

# Calibration Worksheet – Boom Sprayer

Follow this step-by-step procedure to calibrate a sprayer. All liquid volumes are in litres (L), but you can use *either* metric or *imperial* units for distance and area (don't mix them). Circle the units used such as 500 (L/ha) L/acre

After you've finished calibrating your equipment, **write key data in the box at right for future reference.**

Use the pesticide worksheet on pages 241 and 242 to find the area sprayed by a full tank, and to calculate how much of each pesticide you'll need to buy and add to each tank.

Measured delivery rate _____	L/ha L/acre
Area sprayed by a full tank _____	ha acre
Tractor gear _____	
Throttle _____	rpm
Forward speed (if Timed Output) _____	km/h mph
Nozzles _____	
Regulator Pressure _____	kPa(psi)
Date _____	

## 1. SET-UP

### Inspection Before Sprayer Start-up

- Tank size is \_\_\_\_\_ L
- Calibration strip or dipstick for tank?
- Tire size & pressures okay?  
(Record on p 245)
- Hoses in good condition?

#### Filler opening screen

- in place? clean? good repair?
- mesh size correct? \_\_\_\_\_

#### Suction screen

- in place? clean? good repair?
- mesh size correct? \_\_\_\_\_

#### Nozzle screens (check each one)

- in place? clean? good repair?
- mesh size correct? \_\_\_\_\_

#### Nozzles:

- nozzle type okay?
- all same size/ID#? (record in box above)
- correct nozzle spacing of \_\_\_\_\_ cm(*in*)
- nozzles spaced evenly?
- clean? not worn?
- aligned?
- are there nozzle check valves?

#### Boom height

- above target? \_\_\_\_\_ cm(*in*)
- is boom level?

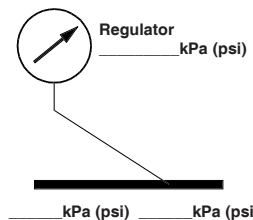
#### Surge tank (piston & diaphragm pumps only)

- working properly?
- air pressure correct at \_\_\_\_\_ kPa(psi)

### Inspection with Sprayer Running

Fill the tank more than half full with clean water.

- start sprayer pump & run tractor throttle at \_\_\_\_\_ rpm.  
Note pump's maximum rpm is \_\_\_\_\_.
- open boom valve to fill lines and begin spraying
- clean nozzles producing distorted pattern and retest
- throw out damaged nozzles and repl them



#### Check and fix any problems

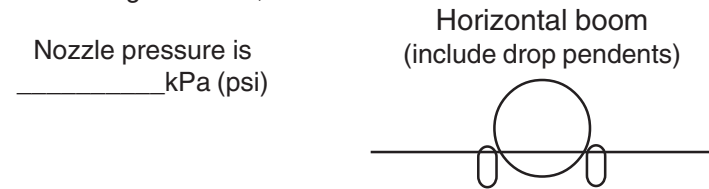
- leaks?
- valves working?
- agitation okay?
- bypass flow okay?
- adjust pressure regulator to get right spray pressure at the nozzles

Measure pressure at regulator and nozzles along boom. Draw extensions of the boom as necessary.

- pressure gauge working?
- Pressure drop less than 10%?

# Measuring Nozzle Output

Draw nozzle locations on the diagram below and number them to identify which ones may need to be cleaned or replaced after testing. As the sprayer runs, collect and record the output for a set time eg. 1 minute, 30 sec or 15 sec. Measure in litres.



1. In the box below, divide Total Output in L by the number of nozzles to find the average output per nozzle for collection time.

Total Output Collected	÷	# of nozzles	=	Average Output Collected
L	÷	noz.	=	L

2. For uniformity, find the maximum and minimum acceptable output (5% more or less than average.) Replace if above maximum output.

Minimum Output = 0.95 x _____ Average Output = _____ L
Maximum Output = 1.05 x _____ Average Output = _____ L

3. Replace all nozzles if average output is 15% more than a new nozzle's output (from manufacturer's chart or discharge test).

Average Output per Collection	÷	Collection Time	x	Conversion	=	Average Output
L	÷	sec	x	60 sec/min	=	L/min

New Nozzle Output	x	Constant	=	Maximum Average Output
L/min	x	1.15	=	L/min

**Swath Width** Do only ONE of these. You'll use the swath width on the next page.

**Broadcast swath:** multiply number of nozzles by nozzle spacing; convert to metres or feet

# nozzles	x	spacing	÷	conversion	=	swath width
noz.	x	cm	÷	100 cm/m	=	m
noz.	x	in	÷	12 in/ft	=	ft

**Band swath:** multiply number of bands by width of each band; convert to metres or feet

# bands	x	band width	÷	conversion	=	swath width
bands	x	cm	÷	100 cm/m	=	m
bands	x	in	÷	12 in/ft	=	ft

**Row crop swath:** multiply number of rows by width of each row. (Note: rows are stated in metres or feet, so no conversion is needed).

# rows	x	row width	=	swath width
rows	x	m	=	m
rows	x	ft	=	ft

Nozzle Output		Nozzle Output	
Litres per ____ sec		Litres per ____ sec	
1.	_____ L	26.	_____ L
2.	_____ L	27.	_____ L
3.	_____ L	28.	_____ L
4.	_____ L	29.	_____ L
5.	_____ L	30.	_____ L
6.	_____ L	31.	_____ L
7.	_____ L	32.	_____ L
8.	_____ L	33.	_____ L
9.	_____ L	34.	_____ L
10.	_____ L	35.	_____ L
11.	_____ L	36.	_____ L
12.	_____ L	37.	_____ L
13.	_____ L	38.	_____ L
14.	_____ L	39.	_____ L
15.	_____ L	40.	_____ L
16.	_____ L	41.	_____ L
17.	_____ L	42.	_____ L
18.	_____ L	43.	_____ L
19.	_____ L	44.	_____ L
20.	_____ L	45.	_____ L
21.	_____ L	46.	_____ L
22.	_____ L	47.	_____ L
23.	_____ L	48.	_____ L
24.	_____ L	49.	_____ L
25.	_____ L	50.	_____ L
<b>Total Output</b>		_____	L

## 2. MEASURING DELIVERY RATE

You can use either of these methods to determine the actual delivery rate of the sprayer.

### Test Area method

1. Mark out a test strip at least 60 m or 200 ft long. Your strip was \_\_\_\_\_ m(ft) long.  
**Note:** A one acre test strip is =  $43,560 \text{ ft}^2 \div \text{_____ ft (swath width)} = \text{_____ ft. long.}$
2. Fill the tank about half full with water and start sprayer nozzles and agitation. Then set the pressure to what you want. Use the same throttle RPM you'll use in the field. Pressure \_\_\_\_\_ kPa(psi)
3. Choose a tractor gear to get desired forward speed. Gear \_\_\_\_ Throttle \_\_\_\_\_ rpm (as in Step 2 above)
4. Record the volume of water in the tank before the test: \_\_\_\_\_ L Mark where the sprayer is parked so you can return it to the same position to measure water sprayed (level ground is best).
5. Drive towards the first stake at the correct speed, and open the boom valve as you pass it. Check the sprayer pressure. Close the boom valve as you pass the second stake.
6. Repeat until at least 10% of a full tank is sprayed. Record the number of runs ( \_\_\_\_\_ runs).
7. Return to the water filling site and park in the same location as in Step 4. Measure the amount of water remaining: \_\_\_\_\_ L. Number of litres discharged during the test was \_\_\_\_\_ L.
8. Calculate the test area. Multiply the strip length by your swath width by the number of runs.

strip length	x	swath width	x	# runs	=	test area
m	x	m	x	runs	=	m <sup>2</sup>
ft	x	ft	x	runs	=	ft <sup>2</sup>

9. Calculate the Delivery Rate. Divide water sprayed (L) by test area (m<sup>2</sup> or ft<sup>2</sup>).

water sprayed	÷	test area	x	conversion	=	delivery rate
L	÷	m <sup>2</sup>	x	10,000 m <sup>2</sup> /ha	=	L/ha
L	÷	ft <sup>2</sup>	x	43,560 ft <sup>2</sup> /acre	=	L/acre

(L/ha=2.5 times L/acre

L/acre- 0.4 times L/ha)

### Timed Output method

1. Measure the forward speed of your tractor and sprayer with a half tank of water in field conditions. (Tractor speedometers need to be checked for accuracy, see page 243.)
2. Measure total nozzle output by spraying for a set time (such as 10 min) and divide volume (L) by time to find total output (L/min) OR use total nozzle output (L/min) from page 238.

**Tank volume at start** \_\_\_\_\_ L **Tank Volume at finish** \_\_\_\_\_ L **Discharge time** \_\_\_\_\_ min.

**Discharge volume (start-finish)** = \_\_\_\_\_ L

**Total nozzle output = (Discharged Volume ÷ Time)** = \_\_\_\_\_ L ÷ \_\_\_\_\_ min. = \_\_\_\_\_ L/min.

3. Calculate the Delivery Rate. Divide total output by forward speed and swath width and multiply by a constant.

total nozzle output	÷	forward speed	÷	swath width	x	constant	=	delivery rate
L/min	÷	km/h	÷	m	x	600	=	L/ha
L/min	÷	mph	÷	ft	x	495	=	L/acre

(L/ha=2.5 times L/acre

L/acre- 0.4 times L/ha)

### 3. ADJUSTING DELIVERY RATE

If the Delivery Rate of your sprayer is different than the rate listed on the pesticide label or recommended in the production guide, it can be adjusted in three ways:

- Nozzle size** should be changed if you wish to make large changes in delivery rate. Check with your nozzle supplier or agricultural advisor. Obtain a catalogue listing nozzles and nozzle outputs.

The following formula can also be used to find nozzle size.

delivery rate	x	forward speed	x	nozzle spacing	÷	constant	=	nozzle output
L/ha	x	km/h	x	cm	÷	60,000	=	L/min
L/acre	x	mph	x	in	÷	5940	=	L/min

List your nozzle options by referring to a manufacturer's catalogue.

<b>Nozzle Size</b>				
<b>Nozzle Pressure kPa(psi)</b>				
<b>Nozzle Output L/min</b>				
<b>Forward Speed km/h (mph)</b>				
<b>Delivery Rate L/ha (L/acre)</b>				

- Forward speed** changes will adjust the delivery rate. Slower speeds increase the amount sprayed in a field, and faster speeds reduce it. If your delivery rate is 112 L/acre at 6 mph, then by halving your speed to 3 mph you'll double the delivery rate to 224 L/acre.

Use these formulas to calculate alternative combinations of delivery rates and speeds.

present forward speed	x	present delivery rate	÷	new forward rate	=	new delivery rate
km/h	x	L/min	÷	km/h	=	L/min
mph	x	L/min	÷	mph	=	L/min

Speed changes are usually made by using a different gear in order to keep tractor RPMs within the range recommended for the sprayer pump.

present forward speed	x	present delivery rate	÷	new delivery rate	=	new forward speed
km/h	x	L/min	÷	L/min	=	km/h
mph	x	L/min	÷	L/min	=	mph

When you have chosen a new gear, check with your nozzle supplier on which nozzle to use or calculate the new nozzle output (same formula as Step 1).

delivery rate	x	forward speed	x	nozzle spacing	÷	constant	=	new nozzle output
L/ha	x	km/h	x	cm	÷	60,000	=	L/min
L/acre	x	mph	x	in	÷	5940	=	L/min

- Spray pressure should be set for the correct droplet size.** Changing pressure is recommended only for very small changes in delivery rates. Otherwise your droplet size will change and cause drift or runoff problems. Since pressure must be increased four times to double the delivery rate, this is not a good way to adjust delivery rate.

After making the adjustments, measure the delivery rate again and fill in a new Calibration Worksheet.

When your equipment is accurately calibrated and applying the desired delivery rate, you are then ready to spray. Use the Pesticide Use Calculations on pages 241 and 242 to determine how much pesticide to buy and how much pesticide to add to a full or partial tank.

# 4.a CALCULATING HOW MUCH PESTICIDE TO ADD TO A SPRAY TANK — PER AREA RATE

**Example: Pesticide Labels read: “use 3 L/ha in 1000 L of water” or “use 3 L/1000 L of water/ha”.**

Pesticide \_\_\_\_\_ Pest \_\_\_\_\_ Crop \_\_\_\_\_ Date \_\_\_\_\_

Fill in values for only one column – hectares or *acres*. Use only hectares or only *acres*; don't mix them.

Use litres (L) for all liquid volumes. Use the *italicized* line if you are using *acres*.

Field area \_\_\_\_\_ ha \_\_\_\_\_ *acres* (hectares = 0.4 x *acres*)

Spray tank capacity \_\_\_\_\_ L \_\_\_\_\_ *L* ( L = 3.79 x US gal.; L = 4.55 x Imperial gal.)

Pesticide label application rate \_\_\_\_\_ kg or L/ha \_\_\_\_\_ *kg or L/acres* (*L/acres* = 0.4 x L/ha)

Spray volume \_\_\_\_\_ L/ha \_\_\_\_\_ *L/acres* (from label or production guide or field test)

Check your Calibration Worksheets and choose a suitable sprayer setup and Sprayer Delivery Rate

Sprayer Delivery Rate \_\_\_\_\_ L/ha \_\_\_\_\_ *L/acres*

Copy values into the formulas below where needed.

<b>How much pesticide to buy?</b>	field area	x	pesticide label application rate	x	# applications per year	=	<b>pesticide to buy</b>
	ha	x	kg or L/ha	x		=	kg or L
	<i>acres</i>	x	<i>kg or L/acres</i>	x		=	<i>kg or L</i>

## Full tank

**Area covered by a full tank?**

tank capacity	÷	sprayer delivery rate	=	<b>area covered</b>
L	÷	L/ha	=	ha/tank
<i>L</i>	÷	<i>L/acre</i>	=	<i>acres/tank</i>

**How much pesticide to add to a full tank?**

pesticide label application rate	x	area covered by a full tank	=	<b>pesticide to add</b>
kg or L/ha	x	ha/tank	=	kg or L
<i>kg or L/acre</i>	x	<i>acres/tank</i>	=	<i>kg or L</i>

**Number of tankfuls required for area?**

field area	÷	area covered by a full tank	=	<b>tankfuls required</b>
ha	÷	ha/tank	=	tanks
<i>acre</i>	÷	<i>acres/tank</i>	=	<i>tanks</i>

## Partial tank

**How much spray mix to make for a partial tank?**

sprayer delivery rate	x	area remaining	=	<b>spray mix to make in partial tank</b>
L/ha	x	ha	=	L
<i>L/acre</i>	x	<i>acres</i>	=	<i>L</i>

**How much pesticide to add to a partial tank?**

pesticide label application rate	x	area remaining	=	<b>pesticide to add to partial tank</b>
kg or L/ha	x	ha	=	kg or L
<i>kg or L/acre</i>	x	<i>acres</i>	=	<i>kg or L</i>

# 4.b CALCULATING HOW MUCH PESTICIDE TO ADD TO A SPRAY TANK — PER DILUTION RATE

Example: pesticide label reads: “use 1 L/1000 L of water and spray foliage thoroughly”.

Pesticide \_\_\_\_\_ Pest \_\_\_\_\_ Crop \_\_\_\_\_ Date \_\_\_\_\_

Fill in values for only one column – hectares or acres. Use only hectares or only acres; don't mix them. Use litres (L) for all liquid volumes. Use the italicized line if you are using acres.

	<b>Hectares</b>	<b>Acres</b>
Field area	_____ ha	_____ <i>acres</i> ( <i>hectares = 0.4 x acres</i> )
Spray tank capacity	_____ L	_____ L ( <i>L = 3.79 x US gal.; L = 4.55 x Imperial gal.</i> )
Pesticide label dilution rate	_____ kg or L/1000 L of water (may be another amount of water)	
Spray volume	_____ L/ha	_____ <i>L/acres</i> (from label or production guide)
Check your Calibration Worksheets and choose a suitable sprayer setup and Sprayer Delivery Rate		
Sprayer Delivery Rate	_____ L/ha	_____ <i>L/acres</i>

Copy values into the formulas below where needed.

.....

<b>How much pesticide to buy?</b>			pesticide label		sprayer		# applications		<b>pesticide</b>
	field area	x	dilution rate	x	delivery rate	x	per year	=	<b>to buy</b>
	ha	x	kg or L/1000 L	x	L/ha	x	=	kg or L	
	<i>acres</i>	x	<i>kg or L/1000 L</i>	x	<i>L/acre</i>	x	=	<i>kg or L</i>	

## Full tank

**Area covered by a full tank?**

			sprayer		
tank capacity	÷	delivery rate	=	<b>area covered</b>	
L	÷	L/ha	=	ha/tank	
<i>L</i>	÷	<i>L/acre</i>	=	<i>acres/tank</i>	

**How much pesticide to add to a full tank?**

pesticide label					
dilution rate	x	tank capacity	=	<b>pesticide to add</b>	
kg or L/1000 L	x	L	=	kg or L	
<i>kg or L/1000 L</i>	x	<i>L</i>	=	<i>kg or L</i>	

**Number of tankfuls required for area?**

field area	÷	area covered by a full tank	=	<b>tankfuls required</b>	
ha	÷	ha/tank	=	tanks	
<i>acre</i>	÷	<i>acres/tank</i>	=	<i>tanks</i>	

## Partial tank

Measure the area to be sprayed by the last tank accurately to avoid mixing too much spray. **spray mix to make**

**How much spray mix to make for a partial tank?**

sprayer delivery rate	x	area remaining	=	<b>in partial tank</b>	
L/ha	x	ha	=	L	
<i>L/acre</i>	x	<i>acres</i>	=	<i>L</i>	

**How much pesticide to add to a partial tank?**

pesticide label					
dilution rate	x	spray mix in partial tank ÷ 1000 L	=	<b>pesticide to add in partial tank</b>	
kg or L/1000 L	x	L ÷ 1000 L	=	kg or L	
<i>kg or L/1000 L</i>	x	<i>L ÷ 1000 L</i>	=	<i>kg or L</i>	