CONTROL OF *BOTRYTIS CINEREA* IN GRAPES

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SUMMARY

Replicated and split block trials over four seasons have shown that a programme of dichlofluanid during blossom followed by a dicarboximide fungicide pre-harvest provided a high level of control of botrytis (*Botrytis cinerea*) in grapes (*Vitis vinifera*). The level of control from such a programme was equal to that given by a full programme of the dicarboximide alone.

INTRODUCTION

Grey mould, or botrytis is one of the most serious diseases affecting grapes. In some grape growing areas of Europe, under favourable conditions, botrytis infection of ripe berries (noble rot) causes them to crack and dry into a moist raisin with low acid and high sugars. Grapes so affected and the wines made from them demand a premium.

In New Zealand, weather conditions near harvest are often such that grape bunches left untreated would be unfit for wine making. Botrytis also causes bunch stalk rot, stem and leaf infection. Infection of fruit may occur during flowering and remain quiescent until sugar levels rise at veraison (McClellan *et al* 1973) or on the ripening berries near harvest, when rain and periods of high humidity favour infection (Nelson 1956). Berries damaged by diseases, such as powdery mildew (*Uncinula necator*) or birds and insects are particularly susceptible.

Parle and Dodanis (1973) using dichlofluanid and benomyl showed that spraying at petal fall and again from veraison gave good control of botrytis. Additional sprays in the period between petal fall and veraison gave no improvement and commencing at veraison gave no control. In New Zealand officially published spray programmes recommend application of botrytis fungicides twice over flowering and again from veraison at 7-14 day intervals (Anon 1980).

With the advent of MBC resistance in 1978, cost and other factors led many growers to use dichlofluanid over flowering followed by thiram from veraison. Botrytis control with this programme was inferior to that given by a full dichlofluanid programme (J. Rees pers comm).

The introduction of dicarboximide fungicides had potential to improve botrytis control, so this paper reports on the evaluation of dichlofluanid/dicarboximide programme.

METHODS

Six replicated and two split block trials were carried out on commercial vineyards in Hawkes Bay, Poverty Bay and Auckland. Trials were predominantly on c.v Muller Thurgau, which is susceptible to botrytis and constitutes 38% of New Zealand's grape area (MAF 1980). Details of individual trials are in Table 1.

In all replicated trials, sprays were applied using a hand-gun fitted with two D3-45 disc and core nozzles operating at 2100 kPa. Split block trials were treated using a Holder air blast sprayer. In each trial the first two sprays were applied overall, subsequent sprays were directed at the bunch zone.

Timing of sprays relative to stage of vine development is more important to botrytis control than calendar dates therefore growth stage at each application is in Table 1. All fungicides used were commercially available wettable powder formulations, rates in text are in g/100 litres. Trials were protected from other diseases and pests with regular fungicide and insecticide applications throughout the season.

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TABLE 1: Trial Details and Growth Stages.

	A	B	Trial					
			C	D	E	F	G	H
Location*	HB	HB	HB	HB	PB	HB	AUCK	AUCK
Cultivar**	M.T	M.T	M.T	M.T	M.T	M.T	G.B	S5455
Plot size (vines)	6	6	6	6	6	6	0.5ha	0.5ha
Replicates	4	4	4	4	5	5	1	1
Water rate (litres/ha)	run off	1000	1000	1000	1000	1000	1000	1000
Time of Application 1	21	25	25	25	21	19	19	19
2	25	31	31	31	25	25	25	25
3	33	-	-	-	31	33	-	-
4	35	35	35	35	35	35	35	35
5 +	17d	14d	14d	10d	12d	14d	17d	16d
Harvest date	21.3.78	19.3.79	20.3.79	9.3.80	17.3.81	6.3.81	24.3.81	28.3.81

* H.B. — Hawkes Bay, P.B. — Poverty Bay, Auck — Auckland

** M.T. — Muller Thurgau, G.B. — Gamay Beaujolais, S5455 — Seibel 5455

† Growth Stages (After Eichhorn and Lorenz 1977)

+ No. of days after application 4.

In replicated trials, at harvest, 50 bunches were picked from each plot at random and classified according to the percent of bunch infected with botrytis as follows:

0 = no infection, 1 = < 5%, 2 = 6 - 10%, 3 = 11 - 25%, 4 = 26 - 50%,
5 = > 51% of bunch infected.

The degree of infection was then calculated according to the method of Kremer and Unterstenhofer (1967) and percent control calculated after Abbott (1925). The data were then analyzed with untreated data being excluded.

In split block trials (G and H) assessment was made by separating 250 bunches per plot into one of the following categories then weighing:

1 = 0 - 5% of bunch infected (acceptable for wine making)
2 = 6 - 30% of bunch infected (marginal for wine making)
3 = > 30% of bunch infected (unacceptable for wine making)

The categories used in this assessment of these trials are similar to those currently used in the Auckland area, where price differentials are paid depending on disease and insect damage.

RESULTS AND DISCUSSION

The results from replicated trials for the control of botrytis are in Table 2.

Disease pressure in 1977-78 (Trial A) was relatively low, as can be seen from the infection in untreated plots. Vinclozolin commencing at 25% cap fall (GS21) or 80% cap fall (GS25) provided the highest level of botrytis control, although the former was not significantly different from dichlofluanid then vinclozolin commencing at the same time. Dichlofluanid followed by thiram, the MAF recommendation for the area at that time, was less effective ($P < 0.01$).

In 1978-79 (Trials B and C) rainfall during the flowering period and again pre-harvest were favourable to the development of botrytis. Trial B had a substantially higher level of botrytis in the untreated than Trial C. This was the result of high inoculum pressure, from a large carry-over of botrytis sclerotes on canes and in mummified bunches as a result of poor botrytis control in 1977-78. Despite the difference in disease level at the two sites, the effectiveness of the various programmes in controlling botrytis was very similar. Dichlofluanid then vinclozolin 75 g and vinclozolin 75 g programmes resulted in similar high levels of control. A reduction of

the vinclozolin rate in each programme to 50 g resulted in a slightly lower level of control. Iprodione provided good control of botrytis, but was less ($P < 0.05$) effective. At both sites dichlofluanid followed by thiram was much less effective ($P < 0.01$). Because of its poor performance and the extensive adoption of the available dicarboximide fungicides by growers, the dichlofluanid followed by thiram programme was excluded from subsequent trials.

TABLE 2: Percent control of Botrytis Infection

Programme	Rate g/100 litres	Appln*	A	B	C	D	E	F
untreated			0(30)**	0(75)	0(49)	0(74)	0(56)	0(65)
dichlofluanid	100	1,2						
then								
vinclozolin	75	4,5		97 aA	95 aA	86 aA	86a	48 bB
dichlofluanid	100	2,3						
then								
vinclozolin	75	4,5	-	-	-	-	66 a	50 bB
dichlofluanid	100	1,2						
then								
vinclozolin	50	4,5	89 bA	80 cdBC	89 abAB	80 aA	81 a	-
dichlofluanid	100	1,2						
then								
procymidone	75	4,5	-	-	-	-	-	49 bB
49 bB								
vinclozolin	75	1,2,4,5	-	93 abAB	92 aAB	85 aA	84 a	52 bAB
vinclozolin	50	1,2,4,5	97 abA	86 bcABC	87 abAB	58 bB	-	-
vinclozolin	50	2,3,4,5	99 aA	-	-	-	-	-
procymidone	75	1,2,4,5	-	-	-	82 aA	90 a	54 bAB
iprodione	75	1,2,4,5	-	76 dC	79 bB	74 aAB	63 a	26 cC
dichlofluanid	100	1,2						
then								
thiram	360	4,5	71 cB	58 eD	60 cC	-	-	-
Bas 436 00F	50	1,2,4,5	-	-	-	-	-	66 aA
CV %			6.25	7.00	23.1	12.4	19.8	15.9

* Applications as in Table 1

** Figures in brackets are degree of disease infection in untreated bunches.

In 1979-80 (Trials D and E) climatic conditions over flowering and pre-harvest were again conducive to the development of botrytis. Results from dichlofluanid followed by vinclozolin, vinclozolin and iprodione programmes were similar to the previous season. Procymidone was included for the first time and provided good disease control, similar to the other treatments except vinclozolin 50 g. This treatment was less ($P < 0.05$) effective than all others. In Trial E the timing of early season sprays was investigated. Dichlofluanid applied at 20% (GS21) and 80% (GS25) cap fall was compared to application at 80% cap fall and when berries reached 5-7 mm diameter (GS31); the level of disease control from the latter treatment was lower but failed to reach significance.

In the 1980-81 season (Trial F) all programmes failed to give satisfactory botrytis control. The reason was the high rainfall in the time prior to bunch closure; between 19.12.80 and 29.12.80 147 mm of rain was recorded and no fungicide spray was applied after this except in one programme. This programme consisted of dichlofluanid at 5% cap fall (GS19) and bunch closure (GS33) followed by vinclozolin from veraison (GS35). This treatment provided similar botrytis control to a programme where

dichlofluanid was applied at 80% cap fall (GS25) instead of a bunch closure. From this we conclude that both times were equally important for botrytis infection in that season. This was borne out in commercial experience (W. Hazelwood pers comm). Bas 436.00F provided better ($P < 0.05$) control of botrytis than all other treatments. There was no difference in disease control between dichlofluanid followed by either vinclozolin or procymidone, vinclozolin or procymidone alone. Iprodione was less effective ($P < 0.01$) than all other treatments.

TABLE 3: Percentage weight in each botrytis infection category after commercial application.

Trial G					
Treatment	Rate g/ 100 litres	Appns*	% Category by weight		
			1	2	3
dichlofluanid	100	1,2			
then					
vinclozolin	75	3,4	90	8	2
vinclozolin	75	1,2,3,4	88	4	8
Trial H					
dichlofluanid	100	1,2			
then					
vinclozolin	75	3,4,5	80	9	11
vinclozolin	75	1,2,3,4,5	79	9	12

* Applications as in Table 1.

In the commercial split block trials there were no untreated areas. Table 3 shows the percentage weight in each infection class

Dichlofluanid followed by vinclozolin and vinclozolin programmes provided similar levels of disease control.

Botrytis resistance to dicarboximides has been reported from some grape growing areas of Europe (Holz 1979; Lorenz 1980) and some New Zealand glasshouse crops (Anon 1982). The significance of this resistance in the field has yet to be clarified, as the resistant fungi appear to have reduced "fitness" compared to wild strains (Lorenz 1980). In spite of this a number of overseas recommendations are to restrict applications of dicarboximides to minimize the prospects of resistance (Anon 1981). Generalized strategies for the avoidance of fungicide resistance such as rotation of fungicides of different modes of action have been suggested (e.g. Wade 1982). It has been reported (Holz 1979; Lorenz 1980) that dicarboximide resistant spores are sensitive to dichlofluanid. Thus a dichlofluanid then dicarboximide programme offers a viable strategy to avoid or delay the development of dicarboximide resistance without lowering disease control (as shown by results in Table 2).

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