Fungicidal control of grapevine powdery mildew

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Summary

The sterol biosynthesis-inhibiting fungicides myclobutanil (50 mg a.i. l^{-1}) flusilazol (20 mg a.i. l^{-1}), penconazole (25 mg a.i. l^{-1}), propiconazole (25 mg a.i. l^{-1}) and triadimefon (25 mg a.i. l^{-1}) controlled grapevine powdery mildew (*Uncinula necator*) in seasons when all bunches of unsprayed vines were severely mildewed. Control was most effective when fungicides were applied on four occasions between October and January. In one experiment bunch weights almost doubled after fungicides were applied in late December and early January.

Introduction

Powdery mildew caused by *Uncinula necator* (Schw.) Burr. is a destructive disease of grapevines, occurring in all the grape-growing areas of Australia and causing complete crop loss in some seasons if fungicides have not been applied.

Powdery mildew is controlled by four applications of fungicides between mid October and early January. Applications in November and December, i.e. during flowering and fruit set, are the most effective (Wicks *et al.* 1984).

In Australia, sulfur has been widely used to control the disease because of its effectiveness and low cost. However, alternative materials need to be evaluated, as sulfur can be phytotoxic if applied in hot weather and can result in the development of hydrogen sulfide in wines made from grapes sprayed close to harvest.

A number of sterol biosynthesis-inhibiting (SBI) fungicides such as propiconazole, fenarimol and triadimefon have controlled *U. necator* under Australian conditions (Wicks *et al.* 1984; Emmett *et al.* 1984) and have been recommended for use as alternatives to sulfur. Further evaluation of SBI fungicides was undertaken since the chemical structures of these fungicides differ greatly and it is uncertain whether they exhibit the same mode of action at the same site (Koller and Scheinpflug 1987).

This paper reports experiments evaluating SBI fungicides for the control of *U. necator* and includes some that have recently been made available for testing.

Materials and methods

Field experiments were conducted on mature vines of *Vitis vinifera* cv. Crouchen in 1985/86 and 1987/88 at the Nuriootpa Research Centre, some 80 km north of Adelaide, S.A., and on Cabernet Sauvignon in a commercial vineyard in 1985/86 at McLaren Vale, 60 km south of Adelaide. Both vineyards had a history of powdery mildew. Fungicides used at the rates and times shown in Tables 1–3 were: Systhane (40% active ingredient (a.i.) myclobutanil), Nustar (10% a.i. flusilazol), Topas (10% a.i. penconazole), Tilt (10% a.i. propiconazole), Bayfidan (25% a.i. triadimenol), Bayleton (12.5% a.i. triadimefon), RO 151297 (48% a.i. pyrifenox) and wettable sulfur (80% a.i. sulfur).

Fungicides were applied with a knapsack sprayer at Nuriootpa, but at McLaren Vale they were applied with a pressurized spray gun delivering 1100 l ha^{-1} in spring and 3000 l ha^{-1} in summer.

At Nuriootpa, six fungicides were applied to vines on 1 and 27 November and 12 December 1985 in the first experiment. The second experiment compared three fungicides applied on 24 December 1987 and 4 February 1988. At McLaren Vale, three fungicides were applied on 21 October, 13 November, 3 December 1985 and 21 January 1986.

Plots consisting of four or five vines were arranged in a randomized block with five replicates per treatment in 1985/86 and four replicates in 1987/88 in the Nuriootpa experiments. Powdery mildew fungicides were not applied to these vines in the 1986/87 season. At McLaren Vale, plots consisting of 15 to 20 vines were arranged in a randomized block with four replicates per treatment.

In each experiment the severity of powdery mildew was assessed at the time of harvest (February–March) by counting the number of lesions on the basal 30 cm of 10 canes near the crown area of each vine, and estimating the area of each of 20 bunches (berries, peduncles and stalks) infected with mildew (Wicks *et al.* 1984). Bunches were picked at random from either side of the centre vines in each plot. A minimum of 100 bunches and 40 canes were assessed for each treatment. In 1987/88, the bunches from each plot were combined and weighed and a mean bunch weight calculated from the total weight of each treatment.

Results and discussion

The incidence and severity of powdery mildew was low in the 1985/86 Nuriootpa experiment as 56% of bunches developed mildew and less than 13 powdery mildew lesions appeared on canes of unsprayed vines (Table 1). All fungicides controlled powdery mildew. Few cane lesions developed on sprayed vines and, except for the sulfur treatment, 1% or less of the bunches were mildewed.

In the 1987/88 Nuriootpa experiment, powdery mildew developed in all plots. In the unsprayed areas, all bunches were severely infected, with mildew developing on more than 90% of the area of berries and stalks of each bunch (Table 2). Cane lesions also developed extensively with up to 70 per cane on unsprayed vines.

In sprayed vines the incidence of powdery mildew was also high but the severity was less than that in the unsprayed vines as shown by the flusilazol and penconazole treatments where < 50% of each bunch was mildewed. This was also reflected in the bunch weights where bunches from the fungicide-treated vines were significantly heavier than those from the unsprayed vines. Many bunches of unsprayed vines were completely covered with mildew, while in other bunches most berries were split and dehydrated.

Powdery mildew also developed extensively at McLaren Vale in 1985/86 where all bunches of unsprayed vines were severely mildewed and more than 80 lesions were counted on the canes (Table 3). By contrast, all fungicide treatments controlled mildew. Penconazole and triadimefon were more effective than propiconazole on the basis of lesion counts, but this difference was not reflected in the assessments on the incidence and severity of bunch infection.

Overall these results support previous observations (Wicks *et al.* 1984; Pearson and Riegel 1987) showing that SBI fungicides effectively control grapevine powdery mildew.

In both the 1985/86 McLaren Vale and 1987/88 Nuriootpa experiments, all SBI fungicides controlled powdery mildew where the incidence and severity of the disease were high.

The level of control achieved with only two applications of either flusilazol, penconazole or myclobutanil in the 1987/88 experiment was unexpected, considering that the control of powdery mildew was poor in other experiments where a number of SBI fungicides were applied after infection (Emmett *et al.* 1984). This suggests that further experiments need to be conducted to compare the efficacy of SBI fungicides applied after infection.

In the 1987/88 Nuriootpa experiment, powdery mildew was first observed on vines in mid November and developed most rapidly during mild, overcast conditions in late December and early January. Even better disease control (and increase in yield) may have resulted had the fungicides been applied around flowering.

Most bunches harvested from unsprayed vines in the 1987/88 Nuriootpa experiment were completely covered with mildew and many berries were either small or split and dehydrated, making them unsuitable for wine making or distillation. This damage resulted in a complete loss of yield from the unsprayed vines. Commercially acceptable bunches were picked from sprayed vines, although due to the incidence of powdery mildew they were likely to be graded lower than those from healthy vines.

References

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Table 1 Effect of fungicide treatments on the control of powdery mildew on grapes cv. Crouchen (Nuriootpa, 1985/86)

Fungicide (mg a.i. l^{-1})	No. lesions per cane[A]	Bunches mildewed (%)[B]	Area of bunch mildewed (%)[B]
Myclobutanil (75)	0.26	1	0.05
Propiconazole (10)	0.26	0	0
Penconazole (25)	0.59	0	0
Sulfur (1600)	0.62	7.5	0.35
Triadimenol (25)	0.71	0	0
Pyrifenox (48)	0.97	1	0.05
Control	12.82	56	14.95
1.s.d. (0.05)	2.4	15.7	1.69

[A] Assessed from 100 canes per treatment.
[B] Assessed from 100 bunches per treatment.

Table 2 Effect of fungicide treatments on the control of powdery mildew on grapes cv. Crouchen (Nuriootpa, 1987/88)

Fungicide (mg a.i. l^{-1})	No. lesions per cane[A]	Bunches mildewed (%)[B]	Area of bunch mildewed (%)[B]	Mean bunch wt (g)
Flusilazol (20)	15.9	100	37	107
Penconazole (25)	13.4	90	44	98
Myclobutanil (50)	20.1	100	51	92
Control	70.5	100	94	57
1.s.d. (0.05)	6.4	14.3	6.7	17

[A] Assessed on 60 canes per treatment.
[B] Assessed on 120 bunches per treatment.

Table 3 Effect of fungicide treatments on the control of powdery mildew on grapes cv. Cabernet Sauvignon (McLaren Vale, 1985/86)

Fungicide (mg a.i. l^{-1})	No. lesions per cane[A]	Bunches mildewed (%)[B]	Area of bunch mildewed (%)[B]
Penconazole (25)	12.5	39	2.7
Triadimefon (25)	12.6	18	1.1
Propiconazole (25)	35.3	32	1.9
Control	84.7	100	98.5
1.s.d. (0.05)	8.2	18.2	1.0

[A] Assessed from 40 canes per treatment.
[B] Assessed from 100 bunches per treatment.