

# SPRAY COVERAGE TESTING

November 2021 | Warm 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 warm climate testing.

- Quantum™ Smart Spray 3-row 4000 litre with Fusion Controller and terracing
- Quantum™ Smart Spray 2-row 3000 litre with Fusion Controller

## Testing Notes

- Both warm-climate tests were carried out in the Riverland region in Moorook and Renmark
- Quantum Smart Spray units tested in the warm-climate vines were on two different vineyards
  - Three-row unit: row spacing of 3.3 metres (11ft) and a dual cordon
  - Two-row unit: row spacing of 3.6 metre row vineyard with a triple cordon and height of up to 2.5/2.7 metres
- Spray coverage testing was carried out in-line with the rate both growers have been using and at speeds comparable to current grower applications. Both growers use a concentrate spray method.
- Air output data was checked and kept in-line with the design parameters and Croplands' Engineering performance table recommendations
- Set up procedures for successful demonstration and/or grower delivery are outlined in the following report

## SECTION 1: Quantum Smart Spray Three-row

### Sprayer details

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

**Table 1: Grower**

Ryan Pietrolaij & family, Moorook, SA

Approx. 250 acres (100-110ha)

Product/application	L/ha range	Speed range	Target speed
All spraying applications	400-600*	8km/hr all season	8km/hr

\* Ryan starts at approximately 350/400 L/ha early season and moves to 500 L/ha. See below our advice to move up to 600 L/ha. At present he is using a concentrate factor of 2-times and will likely increase this to 2.5-times later in the season.

### Vineyard

Canopy height	Canopy width	Row width	Crop stage
~2.3m (bottom of canopy starting at ~0.9m)	2-2.3m (depending on variety)	3.35m / 11ft	Flowering/early fruit set

Vines mechanically pruned to box-hedge in winter. Tip trimming for skirting, tops and row access carried out from flowering onwards.

**Table 2: Test application**

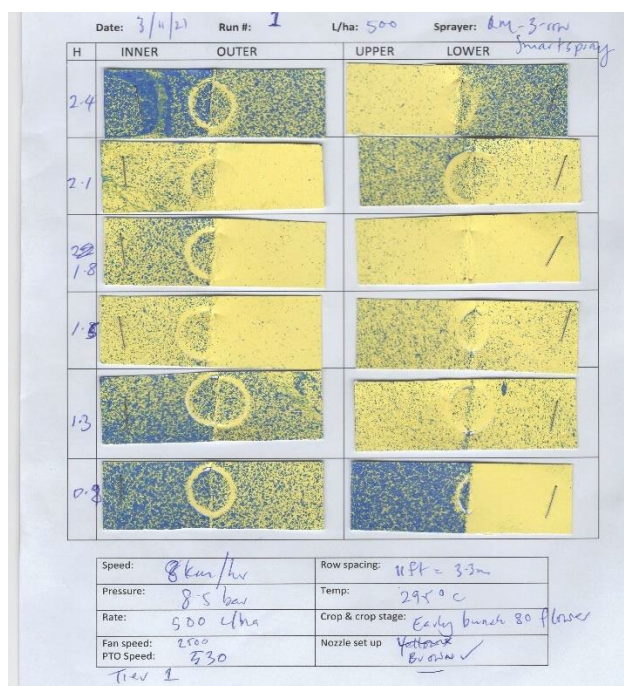
Product/application		L/ha range		Speed range	Target speed
Test runs		500-600*		8km/hr	8km/hr
	Speed	Nozzle set up	Fan speed	Sectors/nozzles	Displayed pressure
Run 1	8km/hr	Tier 1 – 500L/ha	2500 RPM	1 – Brown ATR 80 (33.3%) 2 – Brown ATR 80 (33.3%) 3 – Brown ATR 80 (33.3%)	8.5 bar
Run 2	8km/hr	Tier 2 – 600L/ha	2500 RPM	1 – Brown ATR 80 (33.3%) 2 – Brown ATR 80 (33.3%) 3 – Brown ATR 80 (33.3%)	7.5 bar
Run 3	8km/hr	Tier 2 (adjusted) – 600L/ha  Bottom fan adjusted slightly upward to ~25°	2500 RPM	1 – Yellow ATR 80 (33.3%) 2 – Orange ATR 80 (44.5%) 3 – Brown ATR 80 (22.5%)	7.9 bar

\* We felt 500 L/ha was slightly low, so we increased the rate to 600 L/ha and consulted with the grower on the reasons for the decision based on W/S paper results – see table 3 below.

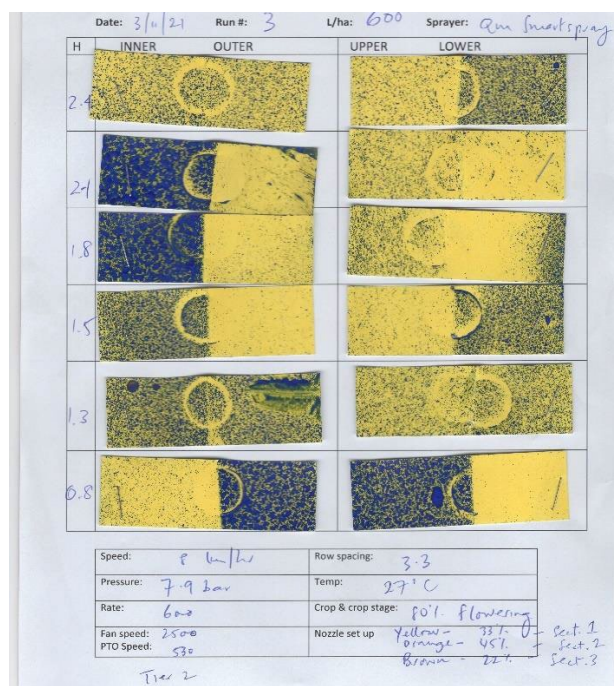
### General notes

- Lifting the rate from 500 to 600 L/ha represents a 17% increase in application – results improved markedly
- To “even out” canopy distribution and to apply sufficient spray volume to the bulk of the canopy in the 1.5-2 metre height range (bunch-line area), a change to the nozzles was made (see above)
- 8 km/hr speed appears to have been fine for this application. Sufficient air was available to achieve excellent coverage. Discussed with Ryan that he could slow down if disease pressure was evident or of concern in the remainder of the season, coupled with further rate increase if needed.

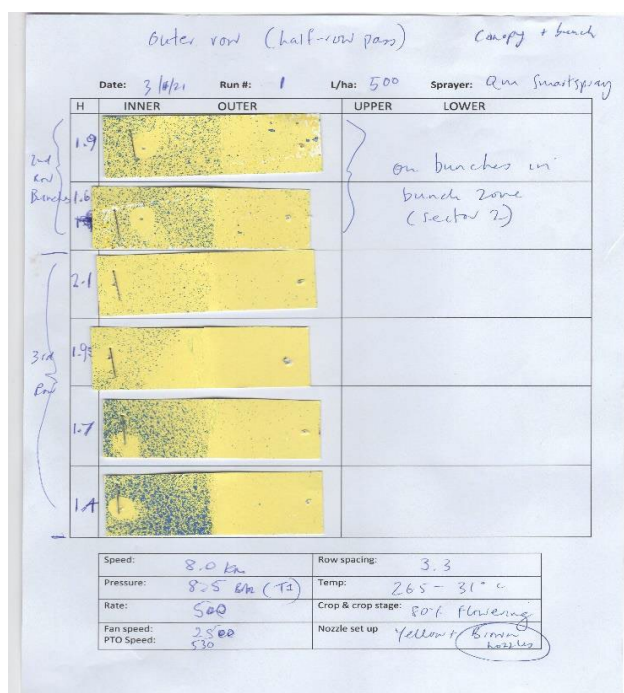
Table 3: Coverage results



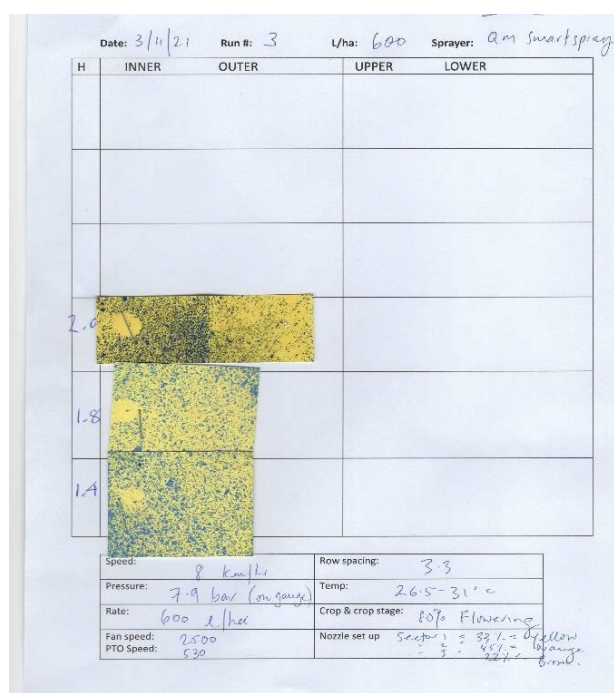
3/11/21: Run 1 - Static pole test, 500 L/ha, 8 km/hr. Set just as the grower has been using so far this season.



3/11/21: Run 3 - 600 L/ha, 8 km/hr with sector outputs adjusted as per table 2.



3/11/21: Bunch-line/canopy W/S papers, run #1



3/11/21: Bunch-line W/S papers, run #3

## Observations and commentary

- The standard fan frame set up was ideal for this application. We made a slight change to the bottom head angle, but apart from that, as set up ex-factory it provided the “wall of air” needed to achieve good results
- The grower's standard set up was providing very good coverage. By making a slight adjustment to rate and changing the sector percentage to match the canopy volume for each sector, coverage improved – especially in the critical bunch-line area. Once flowering is under way, this is the most vulnerable area to fungal disease and insect damage. Top/bottom coverage is still very important, especially for new cane growth
- The outer row appeared not to be compromised. This again is the value of good air and the three fan “wall of air” concept. Wind compensation will be an excellent tool in windy conditions to ensure coverage is maintained
- Early season it is likely that either one fan (sector 2) or two fans (sectors 2 and 3) could be used effectively at a reduced rate. This has not yet been tested but would be worth doing so next season. Air volume would likely be better at a lower speed as well. Setting up the tiers would be another excellent way to reduce drift during the early season, possibly with 40-degree nozzles.
- The static pole was placed as close to the cordon on one side as practicable, approximately 50cm from the outer canopy
- The outer canopy/bunch-line papers were approximately 30-40cm into the canopy and attached onto or near flowering bunches
- Run #2 results are not shown here but are available in the folder provided with the report
- A copy of the Calibration Tool recommendations using the parameters we set for Tier 1 and 2 and the spray rate of 600 L/ha is included in the folder provided – this validates the tool for use with the Quantum Smart Spray 3-row sprayer

## SECTION 2: Quantum Smart Spray Two-row

### Sprayer details

- 3000-litre
- Fusion Controller
- Self-contained Micro Power Pack

**Table 4: Grower**

Tony Trezise and family, Renmark SA

Approx. 280 acres (115ha)

Product/application	L/ha range	Speed range	Target speed
All spraying applications	500	6.3-7km/hr	6.5km/hr*

\* For this large canopy we felt this was the "sweet spot" for coverage. A faster speed early season is likely. Tony spraying at a concentrate factor of 2-times.

### Vineyard

Canopy height	Canopy width	Row width	Crop stage
~2.5m (bottom of canopy starting at 1.2m)	2.2-2.5m (depending on variety)	3.66m / 12ft	Flowering/early fruit set

Vines mechanically pruned to box-hedge in winter. Tip trimming for skirting, tops and row access carried out from flowering onwards. This canopy is a triple-cordon so is very bulky and higher than most at around 8 feet (2.4 to 2.5 or so metres)

**Table 5: Test application**

Product/application		L/ha range	Speed range	Target speed	
Test runs		500-600*	6.3-7km/hr	6.5km/hr	
Speed	Nozzle set up	Fan speed	Sectors/nozzles	Displayed pressure	
Run 1	6.3km/hr	Tier 1 – 500L/ha	2500 RPM	1 – Brown ATR 80 (33.3%) 2 – Brown ATR 80 (33.3%) 3 – Brown ATR 80 (33.3%)	9 bar
Run 2	7km/hr	Tier 2 – 500L/ha Bottom fan adjusted upward	24500 RPM	1 – Brown ATR 80 (37.7%) 2 – Brown ATR 80 (37.7%) 3 – Brown ATR 80 (24.5%)	5.4 bar
Run 3	6.8km/hr	Tier 2 – 500L/ha Tried out 40° HCI nozzles	2450 RPM	1 – Green HCI 40 (37.4%) 2 – Green HCI 40 (37.4%) 3 – Orange HCI 40 (25.2%)	4.8 bar
Run 4	6.3km/hr	Tier 2 – 500 L/ha Top fan dropped by 70-80mm Bottom fan adjusted back to original 40° HCI nozzles	2450 RPM	1 – Orange HCI 40 (28.7%) 2 – Green HCI 40 (42.5%) 3 – Orange HCI 40 (28.7%) Adjusted to lift pressure and increase flow in sector 2	5.4 bar
Run 5	6.8km/hr	Tier 2 – 500L/ha Top fan adjusted slightly downward	2500 RPM	1 – Yellow ATR 80 (37.7%) 2 – Yellow ATR 80 (37.7%) 3 – Brown ATR 80 (24.5%)	5.4 bar
Run 6	6.9km/hr	Tier 2 – 600L/ha	2450 RPM	1 – Yellow ATR 80 (37.7%) 2 – Yellow ATR 80 (37.7%) 3 – Brown ATR 80 (24.5%)	7.5 bar

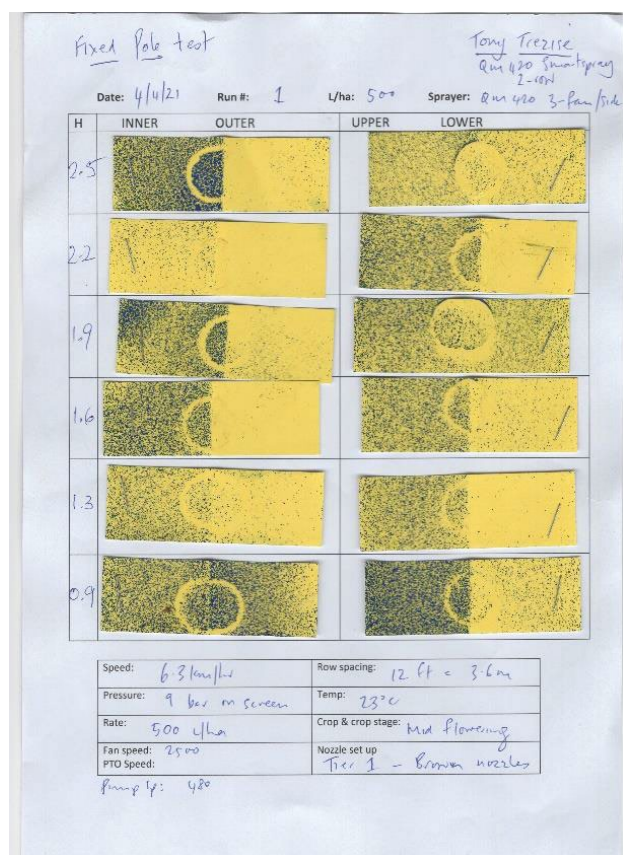


## General notes

- We discovered that Tony had been operating the sprayer in Tier 3 resulting in a pressure lower than our recommended parameters. We commenced our testing using Tier 1 to get the pressure to an acceptable level.
- As we found with Ryan's sprayer, lifting the rate from 500 to 600 L/ha represented a 17% increase in application and improved coverage accordingly. We didn't lift the rate until we felt we had the fans in the correct position for the taller canopy and after we had played with the 40-degree nozzles.
- This canopy was more difficult to spray than Ryan's – the third cordon was like a "wall" – virtually no coverage from the other side of the row is evident on the Outer side of the pole papers.
- As was the case at Ryan's block, the static pole was placed as close to the cordon on one side as practicable, approximately 50cm from the outer canopy.
- Tony's sprayer was fitted with an extended frame to accommodate the taller canopy. This allowed us slightly more adjustment.



Table 6: Coverage results

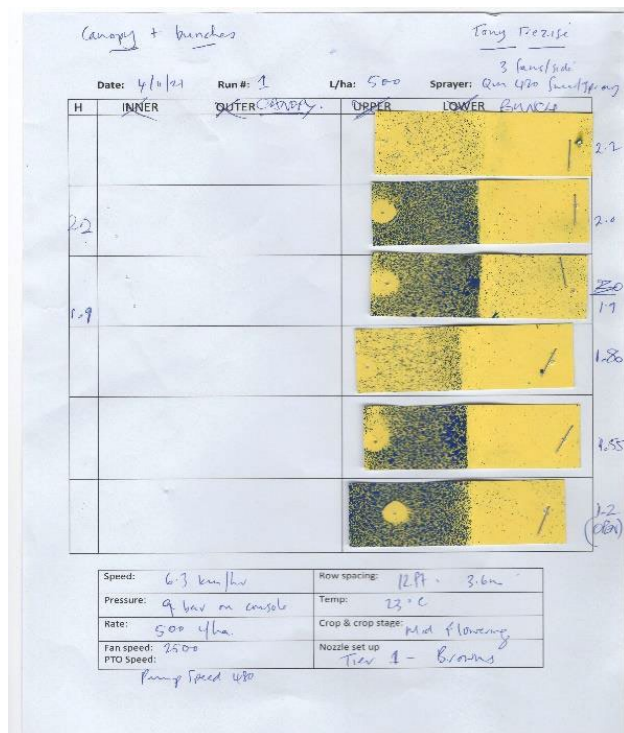


4/11/21: Nothing too much wrong with this coverage – 500 L/ha. We felt the coverage could be improved in the area around 2.2 metres, and that the lower area at 0.9 metres required less coverage as it was basically under where the canopy began.

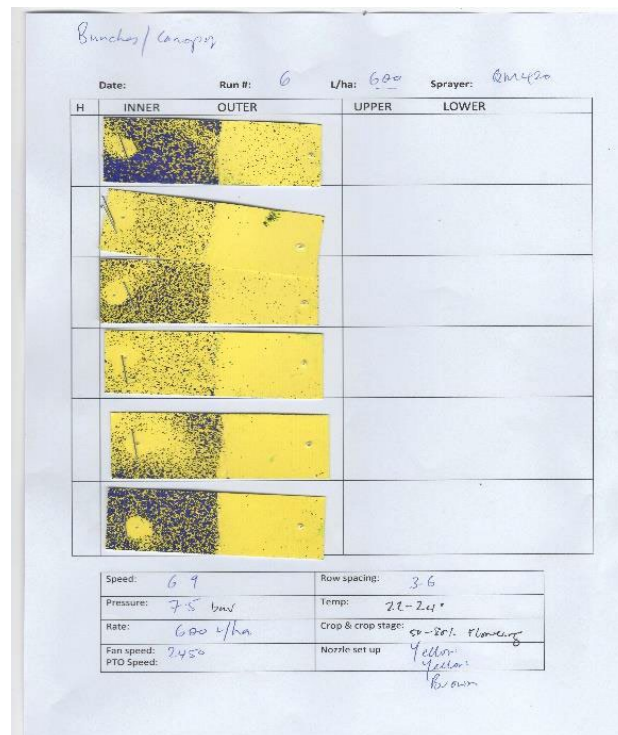


5/11/21: 600 L/ha with fans adjusted – the goal was to improve coverage in the bunch zone and to try and even it out. At the 2.2 metre mark there was a slight gap in the canopy – hence the heavier deposits.

The key difference here is that Run 6 was at 6.9 km/hr and 600 L/ha, whereas run 1 was at the lower speed of 6.3 km/hr/500 L/ha. Distribution and rate provide a slightly better overall result in run 6, but my gut feel is that even a ½ km/hr difference has meant the upper/lower papers may have suffered slightly.



4/11/21: Bunch/canopy W/S test  
500 L/ha, 6.3 km/hr

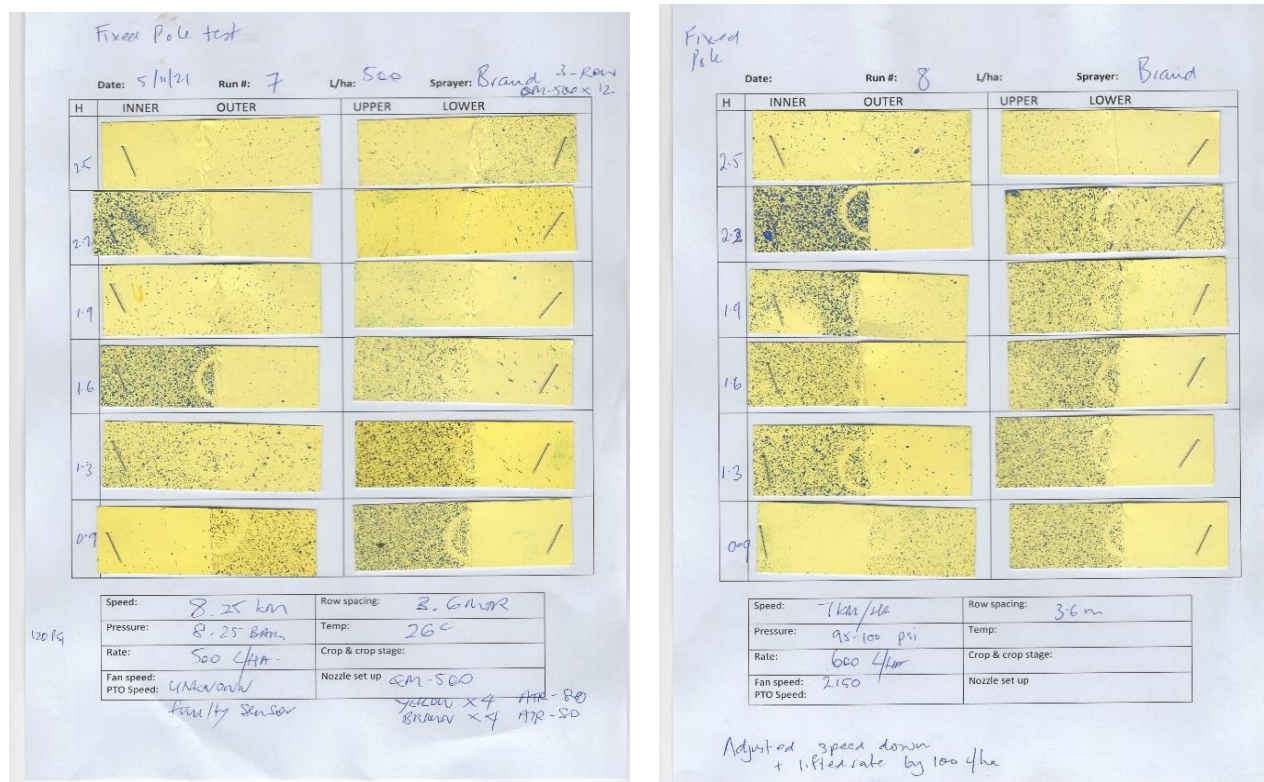


5/11/21: Bunch/canopy W/S test  
600 L/ha, 6.9 km/hr

As per the comments above, there is not much difference in the results here, but my gut feel again is that the extra 0.6 km/hr would possibly make a slight difference to help with dwell time, giving the fans a fraction more opportunity to deliver droplets into the canopy/bunch zone.

**Table 7: Coverage results**

Braud 3-row QM500 fans (two per side) – comparison to Quantum Smart Spray



5/11/21: Braud 3-row unit, 8.25 km/hr, 500 L/ha

5/11/21: Braud 3-row sprayer, 7 km/hr, 600 L/ha

We had the opportunity to run Tony's 3-row Braud harvester/Quantum Mist sprayer to compare to the Quantum Smart Spray with 420 fans. First run showed that speed has a big impact on coverage, but also that two 500 fans struggle with such a big canopy. If we had time to do fan adjustments, we may have been able to improve it.

### Observations and commentary

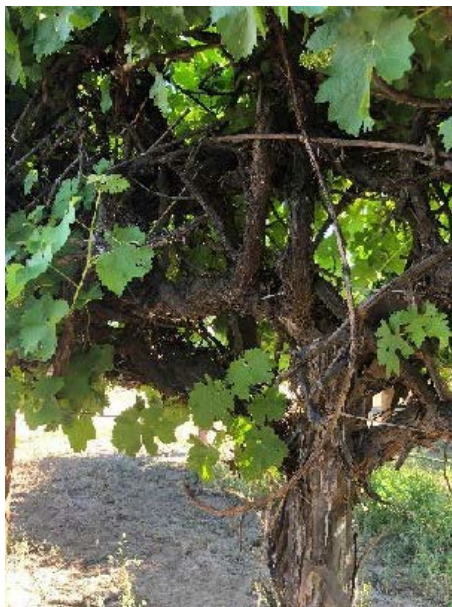
- There is certainly a correlation between speed and coverage in these very heavy vine canopies. As the bunches develop, it will be even more critical not to travel too quickly.
- Not all the runs are displayed in the report – only the first and last are shown in table 6; the rest are available and have been scanned and can be viewed as required.
- As shown in table 8, the 40-degree HCI nozzles did a good job of assisting to penetrate the bunch area, however there is more risk of "stripping" as shown in table 8.
- There is clear evidence that using the sector percentage flow opportunity to improve coverage is an excellent tool – more in the final summary and recommendations.
- As with the day one results, early season it is likely that either one fan (sector 2) or two fans (sectors 2 and 3) could be used effectively at a reduced rate,
- As shown in Braud harvester results, two QM500 fans have been superseded by the 3 x 420 style. The ladder frame set up is also far superior to allow much easier and faster adjustment. Having 3 fans per side in the large canopies allow for a real opportunity to fine tune sector percentage flow to match the canopy. There is a distinct difference in coverage between the Braud and the Quantum Smart Spray 420.



Table 8: Testing site and fan site images



Bunches setting fruit



Gnarly cordon



Evidence of some stripping between sectors 1 and 2 using 40-deg nozzle



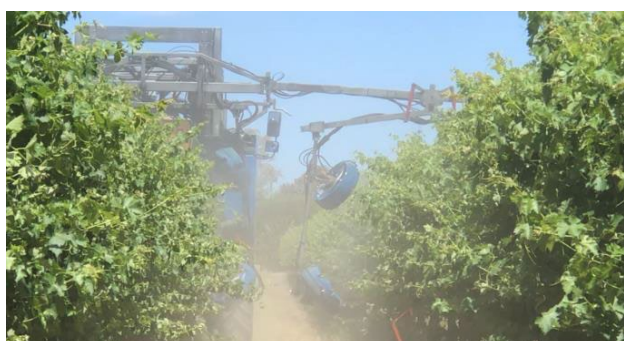
Large canopy – 8ft high



Bottom head adjusted slightly steeper – still some spray “lost” under the canopy. We will try 60-deg nozzles in next test



Final head set up – similar to factory default but top head dropped slightly. Note this is a longer frame than standard



Braud in action. The fan frame on the Quantum Smart Spray makes adjustments to fans a lot easier than the older style droppers



We thought head angles could have been adjusted to improve coverage – closer and flatter to canopy: time did not allow us to have a play.

## Summary

- Large, sprawl type, multi-cordon machine pruned canopies will always provide a challenge for spray coverage. Speed of travel is one of the most important factors for achieving good results. From flowering onwards, a target speed of 6.5 km/hr is recommended.
- Spray pressure is very important to 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. Pressures under 5 bar are to be avoided.
- 40-degree nozzles in these large canopies pose a risk of “stripping” unless the fans can be angled and/or brought quite close together. Standard 80-degree nozzles appear to still provide the best option, especially using tier 1 or tier 2 (5 nozzles per fan).
- The 3-fan per side Quantum Smart Spray fan frame design allows an ideal opportunity to utilise the sector percentage flow to ensure the droplet deposition matches canopy density. The guidelines in this report should help to set up and calibrate for these sprawl canopies.
- It is very likely that fan speed could be reduced for early season spraying. Some work around this would be worthwhile early next season.

## Croplands Horticulture Contact

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