

Metaxanine, A Systemic Fungicide Against *Plasmopara Viticola* on Wine Grapes: Disease Control, Residues and Effect on Fermentation and Wine Quality

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The systemic fungicide metaxanine/methyl D, L-N-(2,6-dimethyl-phenyl)-N-(2 methoxyacetyl) alaninate/, was compared with mancozeb for the control of *Plasmopara viticola* (B × C) Berl. & de T. on grapevines in the Western Cape Province of South Africa. The systemic fungicide gave better control than mancozeb. Good control was obtained with applications of the systemic fungicide at 21 day intervals, despite the fact that weather conditions were particularly favourable for disease development. Residues of metaxanine recovered from grapes were low and did not affect either the onset, or the rate of fermentation of grape juice, nor did it affect wine quality.

Grapevine downy mildew, caused by *Plasmopara viticola* (B & C) Berl. & de T. can become epidemic in South Africa in some seasons. Various fungicides are used to combat the disease, copper and dithiocarbamate compounds being the most popular (Marais, 1977). However, effectiveness is largely affected by the weather conditions during the growing season and control is unsatisfactory under prolonged conditions favourable for the development of the disease. In recent trials in Europe good control was achieved with various systemic fungicides (Meyer, Brechbuhler, & Weber, 1978; Mur, 1978; Shiller, Raspé & Fritzsche, 1979). One of these systemic fungicides has been tested under South African conditions and good control was obtained despite the fact that weather conditions were particularly favourable for disease development (Marais & Van der Walt, 1978). As downy mildew can be a problem shortly before harvest in summer rainfall areas and in vineyards under irrigation, it is sometimes necessary to use a fungicide at this late stage. The choice of fungicides which can be used at such a late stage is limited because of the detrimental effects which residues of certain fungicides have on alcoholic fermentation (Ehrenhardt & Jakob, 1968b; Rágala & Minárik, 1971).

A new systemic fungicide metaxanine^a/methyl D, L-N-(2,6-dimethyl-phenyl)-N-(2 methoxyacetyl) alaninate/ was therefore evaluated in field and laboratory trials under South African conditions to determine whether better control of *P. viticola* can be achieved and whether this fungicide has any detrimental effect on alcoholic fermentation and wine quality.

MATERIALS AND METHODS

Disease control: Three types of experiments were conducted viz.

- (a) The minimum effective dose was determined by spraying Tinta Barocca vines seven times at 14d

intervals with five concentrations of metaxanine as indicated in Table 1. The percentage leaf infection was determined 7d after the final spray.

- (b) The efficacy of metaxanine WP50 (15% metaxanine + 35% copper oxychloride) was compared to that of a traditional spray material, mancozeb, in two experiments on Chenin blanc and Riesling. The different application frequencies are outlined in Table 2. These sprays were all applied by motorized knapsack sprayers and their efficacy was assessed immediately prior to harvest.
- (c) The efficacy of metaxanine as a curative fungicide against *P. viticola* was compared to that of mancozeb in a nursery on vines already infected with downy mildew. Assessment of leaf infection was done at the commencement of the trial. Thereafter the different fungicides were applied, once only, two times with a 7d interval and three times with 14d intervals. The control plots were left untreated. Each treatment was replicated eight times in randomized blocks and treatment plots were 15 m².

In both the experiments (a) and (b) spraying started when the longest shoots were 100 mm long, the sprays applied at a pressure of 200 kPa. A randomized block design with four replicates of five vines each per treatment was used.

In all experiments the degree of infection was assessed according to the method of Unterstenhöfer (1963) and statistical significance of differences between treatments were tested by means of Duncan's multiple range test (Harter, 1960).

Residue studies: Three residue trials, the cultivars Pinotage, Colombard and Cabernet sauvignon were sprayed with metaxanine 30 g active ingredient (a.i.) + copper oxychloride (50 g a.i.)/100 ℓ of water. The vines were sprayed ten times at 14d intervals until four weeks before harvest. The grapes from replicate plots were pooled and wine was made from a representative sample, according to standard wine-making procedures used by the Oenolo-

gical and Viticultural Research Institute. Frozen grapes, as well as bottled wine samples were analysed for residue by Ciba Geigy, South Africa.

Additional trials for residue determinations on Cabernet sauvignon and Colombard were carried out in the 1978/79 season. Plots of four vines each (four replicates per treatment), were sprayed eight times with metaxanine (30 g a.i.) + copper oxychloride (70 g a.i.)/100 ℓ of water at 14d intervals. Grape samples were taken immediately after the treatment (0d) and subsequently 1,2, 4, 8, 16, 23 and 32d after application. Samples from the replicate plots were pooled, frozen and analysed for residues by Ciba Geigy, South Africa.

Fermentation studies: Laboratory fermentations, based on methods described by Ehrenhardt & Jakob (1968a) were made in triplicate at 25 °C using 100 ml sterilized Colombard grape juice in 250 ml Erlenmeyer flasks fitted with fermentation locks. The Colombard grape juice was obtained from grapes which had received ten sprays with 14d intervals between sprays with metaxanine 30 g a.i./100 ℓ. The yeast inoculum consisted of 0,2 g active dried yeast/ℓ juice (*Saccharomyces cerevisiae* strain WE 14) and the subsequent fermentation activity was determined by measuring daily mass loss.

Wine quality: Experimental wines were made in duplicate (10 ℓ containers) from Pinotage, Colombard and Cabernet sauvignon grapes which had been sprayed ten times with metaxanine at 14d intervals until four weeks before harvest, in the cellars of the Oenological and Viticultural Research Institute using standard winemaking procedures. Unsprayed grapes were used to make a control wine. The wines were presented to a panel of judges and evaluated for overall wine quality.

RESULTS AND DISCUSSION

Disease control: From Table 1 it is clear that 2, 4 and 8 g/ℓ applications resulted in a significant lower infection than the 1 g/ℓ treatment and the control, while the 4 g/ℓ and 8 g/ℓ treatment resulted in significant lower infections than all other treatments. There were no further significant differences among the treatments.

TABLE 1

Mean leaf infection of grapevine by *Plasmopara viticola* after treatment with different concentrations of metaxanine

Concentration (g/ℓ)	Leaf infection (%)
Control	76,6
1	65,6
2	21,2
4	3,7
8	3,0
D value (P = 0,05)	11,9

(b) The discussion of the trials in which metaxanine was compared to a traditional spray material is summarised in Table 2.

TABLE 2

Mean leaf infection of grapevine by *Plasmopara viticola* after various fungicidal applications at 14d and at 21d intervals

Fungicide	Interval between applications (d)	Cultivar	Leaf infection (%)
Control	—	Chenin blanc	42,0
Mancozeb	14	Chenin blanc	14,8
Metaxanine W.P. 50	14	Chenin blanc	4,0
Mancozeb	21	Chenin blanc	21,2
Metaxanine W.P. 50	21	Chenin blanc	6,4
D. value (P = 0,05)			7,2
Control	—	Riesling	72,6
Mancozeb	14	Riesling	39,2
Metaxanine W.P. 50	14	Riesling	6,4
Mancozeb	21	Riesling	46,9
Metaxanine W.P. 50	21	Riesling	13,7
D. value (P = 0,05)			17,3

In both trials all the metaxanine treatments were significantly better than the control as well as the mancozeb treatments. In both trials the metaxanine as well as the mancozeb applied at 14d intervals did not differ statistically from the same treatments applied at 21d intervals.

(c) Results of the trial to test the efficacy of metaxanine as a curative fungicide against downy mildew are summarised in Table 3.

TABLE 3

Mean leaf infection of grapevine by *Plasmopara viticola* before and after different fungicidal treatments.

Treatment	Interval between applications (d)	Leaf infection before treatment (%)	Leaf infection after treatment (%)
1 spray			
Control	—	38,0	59,4
Mancozeb	0	38,4	42,3
Metaxanine W.P. 50	0	38,0	23,6
D Value (P = 0,05)			10,9
2 sprays			
Control	—	32,0	63,9
Mancozeb	7	32,8	39,6
Metaxanine W.P. 50	7	33,6	12,0
D. value (P = 0,05)			5,7
3 sprays			
Control	—	34,6	55,8
Mancozeb	14	33,2	40,2
Metaxanine W.P. 50	14	33,4	9,0
D Value			5,7

All the metaxanine treatments resulted in less leaf infection after treatment than before. The percentage leaf infection in both the control and mancozeb treatments were higher than the pre-spray infection.

Residue studies: Residue of metaxanine on Pinotage, Colombard and Cabernet sauvignon grapes and in their wines are shown in Table 4. Results of residues recovered from Colombard and Cabernet sauvignon grapes as determined at various intervals after the final applications, are shown in Fig. 1.

TABLE 4

Metaxanine residues recovered from treated and untreated Pinotage, Colombarid and Cabernet sauvignon grapes and wine.

Cultivar	Residues (mg/l) ^a in	
	Grapes	Wine
Control.....	ND	ND
Pinotage.....	0,96	0,6
Colombarid.....	0,40	0,14
Cabernet sauvignon.....	0,26	0,06

^a—Mean of two determinations.
ND—None detected.

Fermentation studies: The effect of ten metaxanine 30 g a.i./100 l sprays up to four weeks before harvest on alcoholic fermentation of Colombarid grape juice at 25 °C are illustrated in Fig. 2. No significant differences were found in the fermentation rates of musts from treated and untreated grapes.

Wine quality: The wine evaluation data are presented in Table 5.

TABLE 5

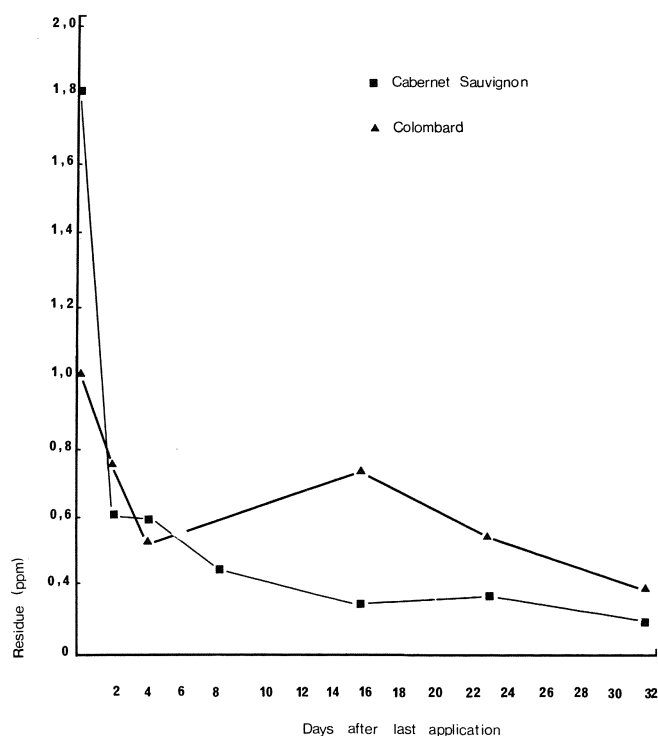
Wine quality rating for wines made from grapes sprayed with metaxanine and unsprayed grapes.

Cultivar	Treatment	Wine Quality rating (%)
Colombarid.....	Control	61,7
	Metaxanine	60,0
Pinotage.....	Control	53,9
	Metaxanine	55,9
Cabernet sauvignon.....	Control	80,0
	Metaxanine	75,3

L.S.D. (P = 0,05) 8,5

FIG. 1

Breakdown of metaxanine residues in Cabernet sauvignon and Colombarid grapes after eight applications of 30 g.a.i./100 l.



From the data it is evident that spraying of grape vines with metaxanine had no detrimental effect on wine quality.

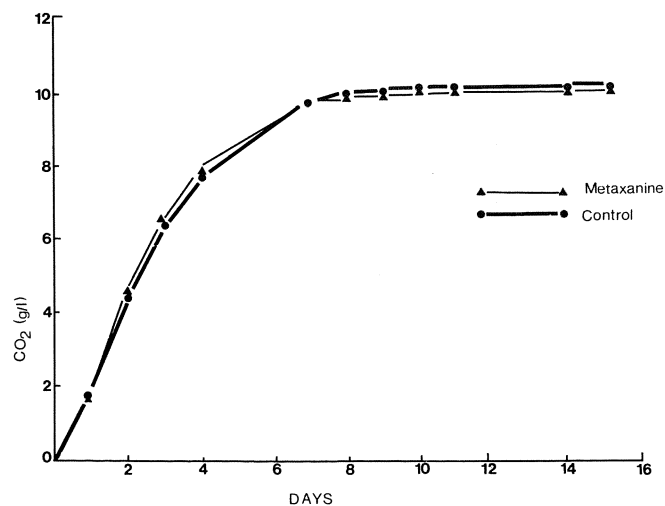
CONCLUSIONS

In field trials metaxanine gave effective control of *P. viticola* on grapevines. Lower percentage infection were obtained than with the standard fungicide applied at the same time intervals. Where metaxanine was applied on vines already infected with downy mildew, the leaf infection after treatment was significantly lower than that following treatment with the standard fungicides. In all cases the final infection was lower than that of the initial infection. This indicates a curative property of metaxanine, but although use can be made of this property prior to flowering, curative treatments after fruits have been attacked will not save an infected crop. In the present study very little residual metaxanine was found either on treated grapes, or in the wine. Most of the residue recovered from the grapes are removed during the vinification processes of the must and wine, resulting in very low residues in the bottled product.

Metaxanine did not affect the fermentation process or the wine quality and it can be concluded that with intervals between applications as long as 21d, even if prolonged rains or sprinkling irrigation occur after application, good control of *P. viticola* is ensured. Low residues can be expected on grapes and in wine and no detrimental effect on alcoholic fermentation or wine quality is likely to occur.

FIG. 2

Fermentation curves of Colombarid must from grapes after eight applications of metaxanine WP 25 30 g.a.i./100 l and must from untreated Colombarid grapes.



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