Calibration & safety of pesticide application equipment

Calibration accuracy and personal safety associated with pesticide application is key to a successful pesticide program.

HOW TO USE THE WORKSHEET (FIGURE 1)

Nozzle Uniformity
1. Enter date, nozzle code and sprayer operating pressure in appropriate box. Verify that all nozzles are the same type and size along the boom.

2. Catch the flow from each nozzle for exactly the same amount of time. The number of seconds used is usually between 20 and 60, but make sure that at least 20 ounces are collected in each calibration jar (to help reduce error size). It is very important to maintain a constant operating pressure throughout the entire operation. Enter catch times in appropriate boxes.

3. Calculate average nozzle output.

4. Determine if any nozzles are significantly worn or clogged by verifying that all flow rates are within + or - % of the average nozzle output. (Typically between 5-10% limit.)

5. Clean, replace or recheck nozzles exceeding the predetermined limit.

Speed Calculator
1. Calculate field spraying speed of the machine by laying out a level test course at least 100 feet long (Use a turf area, not a parking lot or cart path). Fill machine ½ full of water to simulate average load and record the exact amount of seconds to travel entire course at operating speed. Use this data in the equation provided.

Application Rate
** GPM and Speed calculations should appear in appropriate boxes (from previous formulas).

1. Measure nozzle spacing in inches. Enter number (in inches) in box.

2. Calculate the calibration rate using the formula provided. Read the product label to determine if this calibration rate falls within guidelines. Use manufacturer’s catalogue charts to help verify your calculations.

NOZZLE SELECTION AND SIZING (FIGURE 2)

1. Determine the recommended calibration rate. (Refer to product label.)

2. Measure nozzle spacing in inches.

3. Determine the spraying speed you will be using in the field.

4. Determine the appropriate nozzle size from manufacturer’s charts.

5. Calculate the nozzle flow rate necessary to achieve the desired calibration rate with the sprayer.

6. Use nozzle manufacturer’s catalogue to determine the nozzle identification code that corresponds to the nozzle style and
BOOM SPRAYER CALIBRATION: KNOWN AREA METHOD (FIGURE 3)

1. Measure a level test course at least 100 feet long on a turf area (not a parking lot or cart path). The width of this test course will be the spacing between each nozzle in feet.

   Nozzle Spacing in Inches divided by 12 = Test Course Width in Feet. Total square feet of the area is Length X Width.

2. Fill machine 1/2 full of water to simulate average load and record the exact number of seconds to travel the entire test course at normal operating speed. Use a calibration jar to collect the flow from each nozzle for the same amount of time it took to cover the test course. Calculate the average nozzle output and replace or clean any nozzle with a flow rate not within 5% of the average. Average Nozzle Flow in Ounces divided by 128 oz. per gallon = Average Gallons Applied

3. Record all data for future use. Calculate your + or - 5% acceptable error range (Target Area vs. Sprayed Area). Each time you use your sprayer, the calibration rate must fall within these values. Either repair or replace components causing calibration rate inaccuracy.

TIPS: Check for wear more frequently when spraying wettable powders. Verify the accuracy of your measuring devices.

EASY METHOD SPRAYER CALIBRATION (128TH ACRE TEST)

1. Fill spray tank with clean water.
2. Verify that spacing between nozzles is equal (record in inches).
3. Perform nozzle uniformity test.
4. Measure test course. (Use chart below or formula to determine course length.) (Formula: 4080 / Nozzle Spacing in Inches = Test Course in Feet.)
5. Drive the test course at your normal spraying speed and record travel time in seconds.
6. Park sprayer while maintaining the same engine RPM used to drive the test course.

flow rate chosen for the equipment.

7. Follow nozzle manufacturer’s recommendation for proper nozzle height.
7. Set pressure to be used while spraying.
8. Collect the output from one nozzle for the same amount of time it took to travel the course.
9. Each ounce collected equals a gallon per application rate. (Example: 52 ounces collected equals 52 gallon per acre application rate)

**TANK MIXING (FIGURE 4)**

1. Determine the recommended application rate from the product label. This value can be in fluid or dry ounces.
2. Enter the calibration rate measured from the sprayer.
3. Calculate the product per gallon ratio according to the worksheet.
4. Calculate the amount of product required for each tank or partial tank. Before adding product, you should fill the tank 1/2 full of water and begin agitation. After product’s been added, bring tank up to desired level/volume.

For planning purposes, it may be useful to calculate the following:

5. Estimate the area to be treated. This value will be slightly larger than actual green or fairway size due to overspray of irregular areas.
6. Estimate the total water requirements. You can use this figure to determine how many spray tanks the application will require.
7. Estimate the product requirements and check if supplies are adequate before mixing.

**TIPS:** Verify the markings on your spray tank for accuracy and use a dipstick or flow meter to measure partial tanks. Do
not mix more solution than is required for the operation.

INSTRUCTIONS FOR THE ADVANCED SECTION (FIGURE 5)

You’ve measured the actual calibration rate of the sprayer. You want to spray a calibration rate of 2.0 gallons per 1000 square feet. Determine how to make the adjustments in question #1 and #2.

1. If you only want to change your sprayer speed to achieve the new calibration rate, how fast would you need to go? MPH = 136.36 X GPM divided by CR x W

2. Instead of changing your speed to achieve a new calibration rate, you decide to change only nozzle flow. What is the new GPM? Do you need to select a larger nozzle or just change the pressure? GPM = CR X MPH X W divided by 136.36

3. This is a useful method to calculate your actual nozzle operating pressure. The formula allows you to compare field measurements to nozzle performance charts. This calculation is used primarily to track the amount of pressure drop in your sprayer.

GPM (1) = Measured nozzle flow from sprayer (Actual Catch).

GPM (2) = Flow rate from nozzle performance chart.

PSI (1) = Actual nozzle operating pressure. PSI (1) is X, the unknown value. Find X to solve the equation.

PSI (2) = Nozzle pressure from chart that corresponds with GPM (2).

LAWN GUNS, BACKPACK AND BOOMLESS SPRAYER CALIBRATION (FIGURE 6)

1. Pick a level turf area and mark a rec-
SPREADER CALIBRATION WORKSHEET: 
KNOWN AREA METHOD

DATE __________

1. MEASURE AREA OF TEST COURSE:
   LENGTH = ________ FEET
   WIDTH = ________ FEET
   LENGTH X WIDTH = ________ SQUARE FEET

2. MEASURE AMOUNT OF MATERIAL APPLIED OVER TEST COURSE:
   MATERIAL WEIGHT PRIOR TO APPLICATION = ________ POUNDS
   MATERIAL WEIGHT AFTER APPLICATION = ________ POUNDS
   TOTAL AMOUNT OF MATERIAL APPLIED = ________ POUNDS

3. CALCULATE CALIBRATION RATE:
   POUNDS APPLIED = ________ X 1000 = ________ POUNDS PER 1,000
   SQUARE FEET
   POUNDS PER 1,000 SQUARE FEET X 43.56 = ________ POUNDS PER ACRE

DATA RECORD

SPREADER________________________
SETTING________________________
MATERIAL________________________
PASS WIDTH_____________________
MACHINE________________________
GEAR____________________________
RPM____________________________
OTHER__________________________

USEFUL FORMULAS

OUNCES = POUNDS  
16
GRAMS = POUNDS  
454

TIPS:

Maintain a constant operating speed and pressure throughout entire application. Verify the accuracy of your measuring devices. Calibrate your equipment at the same speed, pressure and overlap as you will use in the field.

SPREADER CALIBRATION (FIGURE 7)

1. Select a level area, preferably covered with turf and mark a rectangular test course of approximately: 1,000-5,000 square feet for small spreaders, and 10,000-40,000 square feet for larger spreaders.

2. Measure the exact amount of material applied over the area.

   This can be done by:
   A. Place a (weighed) known amount of material in the spreader. Re-weigh the material left in the spreader after completing the test course; or
   B. On larger machines, it may be necessary to place calibration marks on the spreader bin or place. A known amount of material in the spreader and measure the total area covered after all material is used.

3. Calculate the calibration rate according to the worksheet.

4. Record all data for future use.

   TIPS: Maintain a constant operating speed and pressure throughout entire application. Follow manufacturer’s recommendations for overlap. If unavailable, determine the amount of overlap required by placing a series of catch cans perpendicular to spreader travel and measuring the application pattern or use between 75-100% overlap of the width of throw.
SAFETY—THE “THREE C’S” PROGRAM

Control the spill. Immediate steps must be taken to control the spill. Make sure you are properly protected, isolate the area, avoid contact with the material, drift, or fumes, and evacuate any nonessential people from the area. Do not leave the spill unless someone can relieve you, preferably someone who has “Three C’s” training. Once the spill is under control, get help immediately and notify your supervisor. Depending on the size of the spill, you may need to contact “HAZMAT”, police, fire and rescue units, and the Dept. of Natural Resources.

Contain the spill. Contain the spill in as small an area as possible. Use a rake or a shovel to make a dam or dike around the spill to keep it from spreading. Block off any ditches or depressions in the area of the spill to insure the spill’s containment. Do not allow the flow of material to reach any bodies of water.

Liquid pesticide spills can be further contained by the use of absorbent materials such as sand, sawdust, kitty litter or absorbent pads. Before using absorbent material, make sure the chemical is compatible with the absorbent material used. A reaction may occur between the spill and the material used to clean up the spill. Pesticides with strong oxidizers may create a fire when mixed with sawdust, thereby compounding an existing problem. (Chlorites in some herbicides and ammonium nitrate in some fertilizers are two examples of oxidizers.)

Dry pesticide spills can be contained by lightly misting the material with water, or by covering the spill with plastic.

Clean up the spill. Liquid: Spread absorbent material over the contaminated area, sweep it up and place it in a heavy-duty plastic bag. Repeat this procedure until the spill is cleaned up.

Dry: Material must be swept up and reused if possible. If material gets wet, becomes contaminated with soil or other debris, it must be swept up and placed in a heavy-duty plastic bag.

To decontaminate or neutralize the area, mix full strength, ordinary household bleach and hydrated lime. Wear protective clothing and work the preparation into the spill area with a course broom. Place the contaminated preparation in a heavy-duty plastic bag. Repeat this procedure several times to insure neutralization of the pesticide. Never hose down the contaminated area to dilute the pesticide. Activated charcoal can be used to minimize significant plant injury in smaller spills. Charcoal can tie up or absorb enough chemical to reduce long-term contamination.

Soil contamination: Remove the top two or three inches of soil, cover with at least two inches of lime and cover the lime with fresh top soil. Dispose of the contaminated soil.

Clean or dispose of all equipment and materials used in the clean up in a manner consistent with label requirements and any EPA, local or state regulations.

All materials used to control, contain, and clean up a pesticide spill must be handled as hazardous waste and must be disposed of in a manner consistent with the label requirements and any EPA, local or state regulations.

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Routes of pesticide exposure

TO EFFECTIVELY GUARD AGAINST PESTICIDE EXPOSURE, we must first realize the risk involved when handling pesticides and how they enter our bodies.

FOUR ROUTES OF ENTRY

• **Dermal.** Studies show that about 97% of all pesticide exposures occur through contact with the skin. This absorption is accomplished by careless handling, while mixing or loading, applying or disposing of pesticides and their containers. The most common of these would be splashes, spills, or drift, while mixing or loading (handling the pesticide in its most concentrated form).

• **Inhalation.** We all know that the lungs oxygenate our blood. So if we inhale a sufficient amount of a pesticide into our lungs, complete and rapid pesticide poisoning will occur when the blood passes through our lungs then out, to travel in the blood stream throughout the entire body. Poisoning by inhalation is not limited by any means. Damage to tissue in the nose, throat, and lungs can also produce long-term health problems and illnesses.

• **Oral.** More often than not, children are victim of this type of exposure, greatly due to a careless applicator or even a parent who has removed a pesticide from its original container and put it into an unmarked bottle or other storage container. However, for our purposes, one must realize that oral exposure can occur with a simple lick of the lips, smoking, chewing (tobacco or gum), eating or drinking, while handling pesticides.

• **Eyes.** The eye though very small can absorb enough pesticide to be significantly hazardous. Poisoning here is most generally accomplished through the rubbing of one’s eyes with contaminated hands. Spills, splashes and drift are also methods of entry to guard against.

TOXICITY (LD50, LC50)

What do we need to know about these two numbers? Simply put, the higher the LD50 or LC50 number, the lower the incidence of poisoning has occurred in laboratory testing of that pesticide. On the other hand, the lower that number, the greater the incidence of poisoning has occurred in lab testing, and those pesticides will generally carry a signal word of “Danger.” Signal words are derived from LD (lethal dose) or LC (lethal concentrate) numbers, so if you can’t find one of these numbers on the label, or MSDS, follow the signal word precautions.

For personal safety, always wear protective gear and always wash up immediately following contact with any pesticide.

Personal protective equipment

YOU NEED TO DECIDE! Read the label. The formulation, signal word, precautionary statements, personal protective equipment statements, the application method, and the projected length of exposure indicate the personal protective equipment you need.

MINIMUM EXPOSURE

(Such as granular applications and many other routine pesticide activities.)

• Protective suit (such as fabric coveralls) worn over normal work clothes.

• Chemical-resistant gloves such as rubber, vinyl, or plastic (never use fabric, leather, or paper gloves).

• Socks and shoes or boots

MAXIMUM EXPOSURE

(Such as direct contact with drenching spray, mist blower or knapsack applications, or handling very highly toxic pesticides.)

• Chemical-resistant hood or hat

• Goggles or face shield

• Respirator (if the label requires it or if dusts, mists, fogs, or vapors will be generated).

• Chemical-resistant protective suit worn over normal work clothes.

• (A chemical-resistant protective suit may cause heat stress under some conditions.)

• Chemical-resistant gloves such as rubber, vinyl, or plastic (never use fabric, leather, or paper gloves).

• Chemical-resistant boots or footwear (never wear leather or canvas footwear).
Handling Concentrates

- This is the minimum protective clothing and equipment you should wear while mixing and loading pesticides which are moderately to highly toxic.

- Protective suit (such as fabric coveralls) worn over normal work clothes.

- Chemical-resistant apron

- Chemical-resistant gloves such as rubber, vinyl, or plastic (Never use fabric, leather or paper gloves)

- Chemical-resistant boots or footwear (Never wear leather or canvas footwear)

- Face Shield or goggles

- Respirator (If the label requires it)