SEPTEMBER 09 FUTURE ORCHARD 2012 WALK

Spray Volume in Litres per 100 Metres per Metre of Canopy Height to Set Pesticide Dose

Geoff Furness
Senior Research Scientist
South Australian Research and Development Institute
Loxton Research Centre
Furness.geoff@saugov.sa.gov.au

The aim of the spraying process is to apply a constant dose per square cm of plant foliage. Traditionally accurate spray calibration and dosing of 3 dimensional fruit tree canopies has been very difficult. However, new research over the last decade has now provided the grower with a technique that is so simple and easy to understand, that dosing and calibration can almost be done in your head without even having to use a pocket calculator. Yet in spite of the simplicity, the technique gives much greater accuracy than previous techniques, with dosing to suit the size and density of the canopy, and even the type of sprayer used.

Problems with previous dosing and calibration methods

Hectare based dosing and calibration

Canopies vary greatly in height, density and row spacing, so clearly when spray volumes and amount of chemical are based on one hectare of ground area, the resultant dose of pesticide impacting on fruit and foliage is going to vary enormously, leading to overdosing and potential problems with pesticide residues on produce in some situations, and underdosing and poor pest and disease control (efficacy) in other situations. Scientific work has in fact shown up to 5 fold and in extreme cases up to 10 fold errors in average dosing over the whole canopy, even where growers have been correctly applying the specified label dose. This is regarded as unacceptable.

Techniques based on canopy volume: (Tree Row Volume (TRV), Unit Canopy Row, and Litres per tree based on height x width).

Recent data from the UK and SARDI have shown that canopy volume models, while more accurate than area based calibration, have limitations, and we suggest that they no longer be used. They are also complicated, difficult to understand and require complex formulae (especially TRV). For these models to work accurately, the amount of spray per 100 cubic metres (the Spray Volume Factor (SVF)) should be constant,

but deposition data has shown that the SVF factors that have to be used get rapidly smaller as the canopy size increases, in other words they overdose as the canopy gets bigger, and underdose as the canopy gets smaller. For example:

SVF for grapevines = 20 – 30 Litres per100 cubic metres of foliage
SVF for apples and stonefruit = 6 – 10 Litres per 100 cubic metres
SVF for mangoes and avocados = 4 – 6 Litres per 100 cubic metres
(very large trees, 5 – 6 m tall and wide)

This means that if you used a SVF from a 1 x 1 m canopy on a 5 – 6 m canopy you would overdose 5 fold, and conversely if you used a SVF from a 5 – 6 m canopy on a 1 x 1 m canopy you would underdose 5 fold, which is unacceptable.

Pesticide label change

In recognition of the problems with area (hectare) based dosing, the pesticide label format for fruit trees in Australia was changed about a decade ago. The pesticide rate per hectare was removed from labels and the label rate is now based on:

- Amount of pesticide (or agricultural chemical) per 100 litres of water sprayed to the point of first run-off
- For concentrate spraying, the concentration of chemical is increased in the same proportion as the spray volume is decreased.

Problems for the fruit grower:

- The responsibility for determining the point of first run-off has been left to the fruit grower and the industry. However, if you ask 10 growers to determine the point of first run-off you get 10 widely differing answers.
- The point of first run-off is just as important as the label rate in determining the final impacted dose on the foliage, especially with concentrate spraying. If an error is made in determining the point of first run-off there is a risk that problems with pesticide residues or alternatively poor pest and disease control will be the result.
- If the pesticide rate per hectare is inappropriate for fruit trees, so is specifying spray volume per hectare for the same reasons.

Distance based spray calibration: A solution to the pesticide dosing problem for fruit trees

Point of first run-off

Research by SARDI over the last decade, validated by overseas research, especially in the UK, has lead to a very simple, practical and acurate solution. Spray volume to the point of first run-off is based on the unit:

- **Litres per 100 metres per metre of canopy height (L/100m/m)**

Note: The value is for one complete row sprayed from both sides, or two half rows, as with a standard double sided air assisted sprayer, with one pass down each row.

For very large wide trees, such as mangos and avocados, and also large dense grapevine canopies, where the boom wraps around the tree, height + width should be used instead of canopy height. Also ensure that the boom height and spray swath match the canopy height, otherwise underdosing will occur.

Recent research data is indicating that this unit, at the point of first run-off, is relatively **CONSTANT** for **ALL** fruit trees and grapevines, and although ideally more work is needed, we suggest it can be specified as the range 20 – 30 L/100m/m but increasing to 20 – 50 L/100m/m on certain crops such as citrus where the canopy can be particularly dense. For dense or difficult canopies, growers should use the higher figure. As the canopy becomes less dense, growers should progressively use the lower figure. Growers can also use this range to adjust upwards or downwards depending on sprayer efficiency.

If spray volumes in excess of 50 L/100m/m of canopy height are required for good control on dense canopies, our advice is that concentrate spraying should not be attempted based on these higher volumes, otherwise serious overdosing can occur.

Spray volume for your orchard in Litres per 100 metres (L/100m)

For your orchard, the litres per 100 m (L/100m) to the point of first run-off is:

- Litres/100 m/m x canopy height (m)

For concentrate spraying: If you then divide this value by the L/100m delivered by your sprayer you get the concentration factor (CF)

- CF = L/100m for first run-off divided by L/100m delivered by your sprayer

Then amount to put in the tank is given by the formula:

- Tank concentration (amount per 100 L) = label rate (amount per 100 litres) x CF

The L/100 m delivered by your sprayer can be obtained from a simple look up table, similar to a nozzle flow chart. All you need to know is the litres per minute per row for your nozzles (normally the total flow rate (L per min) of your sprayer) and your travel speed in km/h (see Table 5 below).

This is so simple, most growers who already use this technique are finding that they can do it in their head and do not even need a pocket calculator.

Table 5 Spray Volume Calculator (litres per 100m of row delivered by your sprayer)

Total Flow Rate of All Nozzles (l/min)	Speed (km/h) 3	4	5	6	7	8	9	10
4	8	6	4.8	4	3.4	3.0	2.7	2.4
6	12	9	7.2	6	5.1	4.5	4.0	3.6
8	16	12	9.6	8	6.9	6.0	5.3	4.8
10	20	15	12.0	10	8.6	7.5	6.7	6.0
12	24	18	14.4	12	10.3	9.0	8.0	7.2
14	28	21	16.8	14	12	10.5	9.3	8.4
16	32	24	19	16	14	12	11	10
18	36	27	22	18	15	14	12	11
20	40	30	24	20	17	15	13	12
22	44	33	26	22	19	17	15	13
24	48	36	29	24	21	18	16	14
26	52	39	31	26	22	20	17	16
28	56	42	34	28	24	21	19	17
30	60	45	36	30	26	23	20	18
32	64	48	38	32	27	24	21	19
34	68	51	41	34	29	26	23	20
36	72	54	43	36	31	27	24	22
38	76	57	46	38	33	29	25	23
40	80	60	48	40	34	30	27	24
42	84	63	50	42	36	32	28	25
44	88	66	53	44	38	33	29	26
46	92	69	55	46	39	35	31	28
48	96	72	58	48	41	36	32	29
50	100	75	60	50	43	38	33	30
52	104	78	62	52	45	39	35	31
54	108	81	65	54	46	41	36	32
56	112	84	67	56	48	42	37	34
58	116	87	70	58	50	44	39	35
60	120	90	72	60	51	45	40	36
65	130	98	78	65	56	49	43	39
70	140	105	84	70	60	53	47	42
75	150	113	90	75	64	56	50	45
80	160	120	96	80	69	60	53	48
85	170	128	102	85	73	64	57	51
90	180	135	108	90	77	68	60	54
95	190	143	114	95	81	71	63	57
100	200	150	120	100	86	75	67	60
110	220	165	132	110	94	83	73	66
120	240	180	144	120	103	90	80	72
130	260	195	156	130	111	98	87	78
140	280	210	168	140	120	105	93	84
150	300	225	180	150	129	113	100	90
160	320	240	192	160	137	120	107	96
170	340	255	204	170	146	128	113	102
180	360	270	216	180	154	135	120	108
190	380	285	228	190	163	143	127	114
200	400	300	240	200	171	150	133	120
225	450	338	270	225	193	169	150	135
250	500	375	300	250	214	188	167	150
275	550	413	330	275	236	206	183	165
300	600	450	360	300	257	225	200	180
350	700	525	420	350	300	263	233	210
400	800	600	480	400	343	300	267	240
450	900	675	540	450	386	338	300	270
500	1000	750	600	500	429	375	333	300
600	1200	900	720	600	514	450	400	360
700	1400	1050	840	700	600	525	467	420

Sprayer set up and sprayer type

Optimum set up of the sprayer and type of sprayer used is also important for achieving effective and uniform coverage with good penetration to sheltered sites, especially near the centre of the trees. Nozzle selection, pressure and regular replacement when worn are very important. In addition, most growers do not pay much attention to the set up of the air. This is generally even more important than nozzle selection, since the nature, direction, volume and velocity of the airblast is crucial in determining where the spray ends up. Air volume and velocity should also be calibrated to ensure that it is adequate for the tree and the desired travel speed. This is often not done. Some new types of air-assisted sprayers, such as multi-fan and multi ducted air blast sprayers, have better air profile relative to the tree and can more accurately target air and spray precisely to the canopy. They can be adjusted to suit different styles and sizes of canopy, resulting in improved and more uniform coverage, and may also enable higher travel speeds and lower spray volumes to be used. The nature of the air blast is also a major factor in off target spray drift and soil contamination.

Orchard and Vineyard Spraying Handbook for Australia and New Zealand

By Geoffrey O. Furness, South Australian Research and Development Institute

This book features the following:

- Distance based spray calibration, includes look up charts for the L/100m delivered by your sprayer that can be pinned to the shed wall
- Optimising sprayer set up for all the common types of sprayer used in fruit growing, including discussions on the newer types of air assisted sprayer now becoming widespread in fruit growing in Australia and New Zealand
- Simple grower friendly techniques to estimate spray coverage and impacted chemical dose
- How to minimise off target problems of spray drift and soil contamination consistent with high work rate, lower spray volumes and good spray coverage and dose efficiency

Note: On page 30 in the book the Litres/100m/m of canopy height for pome (pip), stone and other fruit and nut trees, given is 35 – 55. This is now regarded as too high, and we suggest that this be replaced by the range 20 – 30.

As with area based calibration, especially where growers or consultants are measuring deposition and coverage, it may be acceptable to extend this range.

Growers are encouraged to purchase a copy of this book which is distributed by the publisher: info@lifelongvitality.com.au, ph 61 8 8389 2381, Fax 61 8 8389 2460, Prairie Road, Cudlee Creek SA Australia 5232.

"Spraywise" Conversion Tables

Nufarm/Croplands (contact Jorg Kitt: Jorg.Kitt@au.nufarm.com)) have recently produced a complete series of simple look up tables, including the look up table for the L/100 metres delivered by your sprayer, from the Orchard and Vineyard Spraying hand book, but also additional charts that accurately convert Litres per ha and Litres per tree to L/100m for your sprayer (and vice versa), so that you can instantly compare the various calibration techniques and make comparisons to your previous method of calibration. Once growers become familiar with L/100m and L/100m/m values (as with converting to metric currency), it is not necessary to convert to L per ha and L per tree, as it is not required for calibration.

Practical implications for the grower (viticulture experience)

Orlando Wines (a major Australian grape producing and winery network covering about 10 000 ha) now have about a decade of experience with the implementation of a spray application package consisting of:

- Distance based calibration and dosing
- Optimised sprayer set up
- The widespread adoption of the use of multi-fan air assisted sprayers
- Advice from field consultants based on actual coverage and dose assessment in their vineyards

This package has resulted in reduced costs, combined with increased quality throughout the entire grapegrowing and wine making processes, leading to substantially increased profitability for both growers and winemakers.

Prior to the implementation of these new strategies, the average incidence of powdery mildew on grape bunches delivered to their wineries each year was 10 – 15 %. Since implementation, the incidence has consistently dropped to 1 – 3 %, a truly spectacular improvement. In addition, the number of sprays required per season has generally decreased, spraying speeds have increased, spray volumes have decreased and there have been no pesticide residue violations. The wineries have also been able to consistently produce higher quality wines with lower costs in the winery.

These new strategies have also greatly reduced the off target problems of spray drift and soil contamination.

We are confident that implementation of these techniques will give similar results for fruit growing.

These techniques and equipment have been developed in Australia and New Zealand, and have established us as a world leader in pesticide application technology.

Acknowledgements

The review of this article by Jorg Kitt from NuFarm/Croplands in Adelaide, Dr Andrew Hewitt, Manager Chemicals Application Research and Training, Lincoln Ventures Ltd, Lincoln University, Lincoln New Zealand, and Dr Peter Walklate, scientist specialising in spray application research from the United Kingdom, is gratefully acknowledged. Technical inputs made by Dr David Manktelow, Agribusiness Training, Hastings, New Zealand are also gratefully acknowledged.

Key references:

Furness, G.O., Thompson, A.J. (2008). Using point of first run-off and spray volume in litres per 100 metres per metre of canopy height for setting pesticide dose. *Agricultural Engineering International, CIGR Ejournal, (Manuscript ALNARP* 08 006 Vol 10 May 2008)

Walklate, P.J., Richardson, G.M., Cross, J.V., Murray, R.A. (2000). Relationship between orchard tree crop structure and performance characteristics of an axial fan sprayer. *Aspects of Applied Biology* 57 285-292.