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SPRAYER CALIBRATION

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A wide variety of spraying equipment is used to apply agrochemicals. Proper application of chemicals ensures crop and application safety, optimum efficiency and cost effectiveness. For these reasons, calibration and maintenance of spray equipment are essential. Over application of chemicals is costly and may result in crop injury or carryover. Under-application may result in poor control.

Nozzle selection

Nozzles could be considered to be the most important part of the spray equipment. Different materials are used for manufacturing nozzles. Brass nozzles are the cheapest, but the least durable. They are susceptible to corrosion, especially with fertilizers and wettable powders. Plastic is more durable and has good chemical resistance. Hardened stainless steel nozzles have very good wear life and durability and have good chemical resistance. Ceramic nozzles are the best, but are also the most expensive. No nozzle is immune to poor cleaning practices such as wire inserted into the opening.

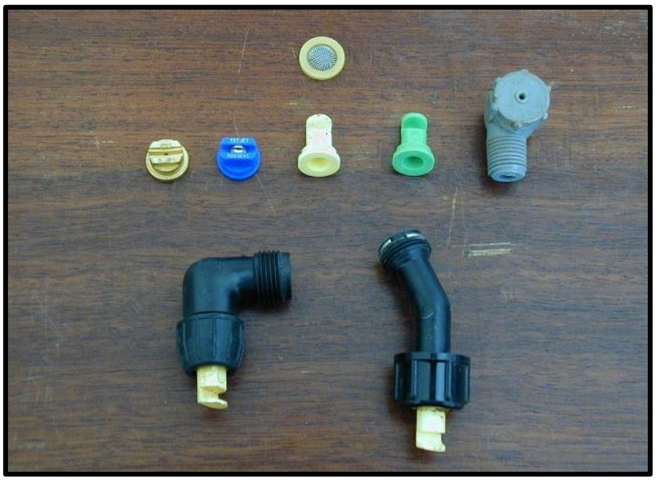

FIGURE 1: *Different type of nozzles*

The nozzle design and spraying conditions will determine the uniformity of droplets, the droplet size and the rate at which the chemicals will be applied. Droplet size is dependent on the nozzle opening size, the spray pressure and the chemical surface tension. Small droplets are the result of a small nozzle opening, high spray pressure and low chemical surface. As the pressure is increased, the amount of fine spray droplets will increase and ultimately spray drift can occur.

For broadcast applications a flat-fan and flood jet nozzle can be used. A flat-fan nozzle has an oval spray pattern with uniform coverage.

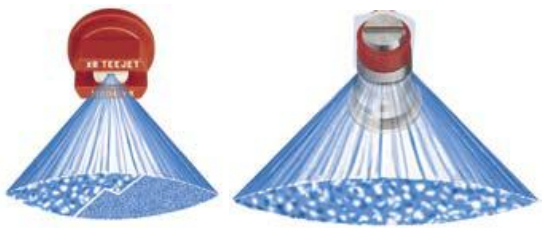

FIGURE 2: *Spray patters of the flat-fan and flood jet nozzles*

The flood jet nozzle produces large coarse droplets with less uniform distribution than flat-fan nozzles. They are more often used for soil applications. Even flat-fan and hollow cone nozzles are used for band application. The even flat-fan nozzle is ideal for banding over the row or between the rows with uniform coverage across the spray pattern. The spray width of nozzles will be determined by the spray angle and height. The hollow cone nozzle produces small droplets and can be used for banding herbicides and insecticides over the row. They are used primarily for fungicide applications.

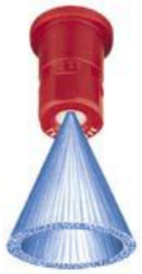

FIGURE 3: *Spray pattern of a hollow cone nozzle*

Water quality

When applying agrochemicals, use the best quality water available and spray as soon as possible after mixing the chemicals with the water. There are three water quality factors that influence the efficacy of agrochemicals:

- The acidity or alkalinity of the water
- Minerals dissolved in the water and
- Suspended soil particles or dirty water.

Acidity and alkalinity

The pH of the water is an indication of its acidity or alkalinity. The ideal pH of the spraying water is pH 5-7. Exceptions do occur, therefore consult the agrochemical label. Some herbicides will degrade in acid water, while insecticides and fungicides degrade in alkaline water. Adjuvants such as a buffer or an acidifier can be added to the water to either maintain the pH or to change it. The following are general guidelines for spraying with water at the following pH. For more information, consult the agrochemical label.

- pH 4-6: sufficient for general spraying in the short term
- pH 6-7: adequate for most agrochemicals. Do not leave the mixture in the tank for more than 2 hours
- pH > 7: add a buffer or acidifier.

Dissolved minerals

The efficacy of especially salt-formulated chemicals such as 2,4-D amine or glyphosate, can be influenced by the presence of the following minerals in the water:

- calcium (Ca)
- magnesium (Mg)
- sodium (Na)
- chloride (Cl)
- iron (Fe) and
- bicarbonate (HCO3).

The electrical conductivity (EC) of the water indicates water quality as it measures the total dissolved mineral content. An EC below 500 µS/cm is unlikely to influence agrochemical performance. “Hard water” reduces the effectiveness of 2,4-D and glyphosate due to the minerals Ca, Mg and Fe in the water.

Dirty water

A rule of thumb is that if a coin is difficult to see in a 10 L bucket, then it is not advisable to use the water for agrochemical applications. The suspended clay and organic matter particles reduce the activity of some herbicides such as paraquat and glyphosate. Plants covered with dust have the same effect. Agrochemicals are inactivated by the clay and organic matter present in soil, water or leaf surfaces. Filtration can be used to reduce the total dissolved particles in the water, but it is advisable to use clean water.

Knapsack calibration

The amount of agrochemical needed for control is determined by the amount of water the equipment delivers and the specific chemical properties. Poor control results are, in most cases, due to incorrect calibration and not the product that was used. Before calibration, make sure that your equipment is in good condition and that the correct nozzle has been selected. The nozzle must be inspected for blockages or physical damage. To calibrate your sprayer, the following information is needed:

- the dosage rate at which the chemical must be applied which will depend on your crop and soil type
- the size of your spray tank
- nozzle spray width and output
- your walking speed.

To determine your **walking speed**:

- Measure out 10 m on a flat surface.
- Pour 2 L of water into the tank.
- Measure the time to walk the distance while pumping at a constant rate and pressure.
- Repeat the exercise three times and take the average of three.

To determine the **nozzle output**:

- At the same pumping rate and pressure used while walking, spray into a container for the equivalent time to walk 10 m.
- Measure the amount of water.
- Repeat the exercise three times and take the average of three.

Calculate the **volume applied** by your sprayer at your walking speed in **litres** per hectare with the following formula:

$$\text{Volume applied (L/ha)} = \frac{10\,000 \times \text{nozzle output (L)}}{\text{distance walked (m)} \times \text{nozzle spray width (m)}}$$

Calculate the **amount of chemical** needed to add to the tank:

$$\text{Chemical Volume (L)} = \frac{\text{tank size} \times \text{dosage rate}}{\text{volume applied}}$$

Example:

You have a problem with grasses in maize. Before the maize emerge, you want to spray a pre-emergent herbicide to control the weeds. Soil analysis indicate that your clay percentage is 37%. The label recommends that the dosage rate is 0.6-0.7 L/ha. Your knapsack tank can hold 20 L of water. You took, on average, 15 s to walk 10 m and the nozzle delivered, on average, 243 ml of water in 15 s. You nozzle spray width is 50 cm.

$$\text{Volume applied (L/ha)} = \frac{10\,000 \times \text{nozzle output (L)}}{\text{distance walked (m)} \times \text{nozzle spray width (m)}}$$

$$= \frac{10\,000 \times 0.243}{10 \times 0.5}$$

$$= 486 \text{ L/ha}$$

NS: Remember to convert the 234 ml and 50 cm to litres and meters in your formula

$$\text{Chemical Volume (L)} = \frac{\text{tank size} \times \text{dosage rate}}{\text{volume applied}}$$

$$= \frac{20 \times 0.6}{486}$$

$$= 0.0247 \text{ L}$$

$$= 24.7 \text{ ml}$$

Therefore you must use 24.7 ml of the pre-emergent herbicide in a 20 L tank.

Boom sprayer calibration

The same principles apply for boom sprayer calibration. The following information is needed:

- the dosage rate at which the chemical must be applied
- the size of your spray tank
- nozzle spray width and output
- tractor speed and gear at which the application is going to be made.

To determine your **speed**:

- Measure out 100 m on a flat surface.
- Pour 100 L of water into the tank.
- Decide on a suitable tractor speed and spray pressure and select a gear and engine speed which will maintain this speed.
- Measure the time the tractor takes to cover the distance from a moving start to the 100 m marker.

- Repeat the exercise three times and take the average of three.

To determine the **nozzle output**:

- While standing still, run the sprayer at the same engine revolutions and pressure it used while covering the 100 m distance.
- Measure the amount of water from each nozzle for the time period the tractor took to cover the 100 m.
- Repeat the exercise three times and take the average of three.

Now use the same formulas to calculate the spray volume and quantity of agrochemical needed.

Example:

You have a problem with grasses in maize. Before the maize emerged, you want to spray a pre-emergent herbicide to control the weeds. Soil analysis indicate that your clay percentage is 37%. The label recommends that the dosage rate is 0.6-0.7 L/ha. Your tank can hold 300 L of water. You took, on average, 40 s to cover 100 m with the tractor. The 10 nozzles delivered, on average, 15.6 L of water in 40 s. Your total nozzle spray width is 0.5 m.

Volume applied (L/ha)

$$= \frac{10\,000 \times \text{nozzle output (L)}}{\text{distance walked (m)} \times \text{nozzle spray width (m)}}$$

$$= \frac{10\,000 \times 15.6}{100 \times 4.5}$$

= 312 L/ha

Chemical Volume (L)

$$= \frac{\text{tank size} \times \text{dosage rate}}{\text{volume applied}}$$

$$= \frac{300 \times 0.6}{312}$$

= 0.576 L

= 577 ml

Therefore you must use 577 ml of the pre-emergent herbicide in the 300 L tank.

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