Pesticide Calibration Made Easy

Proper calibration of agricultural pesticide application equipment can mean the difference in control or failure of a pesticide against the targeted pest and potentially thousands of dollars of savings to the grower. Many growers are now using rate controllers; however, it is imperative to check the accuracy of these rate controllers, as well as application accuracy for equipment that does not have a rate controller. This publication will address many common questions about specific types of calibration and provide examples expressed in a straightforward and simple format.

What Is "1 gallon to X acres"?

This is a common question from entry-level personnel in the industry. Most are not taught this in school; however, it is the most commonly used expression of rates among growers and consultants. It is very common in the agricultural world to hear 1 to 40 (1:40), 1 to 90 (1:90), or similar. This simply means that 1 gallon (or pound if a dry formulation) of the product will cover X number of acres. This likely came about because it is easier to know how much chemical to purchase when expressed this way. If you want to turn a grower off quickly, start quoting rates in pounds of active ingredient per acre.

Example 1: A farmer wants a use rate of 1 to 32 (1:32) of a given pesticide. Again, this simply means 1 gallon of the product will cover 32 acres. If you want to know the actual use rate of the product in ounces per acre for a 1:32 rate, simply divide 128 (which is the number of ounces in 1 gallon) by 32 (for a result of 4). Therefore, the grower is applying 4 ounces of product per acre. Conversely, if you know the use rate in ounces of product per acre, you can simply divide 128 by the use rate in ounces (in our example, it is 4), and you will get 32. Now you're back to 1:32.

Example 2: You can also use the active ingredient (a.i.) rates to get the same answer. For example: If a given pesticide is a 4EC (contains 4 pounds active ingredient per gallon of formulated product) and the use rate is 0.04 lb. a.i. per acre, you can simply divide the 4 by the use rate of 0.04 a.i per acre and get 100. So, in this example, the rate would be 1:100. To determine the use rate in ounces, again divide 128 by 100 and you get 1.28 ounces of actual product per acre.

1:100 = 0.04 a.i. lb. acre = 1.28 oz. of product

Calibrating Broadcast Sprayers

There are many ways to calibrate sprayers. The following is one of the commonly used formulas.

GPM = (MPH × NSI × GPA) / 5940

GPM = gallons per minute

MPH = miles per hour

NSI = nozzle spacing in inches (or bandwidth)

5940 = this is a constant

What this formula tells you is how many gallons you would have to catch in 1 minute (GPM) going X miles per hour (MPH) with X nozzle spacing (NSI) to deliver X gallons per acre (GPA).

Here is an example: A farmer wants to drive his sprayer 5 MPH. His boom has each nozzle spaced 20 inches apart, and he wants to apply 10 gallons of solution per acre.

GPM = (5 × 20 × 10) / 5940 = 1000 / 5940 = 0.16835(GPM)

So you would have to catch 0.16835 gallons in 1 minute to deliver a rate of 10 gallons per acre driving 5 miles per hour with your boom set up on 20-inch nozzle spacing. Because measuring 0.16835 gallons is not feasible, convert that number into a smaller unit like ounces. Because there are 128 ounces in 1 gallon, we can simply multiply 0.16835 by 128, which equals 21.5 ounces needed in 1 minute. Most people will take the 21.5 ounces and divide it by 2 so they only have to catch for 30 seconds rather than 1 minute (11 ounces), or divide it by 4 and only catch for 15 seconds (5.4 oz.).

Now we have an applicator calibrated to deliver 10 gallons per acre and are going to apply 1:32 of a given pesticide. The next logical question is to determine how much of that product is needed in the spray tank. If the sprayer is calibrated to deliver 10 gallons per acre and we know 1 gallon of a given pesticide is needed for every 32 acres, we need 320 gallons of water in the spray tank to spray the 32 acres. So every time you put 320 gallons in the tank, you need to add 1 gallon of the insecticide. If you have a 500-gallon tank, divide 500 by 320, and this tells you that if you filled the tank all the way up, you would need to put 1.6 gallons of insecticide in the 500-gallon tank.

Another way to think about this is using the ounces of product per acre rate. In our example of 1:32, 4 ounces of product is being applied per acre. The sprayer is calibrated to deliver 10 gallons per acre; therefore, for every 10 gallons of water you put in the tank, you need to add 4 ounces of insecticide. In our 500-gallon tank example, you would have to add 200 ounces of insecticide (500/10 = 50 and 50 x 4 oz. = 200 oz.). To get this number back to gallons, divide 200 ounces by 128 (number of ounces in 1 gallon) to get 1.6 gallons again.

Calibrating Banded Applications

The calibration of banded insecticide or herbicide applications can be very confusing. To calibrate your sprayer, use the same formula previously discussed. However, substitute the desired bandwidth in inches (BWI) where you entered nozzle spacing in inches (NSI) previously. Everything else is the same.

GPM = (MPH × BWI × GPA) / 5940

Let's assume your crop is being grown on 38-inch rows and you apply a given pesticide on a 50 percent band behind the planter for cutworm control and you want to apply 5 GPA. Because 50 percent of 38 inches is 19 inches (0.5 × 38″ = 19″), this goes in the BWI part of the formula. Also, you will be planting at 4 MPH, so this would be your speed because you are spraying off the back of the planter. The formula would look like this.

GPM = (4 x 19 x 5) / 5940 = 380 / 5940 = 0.06397 (GPM)

Again, to convert 0.06397 gallons to ounces, multiply by 128, which equals 8.2 ounces needed in one minute (or 4.1 ounces in 30 seconds) from one nozzle to deliver 5 gallons per acre on your 19-inch band at 4 MPH.

Here is where some of the confusion comes in. Let's go back to our 1:32 or 4 ounces of product per acre example. You will still mix everything exactly the same as in the broadcast application example. Because we are delivering 5 gallons per acre in this example, for every 5 gallons of water in the tank, you add 4 ounces of product, or for every 160 gallons of water in the tank, you will add 1 gallon (5 × 32 = 160). Here is the difference: on the 19-inch band (the treated acre) you are spraying, you are delivering 5 gallons per acre and 4 ounces of product, but on a land acre you are only putting out 2 ounces of product and 2.5 gallons of water because it is a 50 percent band.

Remember, you are applying the exact same rate of product and gallons per treated acre as you would be if you were treating a broadcast acre, but you will go 50 percent farther before your tank runs out. You can never have more treated acres than planted acres. For instance, because it is a 50 percent band, your tractor will cover 2 land acres for every 5 gallons of water. Your application rate remains at 4 ounces per treated acre, not 2 ounces.

Multiple Nozzles per Row

It is not uncommon to have more than one nozzle contribute to a band. We see this often early in the season when making spider mite or thrips sprays on small cotton or in hooded sprayer applications. This is useful if better coverage is desired. If you have multiple nozzles per row, this must be accounted for in your calibration. For example, if you have two nozzles contributing to a 10-inch band, you can catch from one nozzle to calibrate, but you have to multiply the answer by 2 because each nozzle is assumed to deliver equal amounts. All other calculations are the exact same as the banded example. Calibrations get more complex with some of the multi-nozzle hoods.

In-Furrow Calibrations

Calibrating in-furrow application equipment is not difficult, but it is calculated a little differently. One of the main differences with in-furrow spray calibration is you use the row width in inches in the NSI part of the formula. In-furrow sprays are common for fertilizers and insecticides. Many insecticides used in-furrow are recommended at use rates of ounces of product per 1,000 row feet rather than ounces of product per acre. This is because, when you use ounces of product per 1,000 row feet, you still deliver the exact same rate of product across a variety of row spacings in the furrow. However, as row spacing narrows, it takes more product per land acre to keep the rate per 1,000 row feet the same.

The table below shows how many ounces of product per acre you need to apply at several row spaces to keep the rate constant at 0.25 ounce of product per 1,000 row feet. These examples use Capture LFR, a commonly used insecticide applied in-furrow.

As shown in the example above, to keep the application rate per 1,000 row feet equivalent, you would have to actually mix for different rates per acre depending on your row spacing. If you are on a 38-inch twin row, this would be the same as a 19-inch row spacing in the table (for calibration purposes) because each row is delivered independently from each other. So it would cost you twice as much to apply the material as it would somebody on a single 38-inch row keeping the rate the same at 0.25 ounce per 1,000 row feet.

To figure this out by hand, you must first know how to figure out how many row feet are in an acre on a given row spacing.

Example: 38″ rows = 3.167 ft. (38″ divided by 12″ to put in feet) wide. There are 43,560 sq. ft. in 1 acre, so if you divide 43,560 by 3.167, you get **13,756 linear feet in one acre on 38″ rows**. Because the rate is 0.25 oz. per 1,000 row feet, you need to know how many 1,000 row feet are in your row spacing. Simply divide 13,756 by 1,000 and you get 13.756. Now simply multiply that by the 0.25 oz. and you see 3.4 oz. of product per acre has to be mixed to deliver 0.25 oz. of product per 1,000 row feet on a 38″ row.

It is important always to read and follow the label when applying a pesticide. For more information on the calibration of pesticides, contact your local Mississippi State University Extension office.

The information given here is for educational purposes only. References to commercial products, trade names, or suppliers are made with the understanding that no endorsement is implied and that no discrimination against other products or suppliers is intended.

Publication 2939 (POD-08-25)

By **Whitney D. Crow**, PhD, Associate Professor, Agricultural Science and Plant Protection, **Angus L. Catchot**, PhD, Director and Professor, MSU Extension; **Darrin Dodds**, PhD, Associate Director and Professor, MAFES Administration; **Jeff Gore**, PhD, Professor and Head, Delta Research and Extension Center; and **Donald R. Cook**, PhD, Associate Research Professor, Delta Research and Extension Center.

Produced by Agricultural Communications.