

## Calibrating and Using Backpack Sprayers (transcript)

### Narrator

Backpack sprayers or knapsack sprayers come in many shapes and sizes. This assortment of products and accessories make backpack sprayers both useful and versatile. In this video, we'll show you how to use this equipment safely and effectively. First, we'll look at the basic sprayer and components and consider the appropriate uses. Then, we'll outline methods of calibration and pesticide mixing. And finally, we'll offer some operating hints.

Now, let's get started. Though sprayers may look different, the key components are basically the same. First, the sprayer has a tank for holding liquids. The tank is connected to a pump. Often the pump is hand operated, but gas, electric, and even solar models are available. Beyond the pump is a triggered wand. At the end of a wand, a nozzle set directs and controls the sprayed liquid. Each sprayer will have a unique combination of these features. Let's review a few. Tank capacity may vary from one to six gallons.

Pumps typically are either piston or diaphragm. Piston types can deliver higher pressure but may wear out sooner. Diaphragm pumps are low maintenance but typically operate at lower pressures. From the pump, liquid moves through a triggered wand. Some sprayers also will have a screen made of various materials and handle body that requires an occasional cleaning.

The last component the liquid encounters before leaving the sprayer is the nozzle set. Because this is such a critical part of the sprayer, the nozzle components deserve a closer look. Typically, a nozzle is composed of four items: nozzle body, cap, strainer screen, and spray tip. The spray tip is the most important nozzle accessory for your sprayer. It breaks the liquid into droplets, forms the spray pattern, and helps propel the liquid. Unfortunately, many users pay little attention to the nozzle tip and know little about alternatives. Tips are designed for different crops, pressures, output angles, and volumes. Knowing your intended use, operating conditions, and having a variety of tips to select from make the backpack sprayer even more versatile. For example, tips such as the 1502 give a narrow width. Tips like the 8002 a medium width. A wide flooding tip produces even broader coverage. Adjustable cone tips are useful in spraying brush clumps where it might be difficult to or painful to walk through. And they are useful in straight stream bark applications. Usually, the numbers on tips identify the angle of the spray pattern and the output at a certain pressure. For example, this 8002 tip sprays at an 80 degree angle and delivers .02 gallons per minute.

Screens are another part of the nozzle. They are needed in advance of the spray tips to reduce clogging. The smaller the tip opening, the finer the screen mesh needed to protect to the tip. Nozzle tips like the 8001 require a 100 mesh screen as on the right. But larger nozzle openings like the 8004 need only a 50 mesh screen. The manufacturer will recommend the screen mesh size you need. Now that we know something about how these sprayers work, let's look at how they are used. Often backpack sprayers are used in situations where larger tractor-

mounted or aerial sprayers are inappropriate or unavailable. They work well in smaller areas, rough terrain, or hard to reach locations.

There are also special situations suited for backpack applications. One forest application is commonly referred to as Basil drench. Here, the lower portion of the stems of the problem brush or trees are soaked with the spray mix. The length of the stem covered and the amount of stem soaking needed will vary. Another treatment where the herbicide will run through the bark is called the thin-line method. Here, a narrow stream of concentrated herbicide is sprayed against the stem of problem plants. To ensure a coverage around the stem, application from three locations around stem clumps is often required. Backpack sprayers are even used in road crops when the treatment covers only a minor portion of the field or larger sprayers are unavailable. Spraying along crop rows too narrow for equipment passage is another typical application. And so is spraying fungicide or insecticide with motorized mist sprayers. Now let's move on to calibration and mixing.

Calibration is critical to achieving desired results. Simply put, proper calibration enables one to accurately deliver a known amount of pesticide to a target area. It takes a little work and a few calculations, but it is vital. Without calibrating your sprayer, it is impossible to know if you are applying the correct amount of pesticide. Misapplication may result in dead crops, wasted time and money, and it's against the law. To understand calibration, you need to first understand how the four variables you control affect application rate. These are walking speed, pressure, nozzle tip selection, and nozzle height. We'll talk about each variable.

First, look at walking speed. The person in the foreground is walking faster than the fellow in the back. If both applicators are using the same spray mix concentration, pressure, and nozzle tip, the fellow walking slower will be applying more pesticide to a given area. So walking speed is important. Walking speed should be a comfortable pace. It must be a pace you can maintain consistently, whether you go up hill or downhill. And it must be the same pace you use while calibrating your sprayer. Remember, if you change walking speed, you change application rate.

Pressure also helps to determine application rate. As with walking speed, pressure must be consistent and maintained while spraying. Some sprayers have pressure-regulator devices within the sprayer allowing you to preset a pressure. Other sprayers have gauges. Either is helpful. For broadcast operation, it is best to operate at as low a pressure as possible for the nozzle tip and situation at hand. With the lever-operated backpack sprayers, the pressure is maintained by hand pumping. With practice, a comfortable walking pumping rhythm is developed, so maintaining speed and pressure becomes second nature. Different applications and nozzle tips may require changes in pressure. Remember, if pressure change, output changes.

The third item you control is the nozzle tip selection. Remember, tips are designed for many uses. No one tip will cover the range of potential situations encountered by backpack

applicators. Remember too that tips wear with use and should be replaced. For example, each tip along this boom should produce the same output. But as you can see, the bottle on the right is spilling more rapidly than the others during the time test. The problem nozzle should be replaced to obtain uniform output along the boom.

The final item you control is nozzle or boom height. With backpack applications, nozzle height requires constant monitoring by the operator. Height should also be maintained as close to the target as practical to avoid drift and operator contact. Any height change alters the spray width, which in turn alters application rate.

Now to summarize, the four items you control that determine application rate are walking speed, pressure, nozzle tip selection, and nozzle height. Change any of these and you change the application rate of the pesticide. In most broadcast spraying applications, walking speed and pressure will be set. Output changes are best made by selecting between various nozzle tips. With that background, now we're ready to run through some pre-calibration steps. The first step is inspection. Check nozzle tip pattern and discard problem tips that show poor pattern output. Clean and replace clog screens and filters. Check moving parts and lubricate if needed. Check lines and replace cracked hoses. Check for leaking O-rings and gaskets. With the sprayer in good working order, develop a walking pumping pace that is comfortable and consistent. Next, spend time selecting a nozzle tip. In our example, we'll use a tip that delivers around 15 gallons per acre and 20 psi at our walking speed. Various charts from tip manufacturers help with selection. This selection is important in minimizing the gallon per acre output while still providing good coverage. In broadcast spray situations, tips providing 7 to 20 gallons per acre are good choices.

The prep work is done. Now, we can run through the steps needed to calibrate the sprayer. First, we add a known amount of water to our sprayer. In this example, 2 gallons. Next, mark a starting point. Now, spray as if you were spraying your field. Remember, you must maintain consistent pressure, walking speed, and nozzle height. Spray until the 2 gallons of water in the tank are all gone. Mark the stopping spot. Now, we have a few calculations to make. First, measure the area sprayed in square feet. Our sprayed area was 10 feet by 580 feet for a total of 5,800 square feet. Since most pesticide recommendations are based on an amount per acre, it is helpful to determine what part of an acre our 2 gallons covered. In our case, we divide the square footage in our test area by the square footage in an acre, 43,560 square feet. So our 2 gallons covered .13 acres. To find our gallons per acre output, we divide 2 gallons by .13 acres, and our answer is 15 gallons per acre. This means that our walking speed, pressure, nozzle selection, and height, we will apply 15 gallons per acre. Since this sprayer tank holds 5 gallons, it will take 3 full tanks to cover one acre on a broadcast application.

Now that we know our calibrated application rate, we can determine how much pesticide to add. Because pesticides are sold as liquids, powders, flow bowls, and other formulations, let's look at 2 examples. Let's say we have a liquid herbicide like Roundup, and we want to apply

one quart per acre of product in a broadcast application. What do we do to apply one quart evenly over the entire acre? Well, most of the work is done when we calibrated the sprayer. We have just one calculation to determine how to evenly distribute one quart or 32 ounces into the 15 gallons, so here we divide 32 ounces of Roundup by 15 gallons per acre to get 2.1 ounces per gallon. Since this backpack sprayer holds 5 gallons, each full 5 gallon tank should contain 10.7 ounces of Roundup product. There are many different formulations, concentrations, and types of pesticides. Some pesticide recommendations are based on the amount of active ingredient to apply per acre. Except for products that contain 100% active ingredient, the amount of product applied per acre will be greater than the amount of active ingredient recommended per acre. For example, a herbicide guide may suggest you apply 2 pounds per acre of the active ingredient of Princep. This particular product formulation is 80% active powder to be mixed in water. To determine the amount of product to apply per acre, we divide the 2 pounds active ingredient by the 80% active ingredients in the product. Our answer is 2.5 pounds of the product Princep per acre.

Figuring out how much to add per gallon in our sprayer is the next step. First convert everything into ounces. 2.5 pounds times 16 ounces per pound equals 40 ounces of product per acre. Next, to determine how many ounces to add to a gallon, we divide 40 ounces by 15 gallons per acre, to get 2.7 ounces per gallon. So each gallon of water in our sprayer should have 2.7 ounces of Princep added. That concludes calibrating and mixing. Now, some operating tips. First, always review current product labels to find what level of hazard is involved and the types of protective gear needed. Another tip: Where possible, use the liquid formulation of pesticides. Liquids are easier to mix and don't require weighing.

Keep good records. This will help you repeat successes, track down problems, and they can be important legal documents. Maintain a good supply of various nozzle tips and discard damaged ones. Maintain distance from adjacent applicators to minimize potential drift problems. Use protective gear. Protective gear is especially important for backpack sprayer users because applicators are frequently in contact with concentrated products during mixing and frequently walking near or into pesticide sprays. Remember to agitate the mix. Backpack sprayers are seldom equipped with agitating devices. To keep the solution well mixed, the sprayer must be jostled now and then. Investigate useful accessories. Sprayers have many accessories and each has a range of different features.

To summarize, remember when applying pesticides, your application rate will be determined by these factors. Walking speed, pressure, nozzle tip selection, and nozzle height. Change any of these and you change application rate. The backpack sprayer is an extremely versatile tool and can be used in a wide assortment of conditions and places. Operated properly, your backpack sprayer can be a vital tool in producing your next crop.