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Broadcast Sprayer Calibration and Application Plant Materials Tech Note

Introduction

The use of properly calibrated spray equipment is critical to ensure the protection of the environment, the crop and the applicator and to meet the desired goals of the application. Applying too little chemical will provide inadequate control of target pests and contributes to the buildup of resistant organisms. Applying too much chemical can be harmful to off-target species, damage the crop, and poses unnecessary health risks and expense for the applicator. Studies have shown that up to 60% of applicators miss the desired application rate by 10% or more, 4 out of 5 sprayers checked during the study were not calibrated, and one out of every three applicators made errors mixing chemicals (NDSU).

Calibration Procedures

Calibrating a sprayer helps to determine the exact amount of chemical that will be applied over a know distance. This may seem like a daunting task, but can be quite simple. There are many ways to calibrate a boom sprayer. The easiest is based on the relationship of 128 ounces in a gallon, and spraying 1/128th of an acre per nozzle.

With this method, the ounces caught during calibration translate directly to gallons per acre. Table 1, courtesy of Ohio State University Extension, simplifies this method even further. Simply measure the distance between the nozzles on the boom and find the corresponding spacing on the chart. Next, look at the "travel distance" column directly adjacent to the nozzle distance on the chart. This indicates the distance that should be covered to spray 1/128th of an acre per nozzle. Mark this distance off in the field, and record the time it takes to travel with the spray vehicle at the speed used to make applications. It is important to time the distance in the field on similar terrain as speeds may change depending on ground conditions. Record the travel time 3 times and then take the average. It is imperative to use some form

Table 1. Calibration distance for each nozzle to spray 1/128 acre.

Nozzle spacing (in.)	Travel distance (ft.)	Nozzle spacing (in.)	Travel distance (ft.)
18	227	30	136
20	204	32	127
22	185	34	120
24	170	36	113
26	157	38	107
28	146	40	102

*table and additional information may be found at http://ohioline.osu.edu/aex-fact/0520.html

of cruise control or to pick a gear and RPM setting to use when spraying. This maintains a constant ground speed. Vehicles that cannot travel at a constant rate, such as ATVs, cannot be accurately calibrated. It is also important to be up to speed before crossing the first marker when timing the travel distance. Back up from the first flag 20 or so yards, and make sure the tractor is at spraying speed before crossing the first marker and starting the stop watch.

Now that the travel time has been established, you are ready to calibrate. Fill the tank with clean water. Check all the nozzles and clean all the screens. When complete, turn the sprayer on and let it run. Note the fan pattern of each nozzle and look for any irregularities that might indicate a worn or clogged nozzle. Replace any damaged nozzles. When complete, turn the sprayer on again. It is important that the sprayer be running at the same RPM and operating pressure as when making the actual application. Catch the water from one nozzle for the same amount of time it took to travel the distance marked in the field. The volume in ounces represents gallons per acre. If 15 ounces were caught, the sprayer is applying 15 gallons per acre. This should be done for each nozzle. Any nozzle with an output greater than 10% of the average nozzle output should be replaced.

Application

Once the application rate of the equipment is known, it is possible to mix and apply rates of chemical accurately. The applicator determines the amount of acreage to be treated, and multiplies it by the calibrated rate. For example, if the applicator needed to treat 10 acres, and the sprayer was calibrated at 15 gallons per acre, the applicator would need 150 gallons of total volume in the tank. Always remember that some losses occur while starting, stopping, and turning in the field. Always figure an additional 10 – 15% of total volume to compensate for these losses. This will prevent the applicator from running out of spray before completing the task.

Mixing Chemicals

*Read the label and follow all instructions, it's the law.

The sentence above cannot be over emphasized. Always wear the personal protective equipment required by the label, and follow all instructions. Typically it is best to fill the sprayer's tank half way, add the correct volume of chemical, and then fill the tank to the total desired volume. This helps mix the chemical in the tank. The volume of chemical added to the tank should be used to figure the total volume needed to complete the treatment. All labels will have warning signal words. **Caution** means the chemical is slightly toxic or causes slight eye and skin irritation. An ounce to more than a pint taken by mouth could kill an average-sized adult. **Warning** means the product is moderately toxic or causes moderate eye and skin irritation. A teaspoon to tablespoon taken by mouth could kill an average-sized adult. **Danger** means the chemical is highly toxic or could cause severe eye and skin burning. Chemicals in this category carry the skull and cross bones symbol and the word **POISON** printed in red. A minute amount is all that is necessary to kill an average-sized adult when taken by mouth, and skin contact or vapor inhalation could cause acute illness (Stevenson 1991).

The label provides all the information necessary to use the product safely; such as rates for use based on the pest controlled, geographic region, soil type, and desired length of control. Some chemicals call for the addition of an adjuvant such as crop oil or a surfactant. These will increase the effectiveness of the

chemical and should not be ignored. The label will also provide a list of compatible chemicals, if they exist, that may be used as mixes, and gives specific instructions for mixing them. Always follow these instructions. Adverse chemical reaction can occur if tank mixes are not made properly.

Rate information is usually listed in quarts, pints, or ounces per acre. A good conversion website is a handy tool to make rapid calculations. Examples of such websites include: http://www.metric-conversions.org/volume-conversion.htm and http://www.curezone.com/conversions.asp. Table 2 is a quick reference for some of the more common units used when measuring pesticides.

Table 2. Liquid Measure Conversions

	¼ qt	½ pt	1 cup	8 fl oz
	½ qt	1 pt	2 cups	16 fl oz
¼ gal	1 qt	2 pt	4 cups	32 fl oz
½ gal	2 qt	4 pt	8 cups	64 fl oz
1 gal	4 qt	8 pt	16 cups	128 fl oz

Spraying

Early morning application showing proper boom height and nozzle pattern

Now that the tank is mixed, the application can be made. There are a few things to note when applying chemicals. High temperatures, low humidity, wind, and temperature inversions all play a role in the transport of chemicals off the target area. The applicator is responsible for any injury or damage caused by pesticide drift (Stevenson 1991). High temperatures and low humidity increase evaporation rates, high winds can cause spray to drift, and temperature inversions cause chemical vapors to hover near the ground surface and be transported off location. Inversions occur as fog or smoke that hangs in the atmosphere just above ground level, instead of drifting or rising upward. They occur when air near the ground is cooler than the air above it. Avoid making applications when sensitive crops or areas are downwind of the application site. Early morning and late evening are usually the best times to apply chemicals, as temperatures and wind velocities are usually lower.

The applicator should have the spray boom set at a height, usually around 18 inches, such that the spray pattern from the nozzles over lap to ensure complete coverage. The tank pressure and ground speed used to make the application should be the exact same used to calibrate the sprayer. Always allow the boom to overlap between passes made through the field to avoid leaving small, untreated strips. If nozzles and booms do not overlap during application, herbicide will leave a striping effect and weeds which can reseed. If the applicator runs short of chemical or has significant amounts left over applications, the equipments calibration should be checked.

Conclusion

Pesticide application is an important part of the integrated pest management system. In order to be effective, they must be applied at the proper rate. Calibrated equipment is essential in making such applications. The process described above is simple and consumes little time and should be done often to

ensure the equipment is functioning properly. In the end, calibration protects the environment, crop, applicator, and saves money.

References

http://www.noble.org/tools/boom.html

http://www.ag.ndsu.edu/pubs/ageng/machine/ae73-1.htm#introduction

http://www.teejet.com/media/007628e1-9b61-4d14-9a8a-12cb388a4c1b-sprayinsun.jpg