottom of the tank. The shaft is driven by an electric motor or some other device powered by the tractor. This system is more costly than jet agitation. Mechanical agitators should operate at 100 to 200 rpm. Foaming will result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

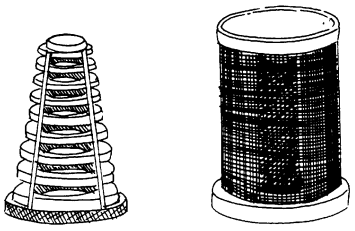
Pesticide sprayers commonly use roller, piston, diaphragm or centrifugal pumps. Each has unique characteristics that make it well adapted for particular situations. Choose a pump that best fits your pesticide application program.



Centrifugal pump.

Strainers

Proper filtering of the spray mixture not only protects the working parts of the spray system but also avoids 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 become 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.

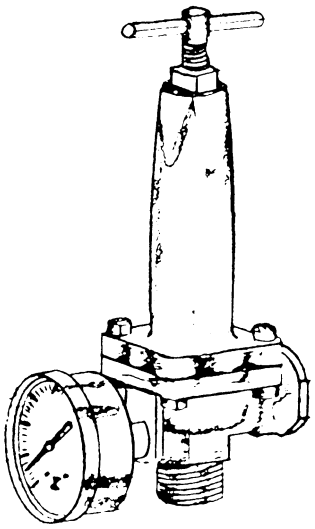
Hoses

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.



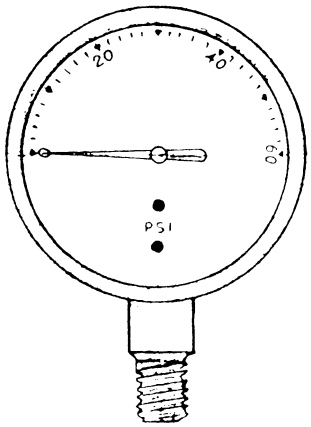
Pressure regulator.

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.

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

Pressure Gauges

A pressure gauge is essential to every sprayer system to indicate correctly 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 than other types but will last indefinitely.



Pressure gauge.

Nozzles

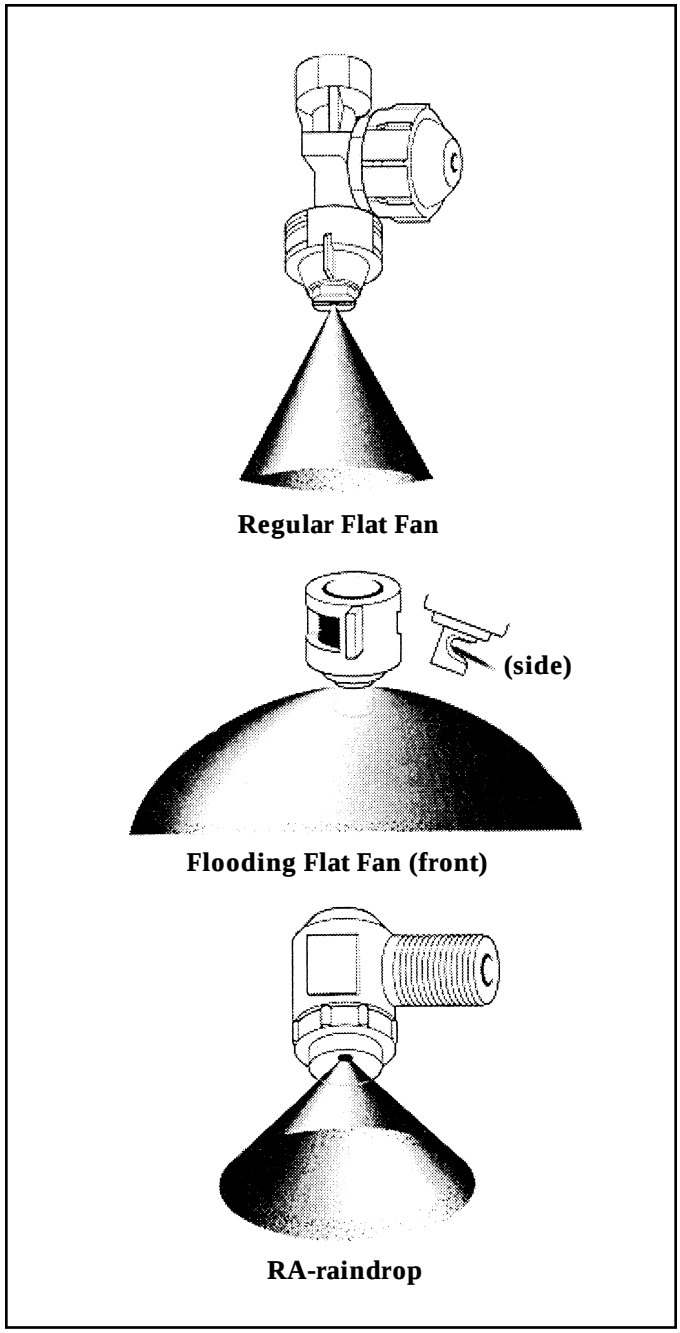
Nozzles control the volume of pesticide applied, the uniformity of application, the completeness of coverage and the degree of drift. Many types of nozzles are available, each one designed for a specific type of application. Regular flat-fan, flood and whirl chamber nozzles are preferred for weed control.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

Regular Flat-fan Nozzle

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. They are typically used for broadcast herbicide and insecticide spraying. The pattern is designed to be used on a boom and to be overlapped 30 to 50 percent to obtain uniform coverage. Spacing on the boom, spray angle and boom height determine proper overlap and should be carefully controlled.

Even Flat-fan Nozzle

The even flat-fan nozzle makes a narrow oval pattern. Spray delivery is uniform across its width. These nozzles are similar to regular flat-fan and are primarily used for band spraying over the crop row. Boom heights and nozzle spray angle determine the width of the band sprayed.



Types of nozzles.

Flooding Flat-fan Nozzle

The flooding flat-fan nozzle produces a wide-angle flat spray pattern. It operates at very low pressure and produces large spray droplets. Its pattern is not as even as the regular flat-fan nozzle pattern. If used for broadcast spraying, it should be overlapped 100 percent to provide double coverage. It is often used for applying liquid fertilizers or fertilizer-pesticide mixtures or for directing herbicide sprays under plant canopies. 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

- Read manufacturer material before purchasing a sprayer to make sure that the sprayer will fit your needs. For example, when using PTO-powered units, make sure that your tractor has enough total horsepower to operate the sprayer at the rated PTO speed.
- 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.
- Select nozzles that will provide adequate coverage for your tree size, shape and row spacing.
- Make sure all nozzles are the same type, size and fan angle.
- Measure the distance between the nozzle tip and the target, and adjust the sprayer accordingly.
- 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.

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.
- 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.

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 is an advantage of low-volume spraying?

   A. Increased runoff.

   B. Decreased runoff.

   C. Increased amount of pesticide used.

   D. Decreased amount of time spent calibrating sprayer.

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

3. The spray produced from air-blast sprayers is very susceptible to drift.

   A. True.

   B. False.

4. Pesticides can corrode certain materials from which spray tanks are made.

   A. True.

   B. False.

5. A spray tank should have:

   A. An opening for filling.

   B. A shutoff before the pump.

   C. A drain plug at the lowest point.

   D. All of the above.

6. 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

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

   A. True.

   B. False.

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

   A. Wettable powders.

   B. Solutions.

   C. Emulsions.

   D. Liquids.

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

   A. True.

   B. False.

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

    A. Too slow.

    B. Too fast.

    C. Too long.

    D. Too little.

11. 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.

12. 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.

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

    A. True.

    B. False.

14. 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.

15. What does the pressure regulator do?

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

    A. Pressure gauges.

    B. Nozzles.

    C. Pressure regulators.

    D. Hose fittings.

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

    A. True.

    B. False.

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

    A. True.

    B. False.

19. 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.

20. In fruit crop production, granular applicators are usually used for:

    A. Foliar applications.

    B. Ground applications.

    C. Nutrient applications.

    D. Desiccant applications.