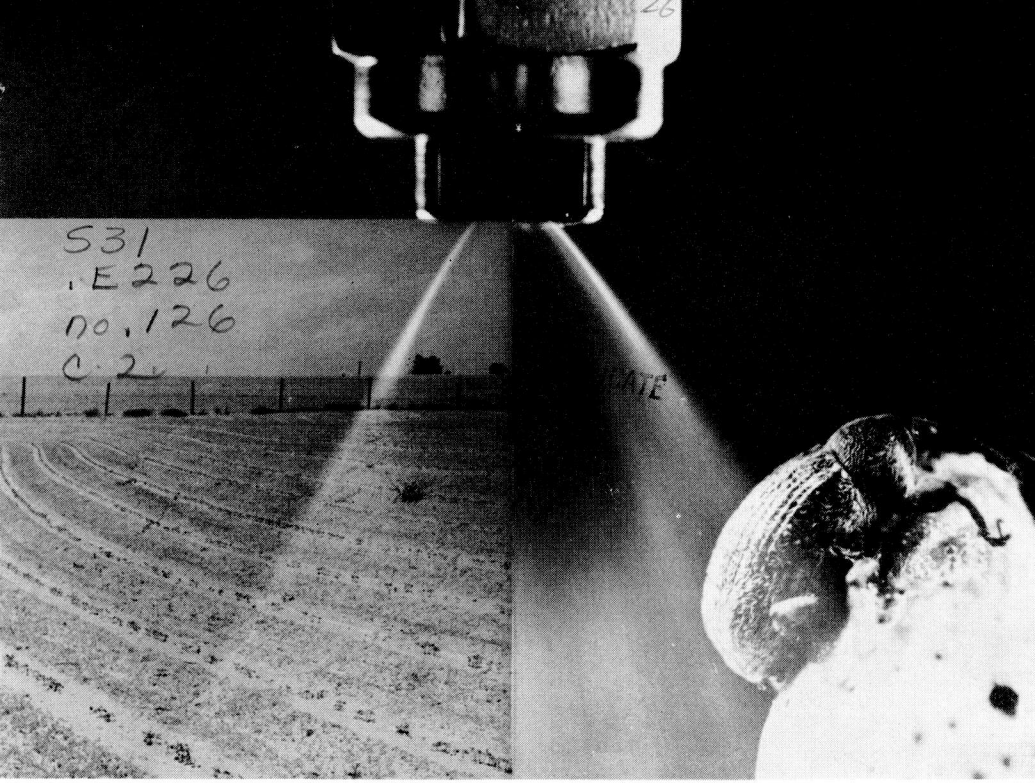

Using LOW-VOLUME FARM SPRAYERS

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Using Low-Volume Farm Sprayers

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SINCE WORLD WAR II there has been increasing interest in farm use of liquid chemicals. This interest has centered around development of chemical weed killers, liquid insecticides, liquid fertilizers, and liquid defoliants and desiccants.

Since high gallonage application of the chemicals in dilute form was sometimes ineffective and impractical, low-volume sprayers were needed. Engineers working with entomologists developed low gallonage, low-pressure sprayers that give effective control of insects with applications as low as 1 gallon of spray per acre. In this publication, a sprayer that delivers 1 to 30 gallons of spray per acre at a pressure of 10 to 100 pounds per square inch (p.s.i.) is considered a low-volume sprayer.

New chemicals and sprayers have been developed at a much faster rate than have their use on farms. Several factors have contributed to the rather slow acceptance of sprayers in Alabama. These include difficulties in mixing spray solutions, in determining the volume of spray applied, and in using, adjusting, and caring for the equipment. The purpose of this publication is to explain proper sprayer use, how to calibrate the sprayer, how to mix chemicals, and special uses of spray equipment. The information presented is based mainly upon 10 years experience with sprayers in cotton mechanization research by the Agricultural Experiment Station of the Alabama Polytechnic Institute. In these studies, sprayers were used for chemical weed control, insect control, and defoliation.

* Cooperative Agricultural Experiment Station of the Alabama Polytechnic Institute and Agricultural Engineering Research Division, ARS, USDA.

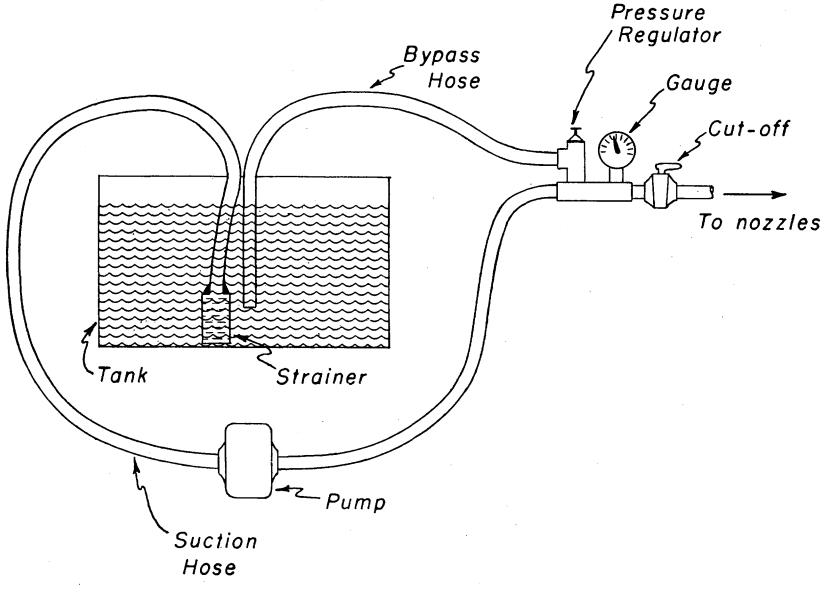

FIGURE 1. Basic parts of a sprayer are shown in this schematic diagram.

Basically, a sprayer is simple in construction and operation. Figure 1 is a schematic diagram of a sprayer. A typical tractor sprayer requires a pump mounted on the tractor power take-off (PTO) with a suction line connecting the pump to a tank mounted on the tractor. As the tractor PTO is rotated, the pump sucks the spray liquid from the tank and puts it under pressure. The liquid leaves the pump under pressure and goes through a hose to a by-pass regulator where the pressure of the liquid going to the nozzle is regulated and excess liquid is returned to the tank. The spray is applied through various types of nozzles, depending upon the job to be done.

BASIC PARTS *of* A SPRAYER

Pumps. Pumps for low-volume sprayers should deliver at least 5 gallons per minute at pressures up to 100 pounds per square inch when rotated at 550 revolutions per minute. There are many types of pumps and several makes and models of each type. Selection of a pump depends on the material to be used, cost, and pressure and volume of spray to be applied. This Station has not conducted comparative tests of pumps, but it has purchased and used gear, roller, diaphragm, and piston pumps, and the following observations were made:

Gear and roller pumps have short life spans when used for pumping suspensions of wettable powder or dirty, gritty water. However, these pumps have given satisfactory service for 3 or 4 spraying seasons when used for pumping emulsions and solutions. Diaphragm and piston pumps will handle wettable powder solutions in addition to emulsions and solutions. These pumps require an air chamber in the line to give a steady flow of liquid to the nozzles.

Strainers. All sprayers should be equipped with strainers or screens to prevent clogging of the nozzles, Figure 2. A strainer should be located either on the end of the suction hose or in the line between tank and pump and each nozzle should be equipped

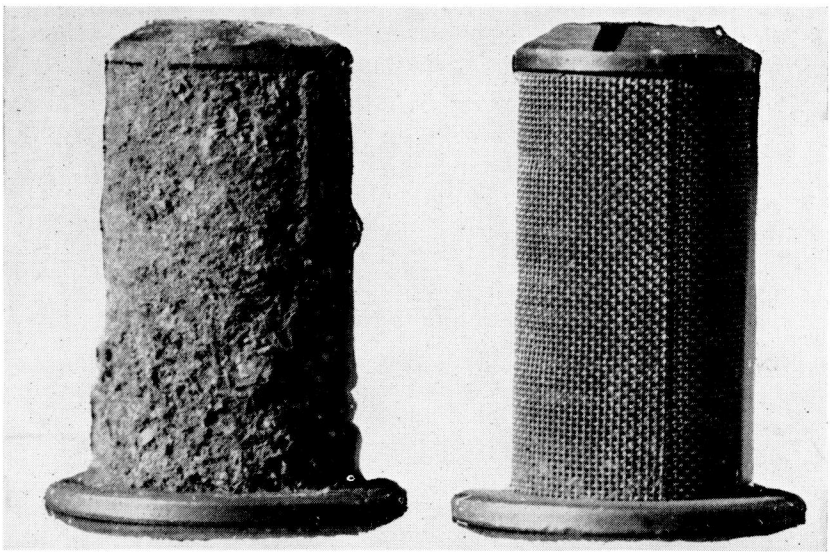

FIGURE 2. Strainers are necessary to prevent clogging of nozzles. A clogged strainer (left)is contrasted with clean nozzle strainer at right.

with a strainer. Line and suction strainers should have 50 to 100 mesh screens and the nozzle should have screens of 50 to 200 mesh, depending upon size of nozzle orifice. The screen mesh must be selected to let all foreign particles pass that will not clog the nozzle.

Hose. From the standpoint of pressure, garden hose is satisfactory for a low-volume sprayer. Garden hose is also satisfactory for most spray solutions but Neophrene hose should be used for handling spray solutions containing oil.

Pressure regulator and gauge. The low-volume sprayer uses a positive displacement type pump. Since it pumps more than the nozzle is applying, a by-pass pressure regulator must be used to return the excess liquid to the tank and to obtain the desired nozzle pressure. When the nozzles are not spraying, all liquid from the pump is returned through the by-pass. The excess liquid returned through the by-pass serves to keep the spray solution in the tank agitated. The nozzle pressure is easily and quickly changed by a simple screw adjustment of the pressure regulator. A gauge should be mounted near the regulator and in easy vision of the tractor driver. The gauge should have a pressure range of 0 to 100 p.s.i.

Nozzles. According to the type of spray patterns produced, nozzles are classified as flat or fan, hollow cone, and solid cone. Each type is further classified according to capacity, and fan type nozzles are also classified according to angle of the spray pattern. These classifications apply to the nozzle tip because this part of the nozzle determines the type and volume of spray. The tips are interchangeable and are easily removed and replaced. Most fan type tips are marked to indicate the angle of spray pattern and the capacity in gallons per minute at 40 p.s.i. Cone type tips are usually marked to indicate gallons per hour at 40 p.s.i. Manufacturers don't use the same markings but they all have charts showing the capacity of each tip. Types of tips needed for specific jobs are discussed on pages 15-20.

Tanks. Clean 55-gallon steel drums can be used for most spraying jobs. Although low in cost, these drums rust and corrode and have to be replaced after 1 or 2 years use. Stainless steel and aluminum tanks are more costly than steel drums, but they resist the corrosive action of most chemicals and result in less nozzle clogging and give many years of service.

Booms. Booms may be up to 30 feet in length, depending upon smoothness of the ground and acreage to be sprayed. Booms longer than 10 or 12 feet need flexible end sections that permit raising for gate and highway clearance and to facilitate turning in close places. Provisions for raising the end sections from the tractor seat are desirable but not necessary. Boom height should be adjustable. Good coverage is usually obtained with the nozzles about 20 inches above the plants. For row crop spraying, outlets should be spaced on the boom to permit mounting one

nozzle over the row and a nozzle with an extension (drop pipe) between the rows. For 40-inch rows, the nozzle outlets should be spaced 20 inches apart on the boom. This same spacing is also satisfactory for broadcast spraying. Galvanized pipe may be used for the boom and drop extensions.

Mounting frame. A frame is necessary for supporting the tank and boom. It should be strong enough to hold the tank and booms rigidly without swaying. A full 55-gallon drum weighs about 500 pounds and it should be mounted so as not to affect stability of the tractor. The frame should be simple to mount and detach. For row crop spraying, the frame should have ample clearance without any low braces. Figure 3 shows a rear-mounted tank and boom support used for pre- and post-emergence weed control, cotton insect control, and defoliation, and a quick-hitch

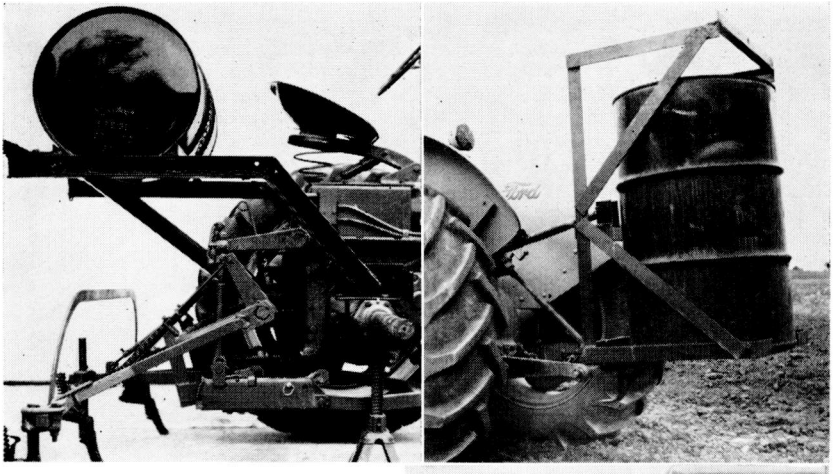

FIGURE 3 (top). At left is a rear-mounted tank and boom support with ample clearance to permit use of rear cultivator during pre- and post-emergence operations. Tractor wheel was removed to show axle mounting of support. A quick-hitch tank support with bracket for mounting a broadcast nozzle is at right.

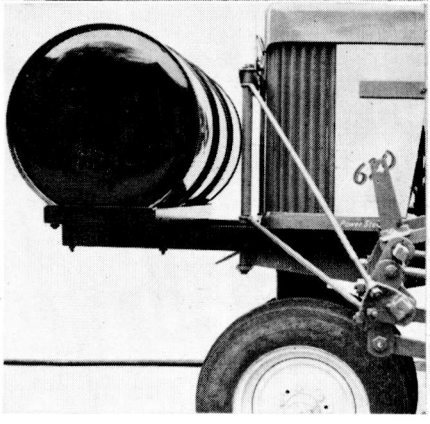

FIGURE 4 (right). This front-mounted tank support is used for pre-emergence chemical application with planters mounted on rear.

tank support with mounting bracket for broadcast nozzle. A front-mounted tank support used for pre-emergence weed control with rear mounted planters is shown in Figure 4. Frames may be purchased or "homemade" like those shown.

Large tanks (100 to 200 gallons) should be mounted on trailers. Several interconnected 55-gallon steel drums can be mounted on one trailer.

CALIBRATION

It is important to know how much spray the sprayer is applying. Proper amounts of chemicals that should be applied for best results have been determined and the sprayer should be adjusted and operated to apply these recommended rates. Too much spray may cause injury and is a costly waste, and too little spray will not do the job.

Calibrating or determining the amount of solution the sprayer is applying can be done by collecting and measuring the solution from a nozzle while operating the sprayer over a measured distance under conditions similar to those that will prevail when actually spraying. The volume of spray applied per acre can then be calculated. To avoid complicated calculations, Figures 5 and 6 can be used to determine rate of spray.

Figure 5. As shown in the instructions on Figure 5, its use is based on catching spray from a nozzle until a pint jar is full. If two people are available, one will drive the tractor and the other will walk and hold the jar under a nozzle. When the nozzle is mounted close to the ground as necessary for pre- and post-emergence weed control, the nozzle can be detached from the mounting bracket so the jar may be conveniently held under it. To calibrate with one person or to eliminate the necessity of detaching a low-mounted nozzle, the following procedure can be used:

With tractor stationary but running with throttle set at operating speed, run sprayer and determine time in seconds required to catch a pint of spray from a nozzle. Then put tractor in field and determine how far it travels in that length of time. Then read chart according to instructions. Example: If the tractor traveled 273 feet in the time required to collect a pint of spray, the chart shows you are applying 6 gallons per acre on 40-inch rows.

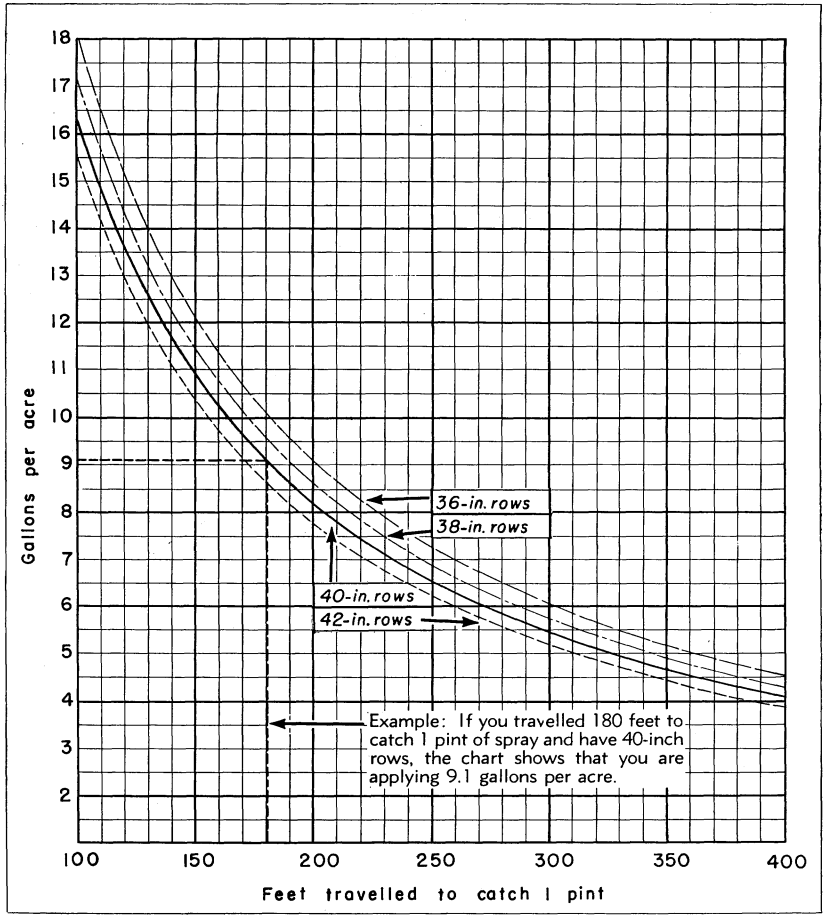

FIGURE 5. Instructions for using the above chart to calibrate row-crop sprayers are given below:

1. Use a pint jar (16 ounces) to catch spray from a nozzle.

2. Put tractor in field in operating position.

3. With water in sprayer and throttle set at operating speed, adjust pressure between 30 and 40 pounds.

4. Put tractor in operating gear with throttle set at operating speed.

5. Mark starting point and start moving about 20 feet behind starting point.

6. Put pint jar under nozzle when you cross starting point and continue in field until jar is full.

7. Measure the distance travelled to fill jar.

8. Read chart according to the following instructions:

a. Move across bottom scale to distance travelled to catch 1 pint.

b. Move up to curve of row width.

c. Move across to vertical scale and read gallons per acre. This is the number of gallons applied per acre with one nozzle per row. If you have more than one nozzle per row, multiply the gallons by the number of nozzles per row to get gallons per acre.

Note: If you must travel more than 400 feet to catch a pint, use a half-pint jar (8 ounces) and the volume of spray will be one-half of that shown on the chart.

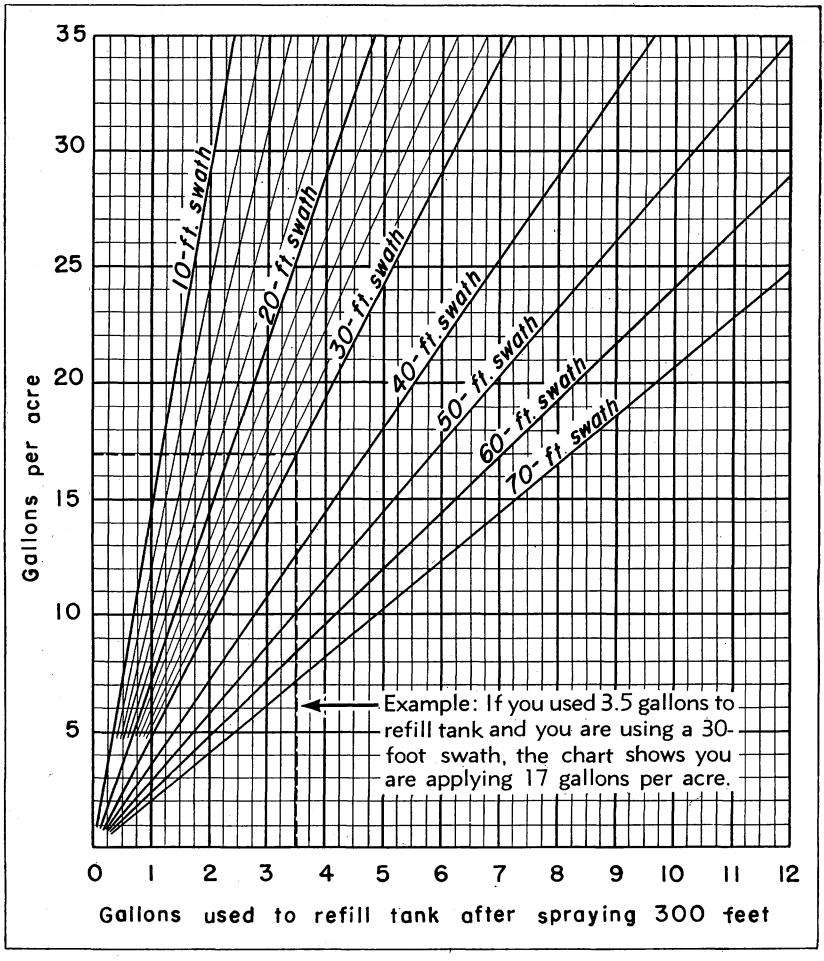

FIGURE 6. Instructions for using the above chart to calibrate a broadcast sprayer (boom or boomless) are given below:

1. Measure a 300-foot distance in field to be sprayed or in an area with surface similar to that in field.

2. With water in sprayer and throttle set at operating speed, operate sprayer and adjust pressure to the desired setting (10 to 60 pounds).

3. Fill tank completely full or to a mark on gauge stick.

4. Put tractor in operating gear with throttle set at operating speed and operate sprayer over the 300-foot distance.

5. Measure to the nearest quart the amount of water required to fill tank to the original level.

6. Read chart according to the following instructions:

- **a. Move across bottom scale to gallons used to refill tank.**
- **b. Move up to the line of your swath width.**
- **c. Move left to the vertical scale and read gallons per acre.**

If you know how many gallons per acre that you want to apply, use chart as follows:

Move up the scale to gallons per acre desired, then across to the curve of your row width, and down to get the distance to travel to catch a pint. Mark this distance off in the field to be sprayed. Now with throttle set at operating speed, determine how long it takes to travel this distance. Then with tractor stationary but with throttle set at operating speed, change pressure and/or nozzle size until a pint is caught in the time required to travel the measured distance. If you change the throttle setting, you must again determine how long it takes to travel the required distance.

Example: If you want to apply 10 gallons per acre on 40-inch rows, the chart shows that you must travel 165 feet to catch a pint. If it required 35 seconds to travel this distance, adjust pressure and/or nozzle size until a pint is collected in 35 seconds. Now your sprayer is adjusted to apply 10 gallons per acre.

Figure 5 was prepared primarily for row crop sprayers, but it can be used for a broadcast boom sprayer. Example: A broadcast sprayer with nozzles spaced 20 inches on the boom would be the same as a 40-inch row crop sprayer with 2 nozzles per row.

Figure 6. Figure 6 can be used for calibrating any type of sprayer, but it was designed especially for a broadcast type. Since it is rather difficult to catch spray from a broadcast type nozzle, the amount of spray applied is determined by measuring the volume sprayed from the tank. As described in the instructions on Figure 6, this is done by starting with a full tank, spraying a measured distance, and measuring the amount needed to refill the tank. The tractor should be on level ground when the tank is filled and refilled, preferably in the exact location.

ADJUSTMENTS *to* OBTAIN DESIRED APPLICATION RATE

Figures 5 and 6 are used to determine how much liquid the sprayer is applying. If the desired amount of solution is not being applied, changes must be made and the sprayer must be calibrated again. The amount of liquid a sprayer applies per acre is governed by the speed of the sprayer, size of nozzle orifice, pressure, type of solution, and the nozzle spacing or number of nozzles per row.

Pressure. The best way to make small changes in volume of spray is to change the pressure. For most insect and weed spray-

ing jobs, the pressure may range between 20 and 100 pounds. The lower pressures (20 to 50 p.s.i.) are usually desirable because with lower pressure, a large orifice will give the same discharge as a small orifice at high pressure. The larger orifice will give less trouble in clogging and produces larger droplets that reduce wind drift.

Example: A fan type nozzle with a rating of 0.1 gallon per minute requires a 100-mesh screen and will apply 10.4 gallons per acre when operated at 80 pounds pressure at 2 miles per hour. A nozzle with a rating of 0.2 gallon per minute requires a 50-mesh screen and will apply the same volume (10.4 gallons per acre) when operated at 20 pounds pressure and at 2 miles per hour.

With the same orifice, the volume per acre can be changed by changing the pressure. To double the volume of a nozzle, the pressure must be increased 4 times. The change in volume in relation to pressure for a fan type nozzle with a rating of 0.2 gallon per minute when operated at 3 miles per hour and with 1 nozzle per row is as follows:

20 p.s.i.	6.9 gallons per acre
30 "	8.4 " " "
40 "	9.9 " " "
50 "	11.4 " " "
60 "	12.4 " " "
80 "	13.8 " " "
100 "	15.8 " " "

The change in pressure also affects the spray angle. For band spraying, this change may be compensated for by raising or lowering the nozzle. For boom spraying, the overlap will take care of slight pattern changes. With a broadcast type nozzle, the swath width may be affected 10 or 15 feet by pressure changes.

When calibrating a sprayer, start with a pressure of about 30 pounds and increase or decrease to make minor changes in volume.

Nozzle orifice. The best way to make a large volume change is to vary the size of nozzle orifice or opening by changing nozzle tips. The amount of spray a nozzle delivers is in direct proportion to the square of the diameter of the orifice opening. In other words, if the diameter of the orifice is doubled the volume is increased 4 times.

Most nozzle orifices are not designated or rated by diameter but by capacities in gallons per minute or gallons per hour at

a certain pressure. In selecting a nozzle size, refer to tables that give volume per acre at different speeds.

Example: The capacity of 1 nozzle per 40-inch row operating at a pressure of 40 pounds varies with nozzle size and speed as follows:

Nozzle rating		*Speed (m.p.h.)*			
Gallons/min.	*Gallons/hr.*	*3*	*4*	*5*	*6*
		Gallons per acre			
0.05	3	2.5	1.8	1.5	1.2
0.1	6	5.0	3.7	3.0	2.5
0.2	12	10.0	7.4	6.0	5.0
0.3	18	15.0	11.1	9.0	7.5
0.4	24	20.0	14.8	12.0	10.0

If it is desired to apply 10 gallons per acre with 1 nozzle per 40-inch row, select a 0.2 nozzle tip if traveling 3 m.p.h. but a 0.3 tip if traveling 4 m.p.h. After selecting the nozzle tip, it may be necessary to make slight pressure changes to get exactly 10 gallons per acre.

Speed of sprayer. The speed of the tractor or sprayer should be the last variable to change. When applying pre- and post-emergence weed control chemicals, the speed should be governed by the planting and cultivating speed. In pasture spraying and cotton poisoning and defoliating, speed is governed by terrain, safety, and damage to crop. Volume is indirectly related to speed. When the speed is doubled, the volume is reduced by one half.

Nozzle spacing or nozzles per row. The amount of spray is directly related to the number of nozzles per row.

Type of liquid. When a chemical is diluted with water, the sprayer can be calibrated with plain water. If the chemical is an oil or is diluted with oil, the same oil must be used for calibration.

MIXING *the* SPRAY SOLUTION

After the sprayer has been calibrated to determine its rate of spraying, the concentrate chemical must be mixed in correct proportion with water. The strength of most spray chemicals is marked on the container and is usually expressed in per cent of active ingredients and/or pounds of technical material per gallon. Many chemicals are sold at different concentrations and it is important to read the container label before mixing and using. Example: Toxaphene may be purchased with 4, 6, or 8 pounds

of technical material per gallon. Most recommendations are expressed in terms of pounds of technical material per acre.

It is relatively simple to mix the spray solution if the following three things are known: (1) amount of solution the sprayer is applying per acre, (2) pounds of technical material per gallon of concentrate chemical to be used, and (3) pounds of technical material recommended per acre. Example: Assume that (1) your sprayer is applying 5 gallons per acre, (2) you are using toxaphene containing 4 pounds of technical material per gallon, and (3) you wish to apply 2 pounds of technical toxaphene per acre. Each gallon of the toxaphene contains enough technical material for 2 acres $\left(\frac{4 \text{ pounds per gallon}}{2 \text{ pounds per acre}} = 2 \text{ acres}\right)$. Or ½ gallon of this toxaphene contains enough technical material for 1 acre. Therefore, for each acre you should mix ½ gallon of concentrate toxaphene with 4½ gallons of water. Or for each gallon you should mix 9 gallons of water. To mix a 55-gallon drum of spray (enough for 11 acres), fill drum about half full with water, put in 5½ gallons of concentrate toxaphene (enough for 11 acres) and then fill drum with water. Always have water in the tank when adding concentrate chemicals. After pouring the water and chemical in the tank, operate the pump for several minutes with the nozzles turned off to thoroughly mix the spray solution.

All chemicals are not marked in terms of technical material per gallon. However, the label or the recommendations will tell how much of the concentrate chemical to apply per acre.

The strength of wettable powders is expressed in percentage of active ingredients, and the recommendations are usually in terms of pounds of powder per acre. Make sure that the powders are thoroughly mixed with water before pouring into the tank.

CAUTION. Before mixing any chemical, read and understand the precautions and directions for safe handling. This information is on the container label. The mixing process involves handling highly concentrated chemicals and even non-toxic chemicals in concentrate form can cause severe burning, blistering, and other harmful effects. Avoid as much as possible contact of the chemical with skin and clothing. If the chemical gets on the skin, wash thoroughly with soap and water immediately. If it gets on clothing, remove clothing at once. Always have soap and water readily available. Make sure that measuring and mixing containers are thoroughly washed before using for other purposes.

SELECTION *and* ADJUSTMENT *of* EQUIPMENT *for* DIFFERENT SPRAYING JOBS

The basic elements of a sprayer (pump, strainers, hoses, and tank) may be used for many jobs. Nozzle types, sizes, arrangements, and methods of mounting vary with the job.

Pre-emergence Weed Control

Pre-emergence chemicals are applied after planting and before the crop and weeds emerge or come up. Cotton, peanuts, and corn are the main crops in Alabama that lend themselves to pre-emergence treatment. Although chemicals can be applied broadcast over the entire field, it is more economical to treat only the row (band application) and use sweeps to control weeds between rows.

For band application, the chemical should be applied in connection with the planting operation. Application of the chemical after crop is planted means an extra operation, makes it difficult to center band over the planted row, and introduces a chance of rain preventing treatment before the crop emerges.

To apply pre-emergence chemical at planting, mount the sprayer on the tractor with a nozzle over each row. The fan type nozzle with an even, flat spray pattern was designed for band

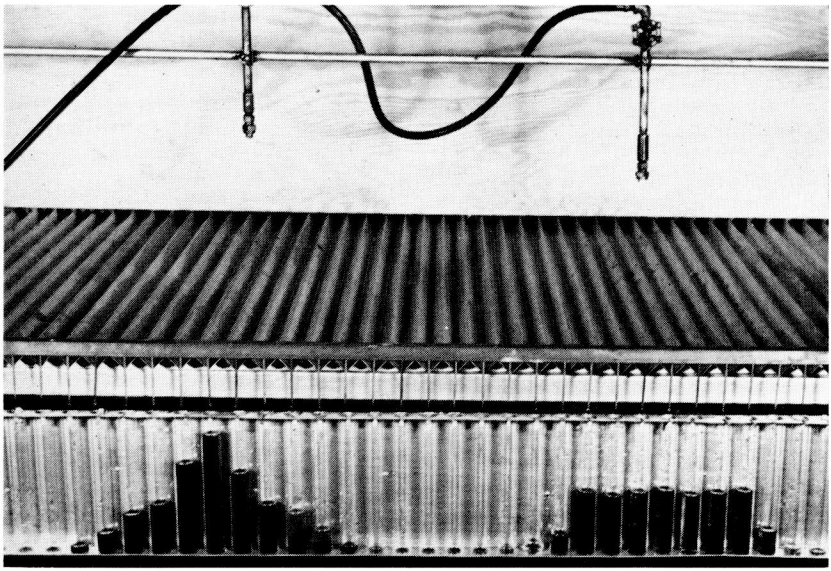

FIGURE 7. Distribution pattern of an even, flat spray nozzle at right is compared with a regular, flat nozzle with a tapered edge pattern at left.

application of pre-emergence chemical, Figure 7. However, the regular fan nozzle with tapered edge pattern may be used. Use 65- to 110-degree fan type nozzles with a capacity of 0.2 to 0.4 gallons per minute. Nozzle pressure may vary from 20 to 50 p.s.i. The table on page 13 will serve as a guide for selecting the correct size nozzle for your operating speed. The volume of spray may vary from 7 to 14 gallons per acre. Some states recommend a gallon of spray per acre for each inch of band width. The nozzle should be mounted behind the planter press wheel in such a manner that it will remain a constant height above the row. To do this, the bracket supporting the nozzle is attached to the mounting frame of the planter press wheel. The nozzle should be mounted to permit vertical adjustment so that the desired band width can be obtained by raising or lowering the nozzle. A band width of about 12 inches has proved satisfactory. A regular press wheel can be used but the wide, solid press wheel, Figure 8, leaves a desirable surface on which to apply post-emergence chemicals.

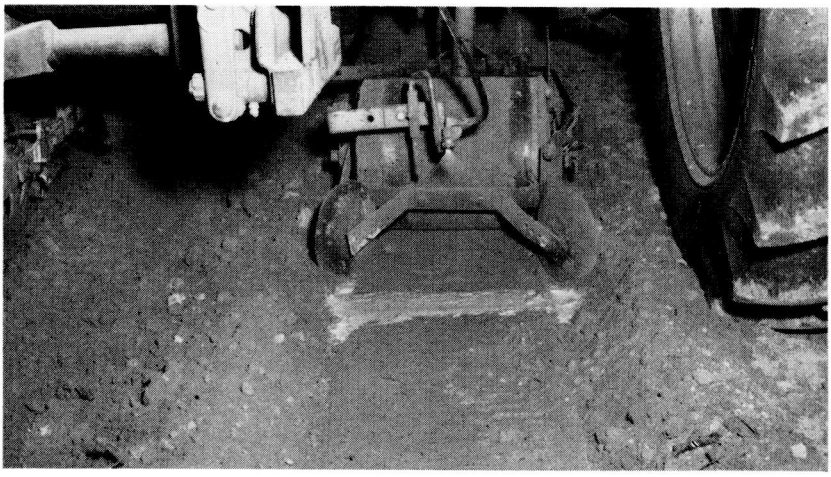

FIGURE 8. This 12-inch solid press wheel leaves a desirable surface for applying pre- and post-emergence chemicals. The two small disks mounted behind the press wheel are not necessary but they eliminate ridges on each side of row and provide small furrows for row drainage.

Post-emergence Weed Control

Post-emergence chemicals are applied after the crop and weeds emerge. Post-emergence sprays are recommended for cotton, corn, sorghum, and small grains. Post-emergence application is easy for corn, sorghum, and small grains because these crops will

tolerate light doses of the weed-killing chemicals. Although corn and sorghum will tolerate the weed-killing chemicals, the nozzles should be set to direct spray toward base of the stalk to prevent chemical from hitting the corn or sorghum leaves. In small corn, the nozzles can be attached to the cultivator. For large corn, an overhead boom with drops in each middle is needed. Post-emergence weed control in cotton is more difficult because the weed-killing chemicals cannot hit the young cotton leaves without damaging or killing the cotton. However, the chemicals may strike the shank of the young cotton stalk before the true bark forms without damaging it. This makes it possible to spray small grass and weeds in the drill without damaging the cotton. Cotton plants should be at least 2½ to 3 inches tall at time of first application. The chemical should be applied without disturbing the soil in the drill. At the same time, the middles can be cultivated with sweeps. The chemical can be applied when the ground is too wet for sweep cultivation but will support the tractor.

Figure 9 shows shields used to keep the sweeps from throwing dirt into the row drill. Nozzles mounted on the shields are di-

FIGURE 9. Shown are parallel action shields with nozzles (arrows) mounted for applying post-emergence chemicals. These shields prevent sweeps throwing dirt on the row when cultivating and applying post-emergence chemicals.

rected to spray weeds in the drill. The flat plate on the bottom of the shield and the parallel linkage cause the shields to float on the ground surface, thereby keeping the nozzles at the same height. The nozzles should be mounted on each side of the row about 1 inch above the ground surface and directed so that the spray hits only the bottom inch of the cotton stalk. The nozzles may be directed to the rear at an angle of about 30 to 40 degrees with the row or pointed straight across the row. In either case, the nozzles should be set to cover an 8- to 10-inch band on the row. If the nozzles are pointed straight into the row, make sure that they are offset (not set opposite each other) so that the sprays will not meet and "bounce" up and onto the cotton.

For post-emergence spraying, use 65- to 95-degree fan type nozzles with a capacity of 0.05 to 0.1 gallon per minute. Operating pressure may vary between 15 and 40 p.s.i.

Insect Control

Sprayers can be used effectively to apply insecticides on most crops. Nozzle arrangement varies with the crop and insect.

For cotton insects, the nozzles should be arranged to give good coverage of the terminal growth. Figure 10 shows an eight-

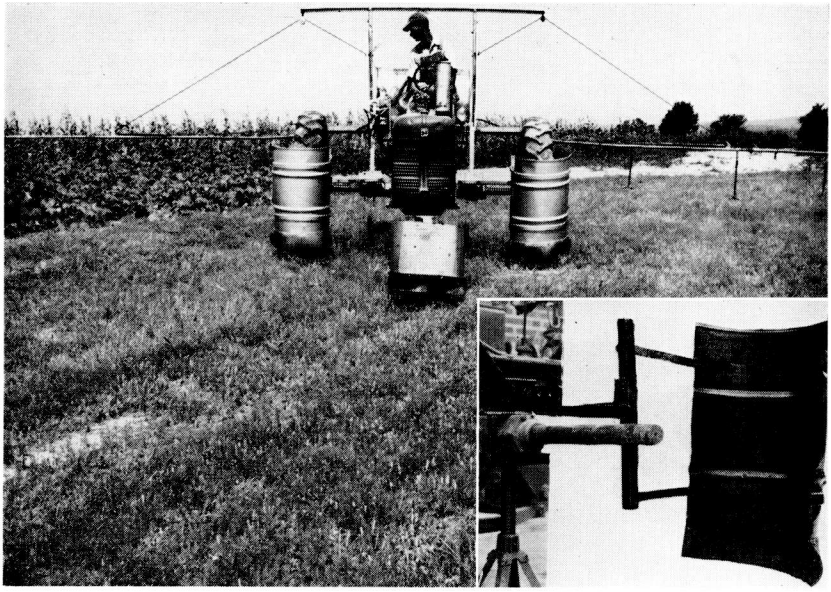

FIGURE 10. This 8-row sprayer is equipped with 3 nozzles per row for applying cotton insecticides. The inset shows how home-made shields are mounted on tractor to reduce mechanical damage to cotton during insecticide application.

row sprayer for applying insecticides to cotton. This sprayer is equipped with 3 nozzles per row (1 centered over the row and 1 on each side). This nozzle arrangement has given good control in test work in Alabama. For small cotton, 1 or 2 nozzles per row will give good coverage.

Cone nozzles with a capacity of 4 to 6 gallons per hour or fan nozzles of equal capacity (0.067 to 0.1 gallon per minute) are recommended for applying most cotton insecticides. Nozzles with smaller orifices will give adequate coverage but cause more trouble in clogging. Nozzles with larger orifices can also be used and may be needed during windy weather and for high rates of application. The table on page 13 may be used as a guide for selecting nozzle size. Good coverage can be obtained with 5 to 10 gallons of spray solution per acre.

For the corn earworm (on sweet corn), direct the spray into the ear zone. Because of non-uniform ear height, 2 nozzles on each side of the row should be used.

For the corn borer, use 1 nozzle above the row and 1 on each side, directed to get the spray into the whorls.

Defoliation

Cotton is the main crop that is chemically defoliated in Alabama. Defoliants can be applied with the same equipment used for applying insecticides. Larger volumes of spray are needed for defoliation than for insect control because each leaf must receive an application of the chemical. Defoliants should be applied in 15 to 25 gallons of water per acre. A coarse spray with large droplets is desirable. The larger nozzles recommended for insect control can be used for applying defoliants. An overhead boom with drop extensions in each middle and 3 to 6 nozzles per row will give good coverage in cotton under 5 feet in height. For larger cotton, a second application is usually needed.

The broadcast type nozzle, Figure 11, has given excellent defoliation in tall irrigated cotton for 2 years at Auburn. Good coverage was obtained on all rows of an 8-row swath, but with wider swaths outside rows did not always get ample coverage.

Flooding type nozzles mounted overhead have given excellent results in defoliating rank cotton in other states.

Sometimes it may be desirable to defoliate the lower part of cotton plants without disturbing the top. This can be done by using an overhead boom with a drop extension in each middle. Mount nozzles only on the drop extensions and direct them to

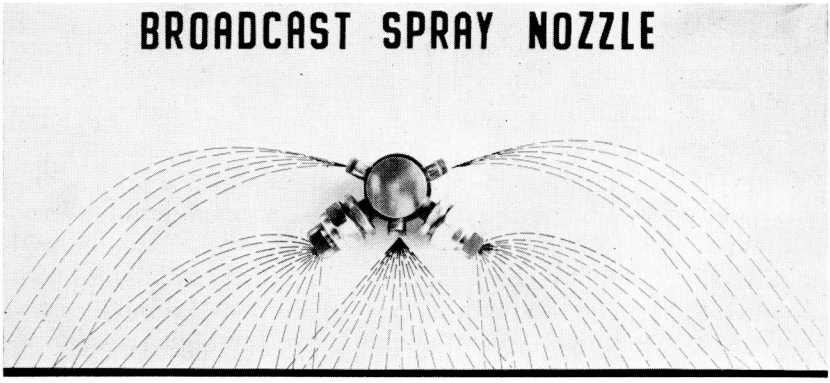

FIGURE 11. Shown above is one type of broadcast nozzle. This nozzle covers swaths up to 60 feet.

cover the lower portion of the plant. A shield (6 to 8 inches wide) mounted on the drop extension will keep leaves from brushing across the nozzle orifice.

Pasture Weed Control

The greatest use of low-volume sprayers in Alabama has been for spraying weeds in pastures. Broadcast type sprayers are used for pasture spraying and are of two types: (1) boom type sprayers with fan nozzles spaced 18 to 20 inches on the boom, and (2) broadcast nozzle type sprayers with a cluster of nozzles arranged to cover a wide swath. The broadcast type nozzle has become very popular for pasture weed control. Spraying with a broadcast nozzle as compared to spraying with a boom type sprayer has the following advantages: (1) lower equipment cost, (2) fewer nozzles to maintain and to cause clogging, (3) easier to operate, and (4) permits spraying wider swaths. Disadvantages of spraying with a broadcast nozzle are: (1) wind materially affects the nozzle pattern, (2) difficult to maintain uniform distance between wide swaths, and (3) greater danger of spraying nearby crops.

With either type sprayer, good coverage may be obtained with 10 to 25 gallons per acre. For large acreage, trailer type sprayers equipped with large tanks are desirable.

Wheel Fenders

Mechanical damage to crops caused by ground applicators of insecticides may be quite serious, especially during late season in tall crops. Wheel fenders such as those shown in Figure 10 aid greatly in reducing this damage. These are "shop-made" fenders

constructed from a 30-gallon insecticide drum and mounted to the sprayer frame. They can be mounted independent of the sprayer frame by clamping to the tractor axle. They are mounted in a fixed position and a piece of 10-inch belting is fastened to the bottom of the drum. This belting will push the low limbs out of the way of the tractor wheel but will give or flex when the wheel drops in a ditch or crosses a terrace channel. Wheel fenders such as these may be constructed and adapted to any make tractor. Similar wheel fenders are available commercially.

High-Clearance Sprayers

Self-propelled, high-clearance sprayers are relatively costly, but they are desirable for use on large farms and by custom operators. The use of self-propelled, high-clearance sprayers reduces mechanical damage to growing crops and eliminates need of a farm tractor for spraying.

High-clearance sprayers are especially adapted for application of chemicals in tall crops, such as corn and irrigated cotton. They may also be used to apply liquid fertilizer, chemicals for weed control in pasture or row crops, cotton defoliants, and for other spraying jobs.

Miscellaneous Spraying

The low-volume farm sprayer can be used for spraying livestock, buildings, manure piles, orchards, ditchbanks, fence rows, and shrubs, for washing and cleaning farm equipment, for fighting fires, and numerous other jobs.

A hand gun and a 25-foot hose are the only extra equipment needed to adapt a row crop or pasture sprayer for the above miscellaneous spray jobs.

OPERATION *and* CARE *of* SPRAYERS

Beginning of Season Care

1. The sprayer mounting frame should be fastened securely and braced properly to the tractor.

2. All pipe and hose connections should be leakproof.

3. Make sure that pump can be turned by hand before mounting it on the tractor PTO. (Note: If pump cannot be turned by hand, it should be disassembled according to instructions furnished with pump.)

4. Do not pound or hammer the pump to get it on the tractor PTO. If the PTO shaft and the pump coupling are clean and free of rust, the pump should go on easily.

5. Secure pump to PTO by means of set screws and anchor pump to sprayer or tractor with chain or chains.

6. Inspect tank and make sure it is clean before mounting.

7. Flush boom with water before attaching the nozzles.

8. Inspect nozzle screens and tips for cleanliness and to make certain all tips are of the same size.

9. Run sprayer to check for leaks and to observe nozzle patterns. Irregular shaped nozzle patterns may be detected by observation and must be corrected. They are usually caused by trash or dirt in and around the nozzle orifice or by a clogged nozzle screen. Do not probe the nozzle orifice with a knife blade or other metal objects. Use a tooth brush or soft wood to clean the orifice.

10. Calibrate sprayer and mark throttle setting and record gear position.

11. Calculate the ratio of concentrate chemical and water and record mixing instructions on tank or other convenient place.

Field Operation

1. It is of utmost importance to always use a clean spray solution.

2. Operate tractor in the same gear and at the same throttle setting as used for calibration.

3. Observe nozzle patterns continuously to detect clogged nozzles and to tell when tank is empty.

4. Do not operate pump when tank is empty. Gear and roller pumps can be seriously damaged by operating dry only a few minutes.

Daily Care

1. At the end of a day's spraying, flush system with clean water.

2. Check suction and line strainers and nozzle tips and screens and clean if necessary. Clean tips and screens by soaking in gasoline and brushing with a small brush or use compressed air.

End of Season Care

1. Flush system thoroughly with clean water and then run a few gallons of fuel oil through sprayer to help prevent rust.
2. Remove and clean nozzles.
3. Remove and drain pump. Before storing, gear and piston pumps should be filled with oil and roller and diaphragm pumps should be flushed with a rust inhibitor. All openings in the pumps should be plugged.
4. Apply a coating of oil to the inside surface of steel tanks.
5. Store sprayer under a shed.

MISCELLANEOUS

Tank Measuring or Gauge Stick

It's a simple matter to mark a stick to use for measuring the amount of liquid in your sprayer tank. With the tank level, add 5 gallons of liquid, insert stick in tank, and then mark or notch stick. Continue to add 5 gallons at a time and mark stick until tank is full. Always make sure the tank is level when using the gauge stick.

The following figures have been obtained for measuring the amount of liquid in a 55-gallon steel drum in a horizontal position:

Inches per 5 gallons		*Gallons per inch*			
Gallons	*Inches*	*Inches*	*Gallons*	*Inches*	*Gallons*
5	3⅛	1	1¼	11	28¼
10	5⅛	2	3	12	31½
15	6⅞	3	4¾	13	34½
20	8½	4	7	14	37¾
25	10	5	9¾	15	40¾
30	11½	6	12½	16	43¾
35	13⅛	7	15½	17	46¾
40	14¾	8	18½	18	49½
45	16⅜	9	21½	19	52¼
50	18⅛	10	25	20	54¼
55	20⅜				

For a 55-gallon drum in a vertical position, each inch represents about 1.7 gallons.

Filling Tank with Spray Pump

The pump on the sprayer may be used to fill the tank as follows:

1. Remove suction line from tank and place it in the water source (creek, pond, or supply tank). Be sure to have suction strainer on suction line.

2. Unscrew the pressure regulator to drop pressure to 0-20 p.s.i.
3. Keep by-pass hose in tank to be filled.
4. Engage pump and water will flow through the by-pass hose into tank.
5. Re-set pressure regulator after tank is filled.

Caution About Using 2,4-D and 2,4,5-T

A sprayer that has been used to apply 2,4-D or 2,4,5-T should not be used for applying insecticides or fungicides to broadleaf plants such as cotton, soybeans, and vegetables. Even if the sprayer has been thoroughly flushed with clean water, there is likely to be enough 2,4-D or 2,4,5-T left to damage sensitive crops. However, the sprayer may be used to spray livestock. Do not spray 2,4-D or 2,4,5-T near sensitive plants, especially when the wind is blowing toward the plants. To reduce drift, use a low pressure and a large nozzle orifice to produce large droplets.