

SPRAY COVERAGE TESTING

November 2021 | Cool Climate Wine Grapes

Project Scope and Objectives

- Conduct field testing of Croplands key Horticulture model sprayers in warm climate and cool climate grapes in Australia
- Validate and document set up procedures for sprayer optimisation and best performance
- Create a new "user guide" library and internal training materials. - (inc. calibration tool U/G).
- Document coverage outcomes and model comparisons

Sprayer Models

Two Croplands sprayer models were selected for cool climate testing.

- Quantum™ Smart Spray 2-row 4000 litre with Fusion Controller (customer unit)
- Quantum™ QM420 3-row 2-heads per side 3000 litre with HV4000 Controller (stock unit)

Testing Notes

- The Quantum Smart Spray tested in the Cool Climate vines was a two-row unit belonging to the Vogelsang family, recently delivered to their vineyard in Padthaway. Row spacing was 3 metres, single cordon, with vines largely untrimmed (the grower prefers not to trim unless necessary).
- The QM420 2-head per side sprayer was a Croplands stock unit in a 3-row configuration. This was tested in the same rows as the Quantum Smart Spray. The objective was to compare coverage in this canopy type between 2 and 3 heads per side.
- Spray coverage testing was carried out in line with the rate used by the grower and at speeds comparable to current grower applications (as currently used in the industry). Spray rate was subsequently raised from 400 to 500 litres per hectare, which was more appropriate for the canopy stage and in line with what the grower was planning for their next spray round. Grower uses a concentrate spray method.
- Growth stage was mid-flowering with bunches well developed and flowering.
- Air output data was checked and kept in line with the design parameters and Croplands Engineering performance table recommendations.
- All tests were carried out in Padthaway, South Australia.
- Testing was carried out over 3 days with some weather interference on day 2, however objectives of comparing nozzle set ups, fan adjustments, two vs three fans/side and nozzle types were achieved.

SECTION 1: Quantum Smart Spray Two-row

Sprayer details

- 4000-litre
- Fusion Controller
- Self-contained Micro Power Pack

Table 1: Grower

Vogelsang and family, Padthaway SA

Product/application	L/ha range	Speed range	Target speed
All spraying applications for the season	400-500*	7.4-7.7km/h	7.5km/hr

* The grower starts at approx. 350/400 L/ha early season, until late flowering, and moves to 500 L/ha. Higher rates later in the season using Tier 3 may be used if disease issues arise (such as botrytis).

Vineyard

Canopy height	Canopy width	Row width	Crop stage
~2.1m (bottom of canopy starting at ~0.9m)	2m (depending on variety)	3m as tested (some of vineyard is 2.75m)	Mid-flowering

Vines are minimally trimmed during the season.

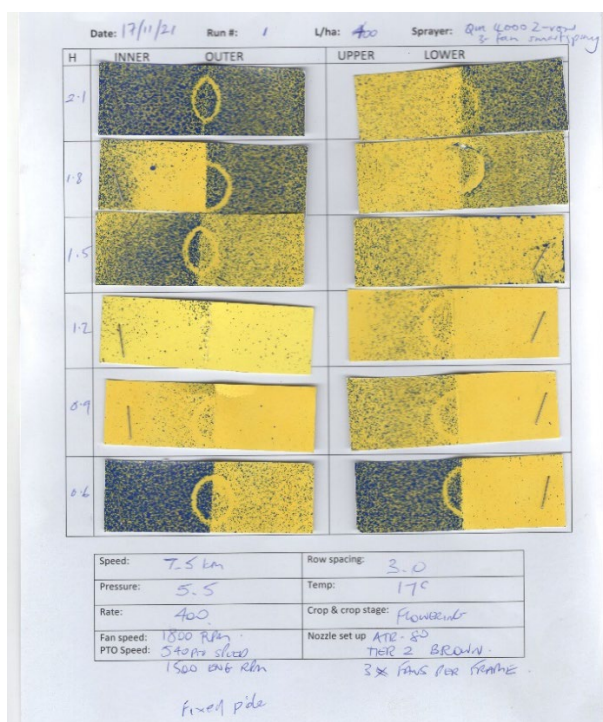
Table 2: Test application

Product/application		L/ha range	Speed range	Target speed	
Test runs (*First run at 400, from thereon 500)		400-500*	7.4-7.7km/hr	7.5km/hr	
	Speed (km/hr)	Nozzle set up	Fan speed	Sectors/nozzles	Displayed pressure
Run 1 Day 1	7.5	Tier 2 – 400L/ha	1800 RPM	1 – Brown ATR 80 (33.3%) 2 – Brown ATR 80 (33.3%) 3 – Brown ATR 80 (33.3%)	5.5 bar
Run 2 Day 1	7.7	Tier 2 – 500L/ha Heads adjusted – top head angled down by another 5°, bottom head up another 10°, middle fan dropped by 50mm	1950 RPM One side 2000, other 1900	1 – Brown ATR 80 (31.0%) 2 – Yellow ATR 80 (46.0%) 3 – Lilac ATR 80 (23.0%)	8 bar
Run 3 Day 2 (windy)	7.7	Tier 2 – 500L/ha 60-degree nozzles fitted in lieu of 80s. Gusty conditions. Wind compensation used.	2500 RHS 2000 LHS	1 – Brown ATR 60 (28%) 2 – Yellow ATR 60 (44%) 3 – Brown ATR 60 (28%)	7.3 bar
Run 4 Day 2 (windy)	7.5	Tier 1 – 500L/ha HCl 40-degree nozzles (ISO). Gusty conditions. Wind compensation used.	2500 RHS 2000 LHS	1 – Orange HCl 40 (28.5%) 2 – Green HCl 40 (43%) 3 – Orange HCl 40 (28.5%)	9 bar

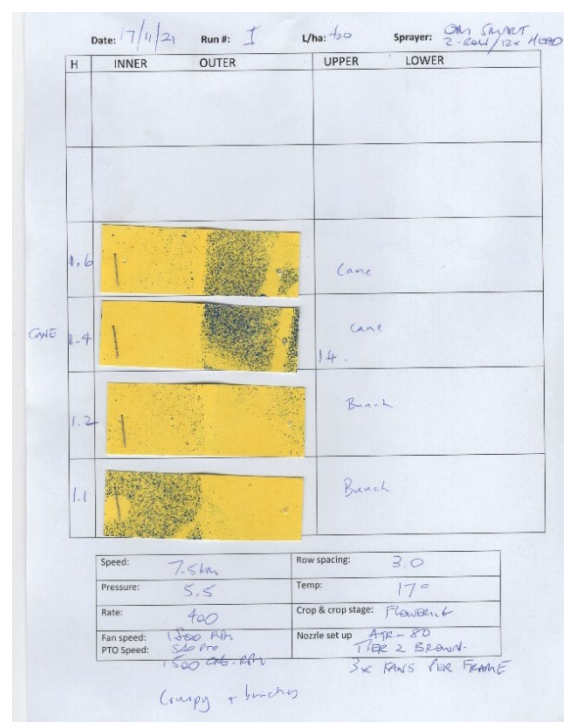
General notes

- Lifting the rate from 400 to 500 L/ha represents a 20% increase in application – results improved as expected.
- To “even out” canopy distribution and to apply sufficient spray volume to the bulk of the canopy in the 1.2-1.5 metre height range (bunch-line area), a change to the nozzles was made (see above) to redistribute flow accordingly.
- 7-8 km/hr speed appears to have been fine for this application. Sufficient air was available to achieve excellent coverage. Discussed with grower that they could slow down if disease pressure was evident or of concern in the remainder of the season, coupled with further rate increase if needed.

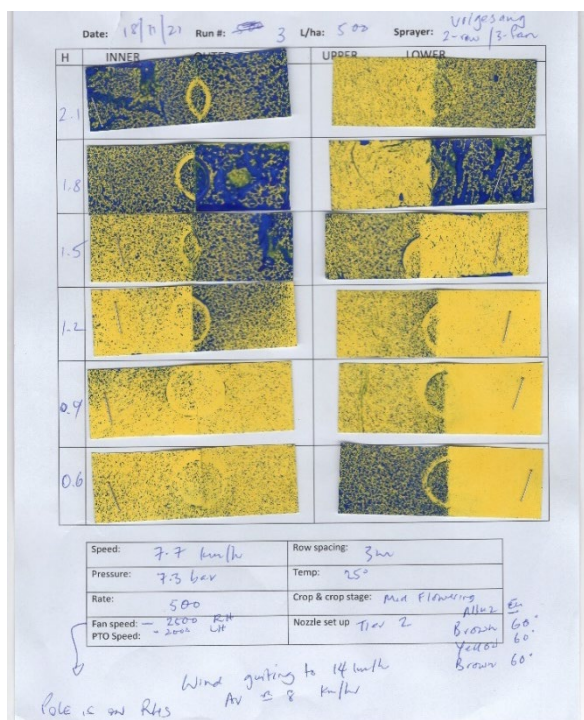
Table 3: Coverage results



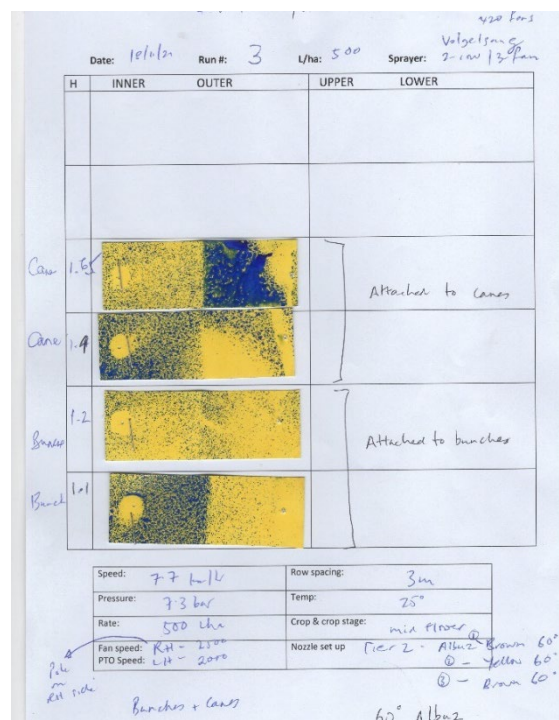
17/11/21: Initial Pole test – 400 L/ha, 7.5 km/hr.
Slightly weak in the lower bunch area
(1-1.3m height)



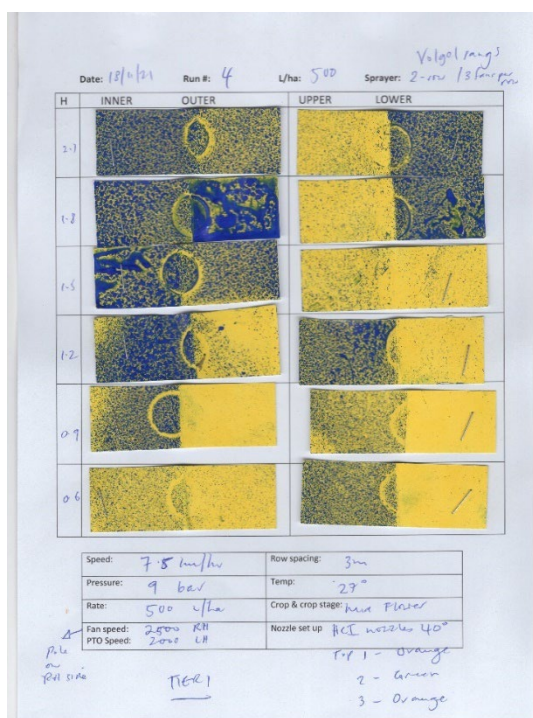
17/11/21: Papers attached to bunches & canes
– slightly weak at 1.2m height



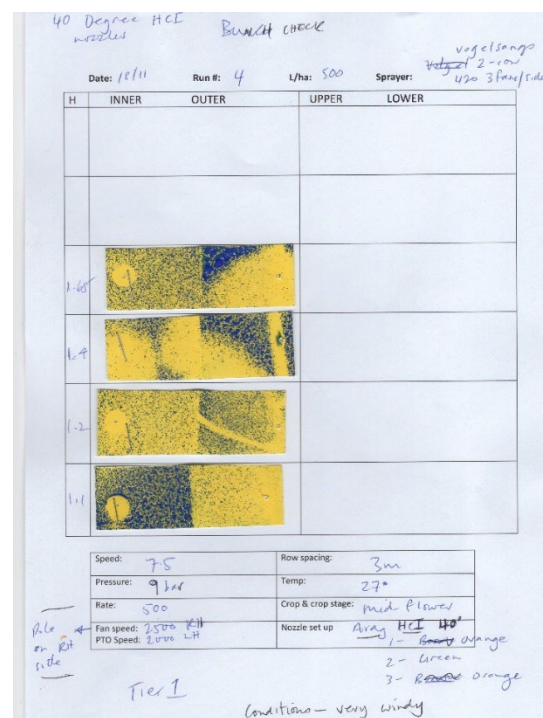
18/11/21: Coverage improved; 500 L/ha,
ATR 80's



18/11/21: Coverage improved; 500 L/ha,
ATR 80's



18/11/21: Last test using HCl 40-degree nozzles



18/11/21: Bunch area appears to be better covered using the HCl 40-degree nozzles

Coverage summary and notes from Table 3

- Standard fan frame set up was ideal for this application, although some adjustments were made to the bottom and top head angles (also noted below) and to the distance between the fans from factory settings. This is very important for improving application outcomes.
- The 4th run, using 40-degree HCl nozzles in a 28.5/43/28.5 percentage fan output split has the edge over the 60-degree Albus – but to be fair there is very little in it. The 40-degree nozzles may provide a slight advantage in “drive” into the zone where the canopy is the thickest, which is in the 1.1 to 1.4m zone in this canopy.
- The pole test had the fixed pole as close as possible to the cordon – within 100mm of the centre of the vine. For the bunch/cane papers (4 in total) we placed the bottom two at 1.1 and 1.2m directly to a bunch stem, at 1.4 and 1.65 we placed them in an inner, upright cane just above the bunch zone.
- There is evidence to suggest that the upper head could have had even less flow (approximately 20%) and the centre head slightly more, but the HCl 40-degree nozzle range stops at the 01 size, which limited our choice to reduce the flow in the top fan.
- At the 1.8 and 2.1 heights there was very little canopy to spray, hence the results. The 0.6m height was to check “wasted” spray as it was below the canopy. At 0.9, there was little canopy – the cordon started at 0.9-1m height.



Spray pole stayed in a fixed position for all tests – lower papers to check coverage in a no-canopy zone to help with head adjustment decisions.



Water sensitive papers were attached to the same bunch stems during testing for comparisons to be valid.

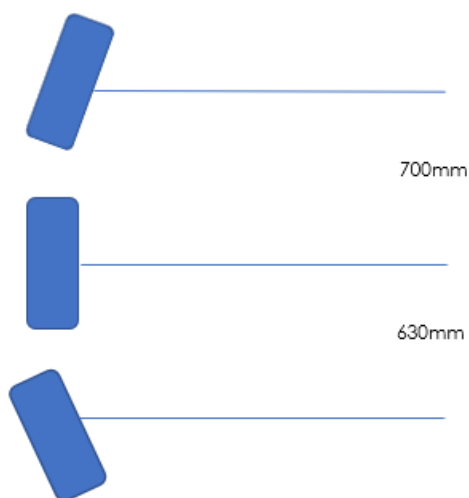


Fan positioning

Lower fans were angled slightly more steeply than ex-factory.

Middle fan was lowered to aim directly at bunch zone and thickest canopy target.

Top fan lowered and angled to reduce lost spray plume to drift.



Adjustments were made to the fan set up – final fan set up pictured left.

SECTION 2: Quantum QM420 Three-row

Sprayer details

- 2-heads per side
- 3000-litre
- HV4000 Controller

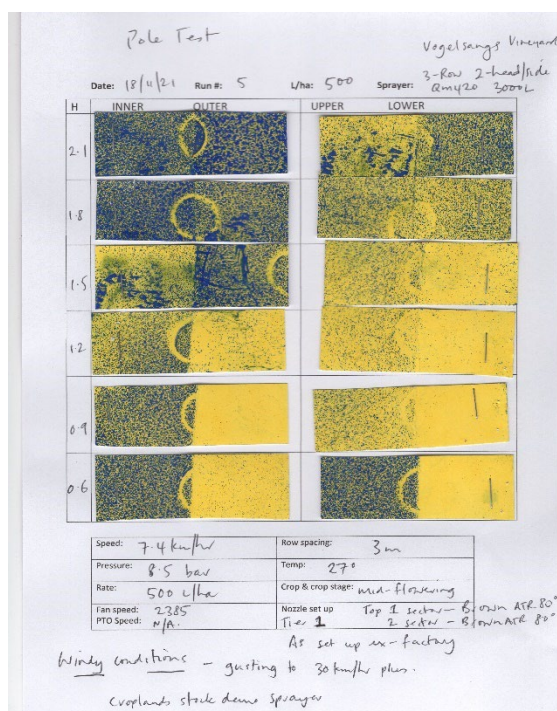
Table 4: Test application

Product/application		L/ha range	Speed range	Target speed	
Test runs		500	7.3-7.4km/hr	7.5km/hr	
	Speed (km/hr)	Nozzle set up	Fan speed	Sectors/nozzles	Displayed pressure
Run 5	7.4	Tier 1 – 500L/ha	2385 RPM	1 – Brown ATR 80 (50%)	8.5 bar
Day 2		Significant changes to head positions from factory settings. Lowered top heads and lifted bottom heads; angle bottom heads up more.		2 – Brown ATR 80 (50%) Nozzles set up as ex-factory	
Run 6	7.3	Tier 1 – 500L/ha	2185 RPM	1 – Brown ATR 80 (40%)	7.5 bar
Day 3		Heads adjusted again, closed fan gap from 750mm to 700mm, more angle on bottom fan.		2 – Yellow ATR 80 (60%) 60/40 split	
Run 7	7.4	Tier 1 – 500L/ha	2180	1 – Brown ATR 60 (40%)	6 bar
Day 3		60-degree nozzles fitted in lieu of 80s		2 – Yellow ATR 60 (60%) 60/40 split	

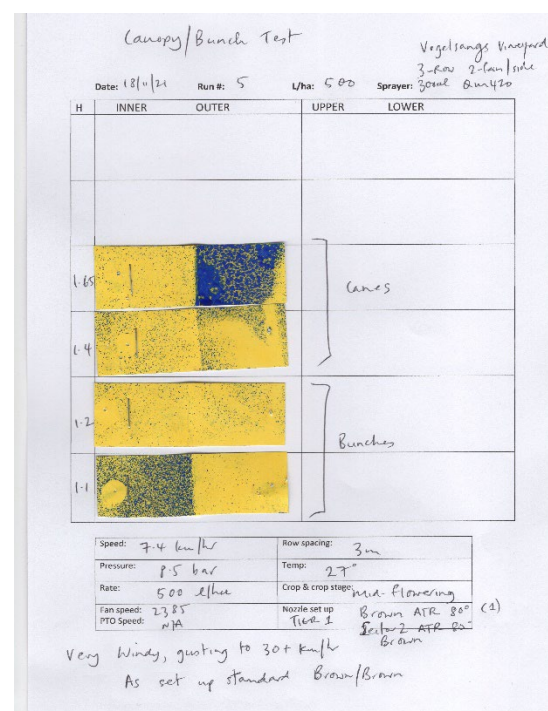
General notes

- From the first day's data, we knew 500 L/ha was the right application rate for the canopy, so this was used throughout days 2 and 3.
- To achieve coverage with two fans, we made significant adjustments to the fan set up. Standard configuration would have resulted in "stripping" in the bunch zone. We adjusted slightly between run 5 and 6 to bring fans closer together (700mm between fans). See recommendations later in the report.
- 7.5 km/hr speed appears to have been fine for this application. Lower speed may be needed later.
- 2 fans per side is well suited to this canopy type (see coverage results)
- The 60/40 bottom/top split made a positive difference to coverage in the bunch zone (1.2-1.5m) pressure was evident or of concern in the remainder of the season, coupled with further rate increase if needed

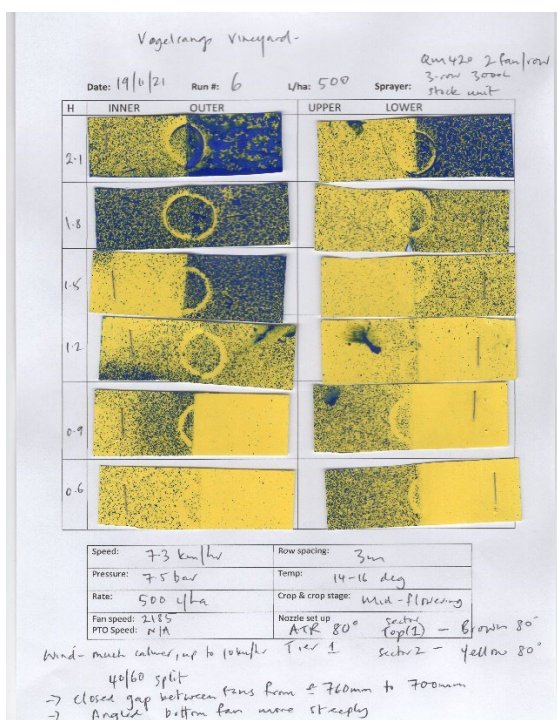
Table 5: Coverage results



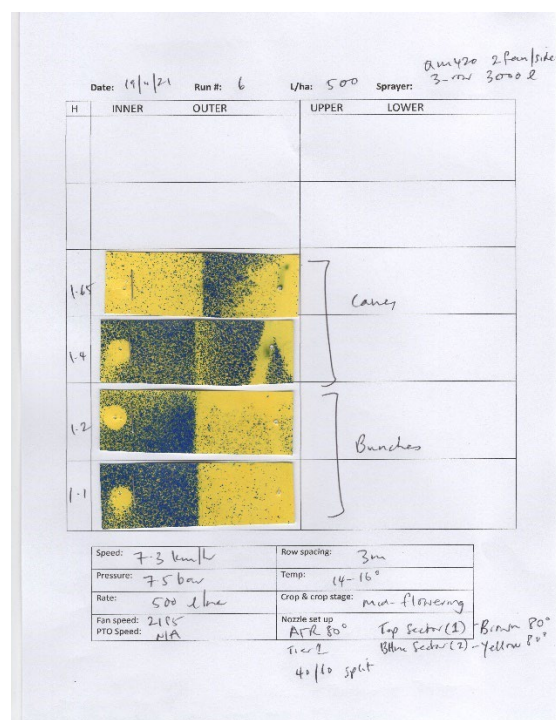
18/11/21: Even using standard 50/50 split, coverage is excellent.
Fans were adjusted prior to first run.



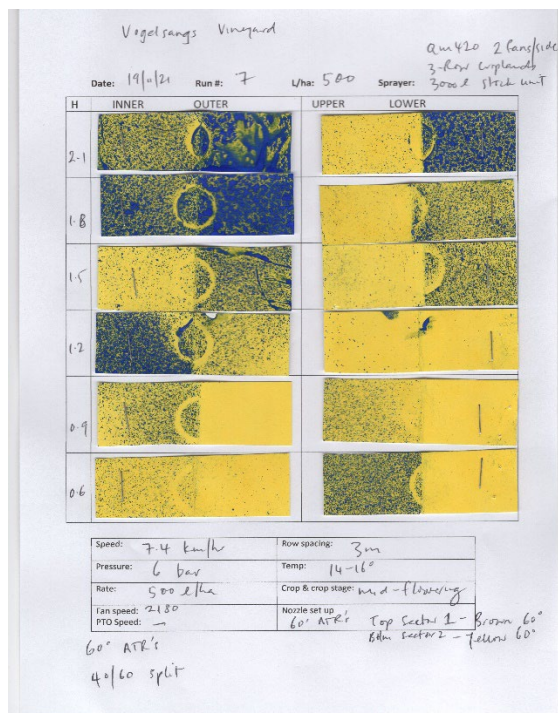
18/11/21: We felt bunch coverage would improve with split of 40/60 (60% from bottom fan)



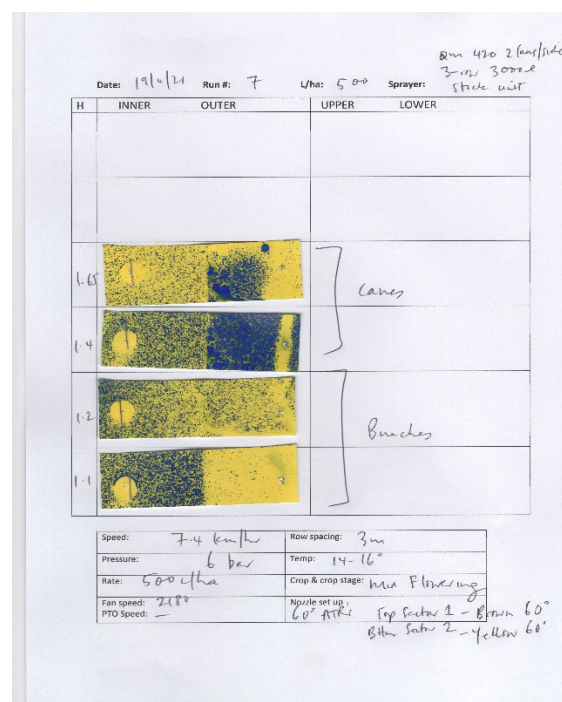
19/11/21: 40/60 split (60 in bottom fan)



19/11/21: Bunch and cane coverage improved (40/60)



19/11/21: 40/60 split using 60 deg ATR's



19/11/21: 40/60 split showing good results

Coverage summary and notes from Table 5

- As for the summary of the Quantum Smart Spray 3-head/side unit, the 0.6m papers were purely to see if there was lost over-spray down low. The critical zone was 0.9/1.0m to 1.4 for bunch and thick canopy, and above that for new cane growth
- Application rate was maintained at 500 L/ha to provide a clear comparison to 3 heads per side in the Quantum Smart Spray configuration
- The coverage test with 80-degree ATRs in a 40/60 split had a marked improvement in the bunch zone. Less spray was lost below the cordon (0.9m and below). We then tried the 60-degree in lieu of the 80 degree and really, there was no significant difference
- We didn't try 40-degree HCL's as we felt with some restrictions (see note below) in our fan set up capability, there was a risk of "stripping" between the two fans
- We dropped the top fan down significantly from the ex-factory standard set up; likewise, we lifted the bottom head up significantly. Reducing the gap to 700mm was necessary to ensure enough overlap of air
- We felt that if we had the opportunity to lift and flatten the bottom head and aim it directly at the bunch area, we may have even gone one step further. This would have enabled us to get to around 650mm between the fans. Unfortunately, this was not possible due to the strengthening bar in the frame for the inner fans – more on this below
- Coverage is still exceptionally good using two fans per side – more of this in the final summary

Table 8: Images of fan set up and things to resolve



Fairly steep bottom fan angle was largely necessitated by the strengthening bar in the inner frame (see arrow below).



Fan distance for the test was 700mm



If the bar was moved and we could flatten the bottom fan towards the bunch zone – and bring the fans slightly closer, the perfect set up would be possible for 2-fans per side in cool climate vines.



A smaller frame dimension (longitudinally) would be possible. Ground clearance to the bottom of the lower fan should be around 750/800mm with the frame just beneath.

Final comments

1. Cool climate vines in Australia, particularly in the Southeast of SA, are slightly larger than Tasmania or New Zealand. Both have unique challenges, but a two fan per side QM420 is more than capable of providing excellent coverage. This is a cost saving, and Andrew and I both felt that for recapture, two fans early season using 40-degree HCI's would be fantastic.
2. The fan speed we used for both tests was around the 2000-2300 range and appeared to be perfectly suited to the canopy need. Speed in the 6-8 km/hr range would be fine with the air available, probably more towards 6.5/7 from flowering onwards. This may vary depending on canopy type and vine architecture.
3. As mentioned in our warm climate test report, spray pressure is very important for providing fine droplets – still the most effective way to allow air to carry droplets into hard-to-reach parts of the canopy. The “sweet spot” for the QM fans is 8-12 bar.
4. The range of application rates offered by the tiered system on the QM420 is perfect for both cool and warm climate growers. Using one fan only early season applying say 200 L/ha, progressing to two fans at say 300/350, then using the 2nd tier to apply 500 from flowering onwards with Tier 3 up their sleeve for high rates if needed – it's a fantastic tool when coupled with air adjustability.
5. A few tweaks to the frame design could be necessary to provide the perfect set up for a QM420 two-fan option. Likewise, a better factory set up than currently being offered is going to be very important to ensure growers start off on the right foot.
6. Consider making an easy grease point standard. It is a WHS issue having to climb to grease the pivot points – this was the first thing the Vogelsangs did to their sprayer (see below).
7. Ensure that each machine has the correct set up for row width before it leaves the factory. We could not adjust the outer arms as we needed to for 3 metres on the stock 3-row machine. We got by, but it was clear that this could be better set up ex-factory. This should be done by check-sheet from the dealer.



Common easy-reach grease point, one per side – fitted by the grower



View of grease points up the mast

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