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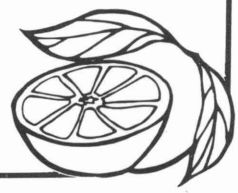
Texas Agricultural Extension Service

Texas Citrus Orchard Spraying

Thomas D. Valco and Henry O'Neal*



Air carrier sprayers are used in citrus orchards to discharge a high velocity of air for propelling and distributing pesticides throughout the trees. These sprayers, sometimes called air-blast sprayers or mist blowers, produce air speeds ranging from 80 to 150 miles per hour (mph) and air volumes of 5,000 to 60,000 cubic feet per minute (cfm). The air stream breaks up liquid into droplets by air-shear or centrifugal energy and distributes droplets to all leaf, bark and fruit surfaces for effective pest control. Good pesticide distribution requires low ground speeds with small droplets or large volumes of pesticide.

The required volume of spray material per acre will vary with the sprayer type used and the target pest. Effective pest control has been obtained with from 5 gallons per acre to 500 gallons per acre. A low-volume application in small droplet size readily adheres to tree parts with virtually no drip or runoff. This generally occurs with high volume sprays. By decreasing application rate, application costs may be lowered through improved sprayer field capacity, achieved by reducing filling and mixing time. **Pesticide label rates should still be used with low-volume application rates.**

Selecting a Sprayer

Different air carrier sprayers operate on different principles to form spray droplets and propel them into the trees. The volume of solution applied per acre dictates the type of sprayer needed. Spray coverage is a result of the air horsepower, a relationship between air velocity, capacity, outlet area and fan pressure—not just air velocity or capacity alone.

A sprayer is a combination of many design features, and it cannot be stated that one machine is better than another because one feature is different. The proof of the sprayer's overall worth comes from how well it controls pests in a crop and not from a higher outlet velocity, a bigger capacity, a mechanical agitator or some other single factor. The most expensive sprayer a grower can buy is one that is not designed for the job.

Some of the low-volume sprayers on the market are much less expensive than most medium- to high-volume machines. Some growers who cannot justify the expenditure necessary for a larger machine may find low-volume sprayers to be the most satisfactory machine.

Nozzles and Nozzle Arrangement

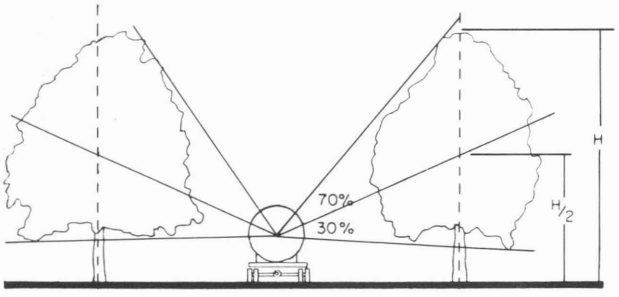
The orifice size of the nozzle and nozzle operating pressure determine the rate of discharge for any given nozzle type. To determine operating pressure at the nozzle, place a pressure gage in the discharge manifold or replace a nozzle with a pressure gauge. Check the pressure on both sides of the sprayer and set it to conform with the manufacturer's specifications. As the nozzle orifice wears, the spray rate increases. This causes most growers to apply more spray then intended. Once a nozzle output exceeds 10 percent of its designed rate, it should be replaced.

To determine nozzle arrangement on the sprayer, determine the gallons-per-minute discharge for each nozzle. This rate may be found in the nozzle manufacturer's catalog. Arrange the nozzles to apply 70 percent of the spray to the top half of the tree and 30 percent to the bottom half (Figure 1). Use larger nozzle sizes rather than more nozzles to obtain the additional output in the upper zone. Larger nozzles produce larger droplets, which are desirable for tree tops.

Spray distribution in the orchard should then be checked with water and dye. The addition of

*Extension agricultural engineers, The Texas A&M University System.

Figure 1. Recommended proportioning of spray material.



hydrated lime to the spray water leaves a traceable residue to help determine coverage. (Mix approximately 10 pounds of hydrated lime per 100 gallons of water. Do not allow material to settle in tank; maintain constant agitation.) Check to see that spray material reaches the tops of the trees but is not excessive. Then examine the lower tree skirts and inside the tree canopy for coverage. If coverage is not as desired, rearrange the nozzles and nozzle orifice sizes to get the desired coverage.

Sprayer Calibration

Proper maintenance and calibration are critical for achieving good pest control. Air carrier sprayers are equipped with centrifugal pumps, piston pumps or roller pumps. Occasionally check engine speed and pump drive belts for slippage because these two factors affect pump operating pressure. Check pump pressure at the discharge manifold rather than at the pump. Clogged strainers, air leaks into pump suction line, worn pump impellers and faulty pressure regulators also affect pump operating pressure.

Other factors which can cause variation in the rate of application are: (1) number of nozzles on the manifold, (2) ground speed and (3) nozzle orifice size. All of these factors must be considered to calibrate a sprayer. Sprayers should be calibrated prior to initial use and periodically during the season.

Step 1: Determine sprayer ground speed.

Load the sprayer tank with water and make a test run to find a ground speed at which desired coverage is obtained and record the gear and throttle setting.

Then make a test run at the desired ground speed and count the number of trees passed in 1 minute. Determine the ground speed in miles per hour (mph) with this formula:

$$\text{mph} = \frac{\text{tree spacing (ft) x trees passed/minute}}{88}$$

Example: If trees are on 15-foot spacings and six trees are passed in 1 minute,

$$\text{mph} = \frac{15 \times 6}{88}$$

Table 1 may be used to determine sprayer speed based on tree spacing. Select the column which represents the tree spacing in your orchard and the speed you desire to travel. From that you can get the number of trees to pass in 1 minute.

Table 1: Tractor speed based on tree spacing.

Speed of tractor (mph)	Tree spacing (feet)					
	10	12.5	15	18	20	22
	(Number of trees passed per minute)					
1.0	9.0	7.0	6.0	5.0	4.5	4.0
1.5	13.0	10.5	9.0	7.0	6.5	6.0
2.0	18.0	14.0	12.0	10.0	9.0	8.0
3.0	26.5	21.0	17.0	15.0	13.0	12.0
5.0	44.0	35.0	29.5	24.5	22.0	20.0

Step 2: Determine the desired sprayer discharge rate with these formulas:

one-side delivery

$$\text{gpm} = \frac{\text{gpa x mph x d}}{990}$$

two-side delivery

$$\text{gpm} = \frac{\text{gpa x mph x d}}{495}$$

gpm = sprayer discharge rate in gallons per minute
gpa = application rate in gallons per acre
mph = sprayer speed in miles per hour
d = tree spacing between rows in feet

Example: Orchard requires a 100-gallons-per-acre application rate with tree rows spaced 25 feet apart. Ground speed is 1 mph for a two-sided delivery sprayer.

$$\text{gpm} = \frac{\text{gpa x mph x d}}{495}$$

$$\text{gpm} = \frac{100 \times 1 \times 25}{495}$$

$$\text{gpm} = 5.1$$

Step 3: Determine the actual sprayer discharge rate.

The discharge rate in gallons per minute for a specific nozzle and pressure may be obtained from the nozzle manufacturer's catalog. To verify sprayer output, make a. trial run with the sprayer in operation.

a. Fill the tank with water to a known level.
b. Set gear and throttle setting for desired ground speed.
c. Select the pressure setting recommended by sprayer manufacturer.
d. Spray for a measured interval of time.
e. Refill the tank to the known level, measuring the number of gallons of water required.
f. Determine the actual discharge rate with this formula:

$$\text{gpm} = \frac{\text{spray discharged in gallons}}{\text{time interval in minutes}}$$

Example: 15 gallons sprayed in 3 minutes.

$$\text{gpm} = \frac{\text{spray discharged in gallons}}{\text{time interval in minutes}} \quad \frac{15}{3}$$

gpm = 5

Compare the desired spray discharge with the actual discharge from the sprayer. If the actual output is greater than desired, increase sprayer ground speed or reduce nozzle sizes or do both. (**Caution:** Because the volume of air discharged is an integral part of the coverage, increasing ground speed beyond 2 miles per hour can cause poor spray distribution.) When the output is less than desired, reduce tractor speed, select larger nozzles or do both.

Sprayer Maintenance

The owner's manual supplied by the manufacturer is the best source of information on routine sprayer maintenance. Maintenance of the engine is the same as for any engine. Lubricate, check filters and service cooling systems daily.

More pumps are ruined by improper maintenance than are worn out. Pump wear and deterioration occur with ordinary use but these are accelerated by misuse. These suggestions will help minimize problems and prolong the useful life of the pump and sprayer:

- Put clean chemicals, solutions and water in the sprayer. Small amounts of silt or sand particles rapidly wear pumps and parts of the sprayer system.
- Use chemicals that the sprayer and pump were designed to use. For example, liquid fertilizers are corrosive to copper, bronze, ordinary steel and galvanized surfaces. If the pump is made of these materials, it can be ruined by just one application of liquid fertilizer. Use stainless steel pumps for fertilizer application.
- Before using a new sprayer, clean the screens and nozzles of all metal chips and other foreign material.
- Flush the spray system with clean water after each day of spraying.
- Inspect screens and nozzle tips after each day of spraying. Clean by soaking and using a soft brush such as a toothbrush. Tips and screens may be damaged if cleaned with metal objects such as a knife or wire.
- Clean the sprayer thoroughly after each use or when chemicals are changed. Many chemicals cause metal corrosion and a chemical residue sometimes will react with succeeding chemicals, causing a loss of effectivness.

Safety

Pesticides are potentially dangerous when not used properly. Sprayer operators should be thoroughly familiar with both chemicals and equipment before spraying. Read the pesticide label for all safety instructions. Wear protective clothing and equipment such as goggles, respirator, gloves, hat, boots, long sleeved-shirt and long trousers during mixing and application of pesticides. Do not smoke or eat while handling chemicals.

Always store and dispose of chemicals and containers properly. Triple rinse empty containers and dispose of them in accordance with the pesticide label instructions.

Make sure that sprayer operators and chemical handlers have the telephone numbers of poison control centers and physicians and that they know which chemical is being applied. Know the signs and symptoms of pesticide poisoning and what to do if it occurs.

Equipment and machinery also can be dangerous. Some important safety practices in machine operation include:

- Stop the engine, disconnect the power source and wait for all machine movement to stop before servicing, adjusting or cleaning equipment.
- Make sure all persons are clear of machinery before starting the engine, engaging power or operating a machine.
- Keep all guards in place when machines are in operation.
- When operating a tractor with a sprayer, watch for dangers and obstacles, especially at row ends, on roads and around trees.
- When possible, avoid operating the sprayer near ditches, embankments and holes.
- Allow no riders on equipment.

References

1. *Hidalgo County Demonstration Handbook,* 1982, "Citrus Spray Volume Demonstration," Texas Agricultural Extension Service.
2. *Citrus Growers Guide to Air Spraying,* Florida Cooperative Extension Service, Circular 351.

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