Managing Disease - Spray Coverage on Large Grapevine Canopies

G.O. FURNESS1, R.W. EMMETT1, P.A. MAGAREY2 and T.J. WICKS2

1. Loxton Research Centre, South Australian Research and Development Institute, PO Box 411, Loxton, S.A. 5333
2. Sunraysia Horticultural Centre, Agriculture Victoria, PO Box 905, Mildura, Vic. 3502
3. Plant Research Centre, Waite Campus, Primary Industries South Australia, GPO Box 1671, Adelaide, S.A. 5001

Spray coverage is an important component of disease and pest management programs in Australian viticulture. Inadequate spray coverage can be responsible for poor disease and pest control even when spray applications are well-timed. It can limit, for example, gains in efficiency offered by strategic spray programs where spraying is mostly restricted to periods when diseases and pests are active in vineyards. Effective control relies more heavily on good coverage under these circumstances.

Changes in canopy management and other viticulture practices adopted by grapegrowers (e.g., pruning, shoot training, use of rootstocks, etc.) have also resulted in vineyards with different canopy architecture that require different treatment by spray machines. While some management practices may facilitate treatment and reduce disease and pest pressure on vines, others increase the volume of foliage to be treated and fully test the capacity of spray machines. For example, where vines are vigorous and are minimally pruned or mechanically hedged, this paper reviews preliminary results of studies of spray coverage on grapevines with canopies of various types when treated with a range of widely-used spray machines.

Methods

Trials were conducted in established commercial vineyards in the Riverland district and at Coonawarra, South Australia in 1992–93 (Furness et al. 1993) and 1993–94. Fluorescent dyes were used to indicate spray distribution on vines with different types of canopy including those that were minimally pruned. A flut treatment, leaves and bunches were sampled from the sides, centre and upper parts of the canopy, examined under ultra-violet light and scored for percent surface area covered with deposits. In some tests, water-sensitive papers placed in various positions within vine canopies, were also used to indicate droplet distribution and deposition.

All sprays were applied by commercial vineyard operators. Spray machines evaluated included the standard airblast sprayer with a range of nozzles and spray volumes, the airblast sprayer with an overhead hydraulic boom, the simple hydraulic side boom machine, the Silvan Turbomiser/Electromiser, the Hardi Varian ducted, air-assisted sprayer, the Span sprayer and the Holder QU cross flow air curtain sprayer. All spray machines were set up and adjusted according to the manufacturers’ recommendations.

Results

Figures 1–5 (Furness et al. 1993) show schematic representations of the coverage achieved with some of the machines tested. Numbers on the diagrams indicate the percent area of leaves adequately covered with spray deposits. Numbers in brackets refer to the percent area of bunches adequately covered with spray.

Overall, none of the spray machines tested provided sufficient coverage for good disease and pest control in all parts of large vine canopies. Also, coverage was often uneven, especially during low volume applications. With most machines, coverage was most inadequate on lower leaf surfaces in the upper centre section of large canopies. In a number of tests, control of diseases such as downy and powdery mildew was also inadequate in parts of vines where ratings of spray coverage were low.

Observations of disease incidence in relation to spray coverage indicated that ratings of spray coverage of 80% or more were required for good disease control. However, more detailed studies are required to define the relationship between spray coverage, density of spray deposits and disease control more precisely.

In most cases, bunches were also poorly covered. Often spray deposits were found on one side of bunches only and little or no spray was observed on inside berries even when vines were treated well before bunch closure. Coverage on bunches was usually slightly less than the lowest level observed on leaves.

Standard airblast and simple hydraulic side boom machines also gave poor coverage on the lower surface of leaves on the outside of vine canopies, i.e., on leaves directly in line with and close to spray nozzles. Although still inadequate, better-than-average coverage was achieved when modifications were made to some machines. Some examples were: airblast machines with an overhead hydraulic boom, airblast machines with an enlarged air duct and a large number of fine jets, and the Silvan Turbomiser with two heads per side, one low and one high with both directed at the centre of the canopy.

Discussion

Poor spray coverage appears to be a major factor contributing to the poor disease and pest control. With better coverage it should be possible to contain most disease epidemics, especially when sprays are applied early in the season. Poor and uneven spray coverage increases the amount of chemical that is used when sprays are applied early in the season. Poor and uneven spray coverage can be responsible for poor disease and pest control. With better coverage it should be possible to contain most disease epidemics, especially when sprays are applied early in the season.

Studies so far indicate that the performance of standard airblast machines can be improved by enlarging the size of the air duct (the most important factor affecting performance), by using a larger number of fine jets at high pressure and by adding a simple hydraulic boom over the top of the canopy.

Further research

Only preliminary results have been presented in this paper and further studies of the effects of canopy architecture on the spray deposition achieved by spray machines will be conducted in 1994–95.
Figure 1. Spray coverage on vigorous canopy grapevines with common vineyard sprayers

**Sprayer type:** Silvan Turbomiser with 4 heads, two per side, one high and one low, both aimed at closest row, 350 L/ha, 8.5 km/h
Chardonnay, minimally pruned, vigorous canopy

Figure 2. Spray coverage on vigorous canopy grapevines with common vineyard sprayers

**Sprayer type:** Silvan Electromiser with two heads low down, one per side, 400 L/ha, 7.5 km/h
Chardonnay, T-trellis, conventionally pruned, medium density foliage

Figure 3. Spray coverage on vigorous canopy grapevines with common vineyard sprayers

**Sprayer type:** Orchard air-blast, Metters MBP, 4 D6 hollow cone nozzle/side, 2,000 kPa, 615 L/ha, 7.5 km/h
Ruby Cabernet, T-trellis, conventionally pruned, moderate canopy size and vigour

The uniformity of spray coverage, especially on the inner canopy of vines and on lower leaf surfaces, can be improved by using multi-head (fan-assisted rotary drum atomiser) air carrier sprayers. However, to date, fan-assisted rotary drum systems have been expensive and unreliable. A new spray head called the ‘fizzle’ (fan + nozzle) is being developed in conjunction with the Department of Aeronautical Engineering of the University of Sydney. With this spray head, both air shear and centrifugal force are involved in the atomisation process. Initial studies indicate that air flow performance is dramatically improved by using broad chord, low speed axial fans that produce a radial flow component to the air flow. With this system, fine droplets can be produced at low rotational speeds. Spray heads with improved low speed axial fans in combination with hydraulic nozzles are also being developed.

**Conclusions**

There is a need for more research on air-assisted spray application technology. Preliminary studies have shown that systems that deliver large volumes of turbulent air at low velocities can provide improved uniformity of spray coverage, especially on the inner foliage and lower leaf surfaces of large vine canopies.

Improved spray coverage has potential to improve spray efficacy against diseases and pests and reduce fungicide and pesticide use. The number of spray applications required for disease and pest control, application costs, off-target washage of spray chemicals and the potential for chemical residues in grapes and grape products. There is also potential to reduce the power requirements of airblast sprayers which would allow development of smaller, lightweight equipment, which in turn would reduce the likelihood of soil compaction in vineyards.

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