Farm Mechanization
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

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CALIBRATION WORKSHEET
- BOOM SPRAYER -

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	

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 left for future reference.**

Use the Pesticide Use Calculation worksheet 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.

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 7)
- ❑ 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.

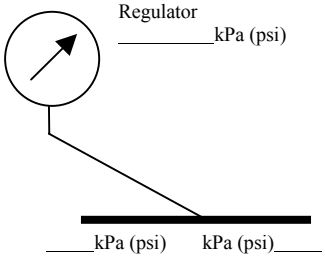
- ❑ start sprayer pump & run tractor throttle at _____ rpm.
  note pump's maximum rpm is _____.
- ❑ open boom valve to fill lines and begin spraying
- ❑ clean nozzles producing distorted patterns and retest
- ❑ throw out damaged nozzles and replace them

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%

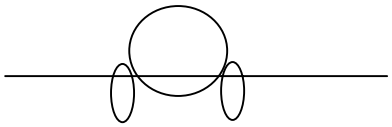


Measuring Nozzle Output

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 e.g. 1 minute, 30 sec or 15 sec. Measure in litres.

Nozzle pressure is _____ kPa (psi)

Horizontal boom
(includes drop pendents)



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 nozzles if above maximum output or below minimum 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).

Nozzle Output Litres per __sec		Nozzle Output 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
	Total Output		_____L

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*

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 ft^2 ÷ _____ *ft* (swath width) = _____ *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^2
ft	x	*ft*	x	*runs*	=	ft^2

9. Calculate the Delivery Rate. Divide water sprayed (L) by test area (m^2 or ft^2).

water sprayed	÷	test area	x	conversion	=	**delivery rate**
L	÷	m^2	x	10,000 m^2/ha	=	L/ha
L	÷	ft^2	x	*43,560 ft^2/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 7.) ____ km/h *(mph)*
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 2.

   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:

1. **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.

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

2. **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 112L/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 speed	=	**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*

3. **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. Fill in a new Calibration Worksheet.

When your equipment is accurately calibrated and applying the desired delivery rate, then you are ready to spray. Use one of the next two pages to determine how much pesticide to buy and how much pesticide to add to a full or partial tank. Choose page 5 if the pesticide is given in a per area rate, otherwise use page 6.

4.a Calculating How Much Pesticide to Add to a Spray Tank – Per Area Rate

Example: Pesticide Labels read: "use 3L/ha in 1000L of water" or "use 3L/1000L of water/ha". (Otherwise see page 6.)

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/acre* (*L/acre* = 0.4 x L/ha)
Spray volume	_____ L/ha	_____ *L/acre* (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/acre* (*L/acre* = 0.4 x L/ha)

Copy values into the formulas below where needed.

How much pesticide to buy?

field area	x	pesticide label application rate	x	# of applications per year	=	**pesticide to buy**
ha	x	kg or L/ha	x		=	kg or L
acres	x	*kg or L/acres*	x		=	*kg or L*

Full tank

Area covered by a full tank?

tank capacity	÷	sprayer delivery rate	=	**area covered**
L	÷	L/ha	=	ha/tank
L	÷	*L/acre*	=	*acres/tank*

How much pesticide to add to a full tank?

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

Number of tankfuls required for area?

field area	÷	area covered by a full tank	=	**tankfuls required**
ha	÷	ha/tank	=	tanks
acre	÷	*acres/tank*	=	*tanks*

Partial tank

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

How much spray mix to make for a partial tank?

sprayer delivery rate	x	area remaining	=	**spray mix to make in partial tank**
L/ha	x	ha	=	L
L/acre	x	*acres*	=	*L*

How much pesticide to add to a partial tank?

pesticide label application rate	x	area remaining	=	**pesticide to add to partial tank**
kg or L/ha	x	ha	=	kg or L
kg or L/acre	x	*acres*	=	*kg or L*

4.b Calculating How Much Pesticide to Add to a Spray Tank – Per Dilution Rate

Example: Pesticide Label reads: "use 1L/100L of water and spray foliage thoroughly". (Otherwise see page 5.)

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/1000L of water (may be another amount of water)	
Spray volume	_____ L/ha	_____ *L/acre* (from label, 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/acre* (*L/acre* = 0.4 x L/ha)

Copy values into the formulas below where needed.

How much pesticide to buy?

field area	x	pesticide label dilution rate	x	sprayer delivery rate	x	# of applications per year	=	**pesticide to buy**
ha	x	kg or L/1000L	x	L/ha	x		=	kg or L
acres	x	*kg or L/1000L*	x	*L/acre*	x		=	*kg or L*

Full tank

Area covered by a full tank?

tank capacity	÷	sprayer delivery rate	=	**area covered**
L	÷	L/ha	=	ha/tank
L	÷	*L/acre*	=	*acres/tank*

How much pesticide to add to a full tank?

pesticide label dilution rate	x	Tank capacity	=	**pesticide to add**
kg or L/1000L	x	L	=	kg or L
kg or L/1000L	x	*L*	=	*kg or L*

Number of tankfuls required for area?

field area	÷	area covered by a full tank	=	**tankfuls required**
ha	÷	ha/tank	=	tanks
acre	÷	*acre/tank*	=	*tanks*

Partial tank

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

How much spray mix to make for a partial tank?

sprayer delivery rate	x	area remaining	=	**spray mix to make in partial tank**
L/ha	x	ha	=	L
L/acre	x	*acre*	=	*L*

How much pesticide to add to a partial tank?

pesticide label dilution rate	x	spray mix in partial tank	=	**pesticide to add to partial tank**
kg or L/1000L	x	L	=	kg or L
kg or L/1000L	x	*L*	=	*kg or L*

Forward Speed Calculations

Date: _____

Calculate the forward speed of your tractor and sprayer in field conditions encountered during spraying. If you change tires, tire pressures, or tire lugs wear significantly, speeds will change. Also speeds will change between dry and very wet field conditions.

1. Mark out a test strip at least 60 m or 200 *ft* long.
2. Fill the tank about half full with water and move to the test strip.
3. Choose the tractor gear and throttle for the forward speed you want. Gear _____
   Throttle _____rpm. Use the same throttle RPM when measuring nozzle output (Step 7).
4. Measure the time in seconds required to pass through the test strip on four runs. Reach the desired speed *before* entering the test strip, and hold that speed constant throughout the test run.
   1st run _____ + 2nd run _____ + 3rd run _____ + 4th run _____ = _____ seconds total time.
5. Calculate total distance travelled. Multiply test strip length (Step 1) by the number of runs.
   Your strip was _____ m(*ft*) long x _____ runs = _____ m(*ft*) total distance.
6. Calculate forward speed using the formula in the box at right.

total distance	÷	total time	x	constant	=	**forward speed**
m	÷	sec	x	3.6	=	km/h
ft	÷	sec	x	0.68	=	*mph*

Tractor #1 _____ Tire Size _____ Tire Pressure _____

Gear						
Throttle	rpm					
Time	sec					
Total distance	in *(ft)*					
Forward speed	km/h *(mph)*					

Tractor #2 _____ Tire Size _____ Tire Pressure _____

Gear						
Throttle	rpm					
Time	sec					
Total distance	in *(ft)*					
Forward speed	km/h *(mph)*					

Sprayer Setup Summary

Sprayer ______________________ **Tractor** ______________________ **Date** ______________________

Sprayer Setup #	**Sprayer Setup #**
Measured (calculated) Delivery Rate ________ L/acre	Measured (calculated) Delivery Rate ________ L/acre
__________ US gal/acre	__________ US gal/acre
Tank Volume __________L _____________US gal	Tank Volume __________L _____________US gal
Area Sprayed by a Full Tank ________________ acre	Area Sprayed by a Full Tank ________________ acre
Tractor Gear _____________throttle __________rpm	Tractor Gear _____________throttle __________rpm
Forward Speed _________mph _____________km/hr	Forward Speed _________mph _____________km/hr
# of Nozzles ____________swath width _________ ft	# of Nozzles ____________swath width _________ ft
Nozzle (size/type) _____________________________	Nozzle (size/type) _____________________________
Pressure @ Regulator _________@ nozzles_________	Pressure @ Regulator _________@ nozzles_________

Sprayer Setup #	**Sprayer Setup #**
Measured (calculated) Delivery Rate ________ L/acre	Measured (calculated) Delivery Rate ________ L/acre
__________ US gal/acre	__________ US gal/acre
Tank Volume __________L _____________US gal	Tank Volume __________L _____________US gal
Area Sprayed by a Full Tank ________________ acre	Area Sprayed by a Full Tank ________________ acre
Tractor Gear _____________throttle __________rpm	Tractor Gear _____________throttle __________rpm
Forward Speed _________mph _____________km/hr	Forward Speed _________mph _____________km/hr
# of Nozzles ____________swath width _________ ft	# of Nozzles ____________swath width _________ ft
Nozzle (size/type) _____________________________	Nozzle (size/type) _____________________________
Pressure @ Regulator _________@ nozzles_________	Pressure @ Regulator _________@ nozzles_________

Sprayer Setup #	**Sprayer Setup #**
Measured (calculated) Delivery Rate ________ L/acre	Measured (calculated) Delivery Rate ________ L/acre
__________ US gal/acre	__________ US gal/acre
Tank Volume __________L _____________US gal	Tank Volume __________L _____________US gal
Area Sprayed by a Full Tank ________________ acre	Area Sprayed by a Full Tank ________________ acre
Tractor Gear _____________throttle __________rpm	Tractor Gear _____________throttle __________rpm
Forward Speed _________mph _____________km/hr	Forward Speed _________mph _____________km/hr
# of Nozzles ____________swath width _________ ft	# of Nozzles ____________swath width _________ ft
Nozzle (size/type) _____________________________	Nozzle (size/type) _____________________________
Pressure @ Regulator _________@ nozzles_________	Pressure @ Regulator _________@ nozzles_________

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