Machinery Calibration: Boom-sprays, Seeders and Fertiliser Applicators

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Introduction

A frequently neglected but essential part of any cropping program is accurate calibration of machinery. Many farmers tend to disregard the fact that the use of accurate quantities and correct placement of such items as seed, fertiliser, or herbicide is essential for producing a good crop to achieve economic success. Excessive use of such a product adds to cost and can even reduce yield, while inadequate use will reduce yield, or simply fail to have the desired effect.

Boom-sprayers, planters and fertiliser spreaders all require careful calibration each season for applying the correct amount of a relevant product. This is necessary because not only do products change in size and/or consistency each year, but machinery wears out slowly and may need a change in the amount of the product used from season to season even when using the same product through the same machine.

Chemical Use

The most common methods of chemical application are by boom-spray, herbicide roller or agricultural aircraft. Boom-sprays provide a relatively cheap and effective method of applying both herbicides and insecticides.

Before applying any chemical:

- Read the label.
- Select the application rate.
- Check that all nozzles on the boom are the same type and size.
- Know the water quality. Poor quality water will adversely affect the performance of the chemical.

Boom-spray

Before calibrating check that:

- The pump is operational.
- By-pass valves are functioning properly.
- The filters are the correct size and are clean.
- The tank is clean.
- All taps are working.
- There are no leaking connections.
- Hoses are clean.
- Nozzles are clean.
- The pressure gauge is working.

Nozzle Type

If a low amount of water is being used, nozzle angles should be increased. If the amount of water used is more than 50 L/ha, use 80 º or 100 º nozzles.

A nozzle of 80 º produces large droplets suitable for applying residual herbicides to bare ground. When applying herbicide to weeds, a 110 º nozzle is preferred as the smaller droplets are less prone to dripping off leaves. Nozzle tips are made of various materials and the rate of wear varies accordingly. A brass tip may only last 5 to 10 hours when using wettable powders, whereas harder tips may last over 50 hours using the same product.

All nozzles should be calibrated every 50 hours, and where there are variations of more than 10% from the average, they should be replaced. Check spray patterns visually at regular intervals and check the cause of any irregularity.

Fan type nozzles are recommended for herbicides and cone type nozzles for insecticides.

Boom-spray Calibration

There are several methods for calibrating boom-sprays. However, whichever method is chosen, it will be a waste of time and money if accurate measurements are not taken. Appropriate calibration will save money by achieving the desired results leading to greater profits.

The following are three simple accurate methods for calibrating boom-sprays:

Method 1

1. Set the pressure at the required level.

2. Using a measuring cylinder, measure the output (in mL) per nozzle for 60 seconds. Any nozzle that varies by more than 10% from the average should be replaced. Note the average output (AV, mL).

3. Measure a distance of 100 m in the field to be sprayed. Record the time in seconds (T secs) that it takes to travel this distance (average of at least three runs) using the same tractor in the same gear and with the same engine speed as you intend to use when spraying.

4. Measure the distance (in cm) between nozzles (Di, cm). Output (L/ha) can now be calculated using the following formula:

$$\text{Boom-spray output (L/ha)} = \frac{\text{Average output to nozzle (mL/min) x 60}}{\text{Nozzle spacing (cm) x Speed of spraying (Km/h)}} = \frac{\text{AV x T}}{\text{Di x 6}}$$

Example:

Assume the following measurements:
Output/nozzle/minute = 700 mL
Time to travel 100 m = 36 secs (10 km/hr)
Distance between nozzles = 50 cm

$$\text{Output in L/ha will be} = \frac{700 \times 36}{50 \times 6} = 84 \text{ L/ha}$$

Method 2

1. Take the same measurements as above except for Number 3. Replace this with the following:

2. In the paddock to be sprayed, measure the distance (in metres) travelled in a minute (Y, m/min) making sure that the gear and engine speed used are the same as will be used when spraying.

3. The formula for calculating output will now be:

$$\text{Output in L/ha} = \frac{\text{AV x 1000}}{\text{Y x Di}}$$

4. Taking the same figures as used in the first example, the distance travelled in a minute would be 166 m.

$$\text{Output in L/ha} = \frac{700 \times 1000}{166 \times 50} = 84 \text{ L/ha}$$

Method 3

1. Take the same measurements as method 1.

2. For Number 3, calculate speed using the formula

$$\text{Speed (km/h)} = \frac{360}{\text{Time in seconds}} = \frac{360}{36} = 10 \text{ km/h}$$

3. Output in L/ha is using the formula

$$\text{Output (L/ha)} = \frac{\text{AV x 60}}{\text{Di x Speed of spraying (km/h)}} = \frac{700 \times 60}{50 \times 10} = 84 \text{ L/ha}$$

There are other methods which you may choose, but remember to check the output of each nozzle to ensure an even spray.

Spraying Operation

Check the following before going out to spray:

- **Wind** - Do not spray in strong wind, which can be dangerous for the operator, be less effective in what you are doing and/or may damage neighbouring crops.
- **Temperature** - Avoid spraying during periods of high temperature.
- **Humidity** - Avoid spraying during periods of low humidity (associated with high temperature, means high evaporation).
- **Soil moisture** - Soil contact herbicides should be sprayed onto moist soil.
- **Plant stress** - Avoid spraying target plants when they are stressed.

Spray Drift

Spray droplets drifting onto nearby susceptible crops when using herbicides can be a major risk. Several factors can contribute to spray drift:

- Weather conditions during and after spraying.
- Droplet size.
- Height of the boom-spray.
- Direction of travel in relation to wind (spraying into the wind increases the risk of drift).

Operating Pressure

The pump should normally be operated at a pressure of 250-300 Kpa.

Height

The proper height of a boom-spray is an important factor in ensuring a complete and even coverage of the target. When spray drift is not a problem, it is best to set the height so as to get a double-coverage spray pattern. Table 1 lists the height required from the nozzle to the target, where nozzles are 50 cm apart, to obtain either a single or a double coverage.

Table 1. Nozzle height (cm) for single and double overlap for nozzles 50 cm apart

Angle (º)	Single coverage	Double coverage
80	46	92
110	25	50

PLANTER CALIBRATION

All planters should be carefully calibrated before sowing starts. This should be done every season because seed size varies and machinery wear can alter rates. Machinery manufacturers supply tables which give some indication of rates, which is a reasonable starting point. The actual calibration is not difficult once you have selected the required rate, which will depend on the eventual plant population required.

The simplest method of calibration is as follows:

1. Place some of the seed to be sown in the planter box.

2. Unhook the seeding tubes and tie bags over the outlets in order to collect any seed which would normally go down the tube.

3. With the sowing mechanism engaged, drive the planter over a measured distance (Di, metres) with a minimum distance of 100 m.

4. Remove the bags of seed and weigh them on accurate scales (kg).

5. Measure the width of the planter in metres (Pw, m).

The formula for sowing rate is: $\frac{10000 \times kg}{Di \times Pw}$ kg seed/ha

That is weight of seed in kilograms, divided by area in hectares.

Example:

If 0.61 kg of seed was collected from a 6-m wide planter over a distance of 100 m, the sowing rate would be:

$$\frac{10000 \times kg}{Di \times Pw} = \frac{10000 \times 0.61}{100 \times 6} = 10.16 \text{ kg seed/ha}$$

If there is a large number of sowing outlets, seed may be collected from a minimum of a quarter of them. In such cases, do not forget to multiply the weight of seed collected from each outlet by the actual number of outlets.
Sowing is the most critical operation in the cropping program. Too much seed leads to waste and a probable yield reduction, while too little seed leads to a probable yield reduction. Therefore, take the time to calibrate accurately.

Fertiliser Calibration

Spreaders

Information provided by spreader manufacturers on the settings required to apply a selected quantity of fertiliser is generally fairly accurate - at very least, it is a good starting point. To check this rate, place a known quantity of fertiliser in the spreader and measure the area that it covers evenly. Divide the quantity used by the area (ha) covered to obtain the rate applied/ha. If alterations are required, adjust the settings and repeat the above exercise on another section of the paddock. Remember that the spreader width will vary with bare ground and crop height. It is important to measure the effective spread width as large particles will spread out farther than small particles. There is a need to allow for overlap.

Fertiliser boxes

This refers to fertiliser boxes fitted to combines or row crop planters. When using fertiliser boxes, the following steps should be taken:

1. Place some of the fertiliser in the box.

2. Remove fertiliser placement tubes from their boot and tie bags over the tube outlets in such a way as to collect any fertiliser which would go down the tube.

3. With the fertiliser box drive mechanism engaged, drive the machine over a measured distance (Di, metres) with a minimum distance of 100 m.

4. Remove the bags and weigh the total amount collected (kg).

5. Measure the total width covered by the fertiliser box in metres (Fw, m)

The formula for fertiliser rate is: $\frac{10000 \times kg}{Di \times Fw}$ kg/ha

That is weight of fertiliser in kilograms divided by area in hectares.

Example:

If 6.54 kg were collected from a 4-m combine over 100 m, the appropriate fertiliser rate would be

$$\frac{10000 \times kg}{Di \times Pw} = \frac{10000 \times 6.54}{100 \times 4} = 163.5 \text{ kg/ha}$$

For further information, contact a DPIR Agricultural Extension Officer, visit your local DPIR office or call the Darwin office on 8999 2214 or the Katherine office on 8973 9737.

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