

FACTSHEET 7: Distance based chemical application rate setting and sprayer calibration for winegrapes

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Key Points

- How can I use canopy height and density measurements to define chemical application rate requirements?
- How can I use distance based spray application volumes required for different canopies to calibrate my sprayer?

Introduction

The chemical mixing rates per 100 litres of spray mix given on agrichemical labels relate to the application of spray to the point of runoff. Canopies of different sizes and densities will require different spray application volumes (and hence chemical application rates) to spray them to the point of runoff. The chemical rate per 100 litres of dilute spray mix allows growers to sensibly adjust their chemical application rates for different canopies in order to achieve equivalent agrichemical doses on the spraying target.

The following is a four step guide to identifying chemical application rate requirements for different canopies and for setting your sprayer to achieve this target:

- In Step 1 you describe the canopy and work out the required chemical application rate
- In Step 2 you work out what sprayer output is required to deliver the desired spray application volume at a desired travel speed
- In Step 3 you work out what nozzles to use to deliver the spray and confirm that these reliably hit the target
- In Step 4 you work out how much chemical to mix for the job

If you need to express chemical application rates and spray volumes on a per hectare basis (to operate older spray controllers or to fill in some spray diaries), an additional table is provided to enable you to convert from row length based application information to rates per hectare.

Step 1: Identify the sprayer application rate required (in litres per 100 metres of row) for your particular canopy (Table 1).

You need to decide how large and dense each of your canopies are and what level of wetting and coverage is required for the spray that is to be applied.

A “Standard” NZ winegrape canopies (as used in product registration trials) is currently assumed to be a medium density (leaf layer number ca. 3) VSP canopy

with a 400-500mm high bunch zone and a total canopy wall height (including the bunch zone) of 1.5 metres. When planted on a 3m row spacing this canopy is assumed to require an application volume of 1000 l/ha to wet it to the point of runoff.

If a canopy on your vineyard differs significantly from the standard canopy it will require either higher or lower application volumes to spray it to the same level.

- In low vigour or very open canopies, lower application volumes will be required
 - larger or denser canopies will require larger application volumes
 - blocks planted on closer row spacings than the standard canopy will have a longer row length to treat per hectare and, unless very much more open than the standard canopy, will require larger application volumes
- **Measure the height of the canopy to be sprayed.** When estimating canopy wall height it is important that the full height of the spray plume required to hit all of the canopy is measured. i.e. Include any lower canopy around the crowns of vines in the wall height estimates. Likewise, if the minimum band of the spray plume from your type of sprayer is larger than the height of the canopy to be treated, use the spray plume band width as the effective canopy height.
 - **Assess the canopy density:** Canopy density is somewhat subjective, but a quick estimate of leaf layer numbers will remove any subjectivity. Point quadrats have been used for some time to describe different grapevine canopies (Smart and Robinson 1991). For a quick check on canopy density, insert a thin rod horizontally through the canopy at intervals of ca. 10 cm along the row. At each insertion record the number of leaves and/or bunches contacted. If none are contacted record a zero. Repeat this at least 50 insertions for each canopy assessed and calculate the average number of leaf (and bunch) contacts. Record this as the leaf layer number for that canopy. Canopy density will vary between the bunch zone and upper leaf canopy. Bunches are the most difficult part of a canopy to spray well and leaf removal in the bunch zone will definitely improve bunch coverage and dose. It may be worth estimating the density of the upper canopy and bunch zone separately. However, it is recommended that spray application volume requirements are estimated for the most dense part of the canopy, which will usually be the foliage above the bunch zone.
 - **Bunchline spraying.** Chemicals that are applied for just Botrytis disease control can usually be applied just to the bunchline area of the canopy. In this case the canopy wall height is the height of the bunchzone plus some additional height to allow for some vertical movement of the spray nozzles as the sprayer travels along the rows. Again, if the minimum output band height that the sprayer produces is larger than the bunch zone height, this is the “canopy wall height” figure that should be used in the calculations. Bunches are far more difficult targets achieve good spray deposits on and higher application volumes are required than those needed to effectively cover leaves. For this reason sprays that target bunches should be treated as if being applied to a very dense canopy.

Table 1a. Spray application volumes required in litres per 100 metres of row length for full canopy spray applications to VSP and related winegrape canopies of different sizes and densities.

Canopy density					
	Open	Medium	Dense		
	Average leaf layer number				
	1	2	3	4	5
Canopy wall height (metres)	Spray volume required Litres per 100 metres				
0.4	3	5	8	11	13
0.5	3	7	10	13	17
0.6	4	8	12	16	20
0.7	5	9	14	19	23
0.8	5	11	16	21	27
0.9	6	12	18	24	30
1.0	7	13	20	27	33
1.2	8	16	24	32	40
1.4	9	19	28	37	47
1.6	11	21	32	43	53
1.8	12	24	36	48	60
2.0	13	27	40	53	67

Note 1) The litre per 100 metre application volume requirements assumes that vine rows are sprayed from both sides to achieve coverage to the point of runoff (ie dilute spray application).

Note 2) Output for full canopy cover sprays to foliage and bunches is best biased towards the fruiting zone - a split of at least 60% to the bunch zone and 40% to the canopy above the bunch zone is recommended.

Note 3) To ensure full canopy coverage, the sprayer output band needs to be greater than the wall height of the canopy. Use the actual output band height to estimate the litres per 100 metre sprayer outputs required.

Table 1b. Spray application volumes required in litres per 100 metres of row length for bunchline spray applications

Bunch zone height (m)	Exposed		Obscured
	Open	Dense	
	Spray volume required Litres per 100 metres		
0.4	9	11	12
0.5	11	13	15
0.6	14	16	18
0.7	16	18	21
0.8	18	21	24
0.9	20	24	
1.0	23		

Step 2: Use Table 2 to work out the sprayer output volume required to deliver the target application rate per 100 metres of row length at your desired travel speed.

Check that your sprayer pump has the capacity to deliver the required output volume at your desired travel speed while still having output in reserve for tank agitation.

Table 2. Sprayer outputs required to deliver target litre per 100 metre of row application volumes at different travel speeds.

Target application volume (litres/100 m of row)	Travel speed (km/hr)						
	4	5	6	7	8	9	10
	Sprayer output required (litres/min) (for two sides of each row)						
2	1.3	1.7	2.0	2.3	2.7	3.0	3.3
4	2.7	3.3	4.0	4.7	5.3	6.0	6.7
6	4.0	5.0	6.0	7.0	8.0	9.0	10
8	5.3	6.7	8.0	9.3	11	12	13
10	6.7	8.3	10	12	13	15	17
12	8.0	10	12	14	16	18	20
14	9.3	12	14	16	19	21	23
16	11	13	16	19	21	24	27
18	12	15	18	21	24	27	30
20	13	17	20	23	27	30	33
22	15	18	22	26	29	33	37
24	16	20	24	28	32	36	40
26	17	22	26	30	35	39	43
28	19	23	28	33	37	42	47
30	20	25	30	35	40	45	50
32	21	27	32	37	43	48	53
34	23	28	34	40	45	51	57
36	24	30	36	42	48	54	60
38	25	32	38	44	51	57	63
40	27	33	40	47	53	60	67
42	28	35	42	49	56	63	70
44	29	37	44	51	59	66	73
46	31	38	46	54	61	69	77
48	32	40	48	56	64	72	80
50	33	42	50	58	67	75	83

Note 1) Identify your target application volume from Table 1. Note that the l/min outputs identified above relate to the volume required to treat both sides of a single row.

Step 3: Confirm that your sprayer nozzle arrangement delivers the required spray volume to the target with acceptable coverage.

The bunches are the most important part of the crop and are also the hardest part to cover with spray. Whenever full canopy sprays are used it is sensible to favour the bunch zone with a greater part of the spray output. New Zealand experience has shown that a split of at least 60% of the output to the bunch zone and the remainder (40% or less) to the canopy above the bunch zone works well. Whatever your decision on this, you should confirm that the air output and nozzle arrangement gives penetration and coverage of bunches and inner canopy foliage. If not, you will need to adjust nozzle and air output angles and you may need to slow down.

Step 4: Mix and apply using the DILUTE rate per 100 litres of chemical on the product label, OR at a CONCENTRATE factor of the dilute rate.

If you are going to use lower volume concentrate sprays, then select a target litres per 100 metres of row out that matches your concentration factor. For example, to apply a three times concentrate spray in a canopy that requires 30 litres per 100 metres of row as a dilute application volume, then your target application volume would be 10 litres per 100 metres of row, with the chemical mixed in the tank at three times the label rate per 100 litres of dilute spray mix.

There is no need at any point in the distance based calibration method above to attempt to relate sprayer setup and application volumes to ground area. The focus on spray application is to deliver an effective dose of chemical to the target with sufficiently even coverage to achieve control of the target pest or disease. Establishing a simple sprayer output requirement per distance sprayed for winegrape canopies of different wall sizes and densities will greatly improve the consistency with which dose and coverage are achieved across the NZ industry.

The use of per hectare spray application terminology is discouraged, as the same canopies on different row spacings need very different litre per hectare application rates but need exactly the same sprayer nozzling setup and outputs. However, most spray diaries and many spray controllers still require litre per hectare inputs. Table 3 provides a back conversion from litres per 100 metres to litres per hectare for a range of common row spacings.

Table 3. Spray application volumes expressed in L/ha for different litre per 100 metre outputs on different row spacings

Litres per 100 metres	Row spacing (<i>metres</i>)						
	1.5	1.8	2.0	2.4	2.5	2.8	3.0
	Application volume (<i>litres per hectare</i>)						
2	130	110	100	80	80	70	70
4	270	220	200	170	160	140	130
6	400	330	300	250	240	210	200
8	530	440	400	330	320	290	270
10	670	560	500	420	400	360	330
12	800	670	600	500	480	430	400
14	930	780	700	580	560	500	470
16	1070	890	800	670	640	570	530
18	1200	1000	900	750	720	640	600
20	1330	1110	1000	830	800	710	670
22	1470	1220	1100	920	880	790	730
24	1600	1330	1200	1000	960	860	800
26	1730	1440	1300	1080	1040	930	870
28	1870	1560	1400	1170	1120	1000	930
30	2000	1670	1500	1250	1200	1070	1000
32		1780	1600	1330	1280	1140	1070
34		1890	1700	1420	1360	1210	1130
36		2000	1800	1500	1440	1290	1200
38			1900	1580	1520	1360	1270
40			2000	1670	1600	1430	1330
42				1750	1680	1500	1400
44				1830	1760	1570	1470
46				1920	1840	1640	1530
48				2000	1920	1710	1600
50					2000	1790	1670

Summary

Dilute spray application volume requirements for different NZ winegrape canopies can be defined in relation to canopy wall height and leaf density. The most practical and consistent system for setting up sprayers to deliver target application volumes to different canopies is one in which the sprayer is calibrated to deliver a target output per 100 metres of travel. On the basis of the results from recent spray deposit testing work undertaken on NZ winegrape canopies, an Australian system for distance based calibration has been adapted for use with VSP type New Zealand canopies. Tables giving recommended spray delivery volumes per 100 metres of sprayed row have been prepared for different sized canopies, along with a table specifying the required litre per minute sprayer output volumes to deliver these target application volumes at different travel speeds.