FUNGICIDES FOR CONTROL OF *SCLEROTINIA* AND *BOTRYTIS* IN DAWRF BEANS

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Summary

Dichlozoline, thiophanate-methyl and benomyl were evaluated for control of *Sclerotinia* and *Botrytis* in process beans over two seasons. Treatments applied before full flower and followed by a second application at late flower, gave significant overall disease control. Results suggest dichlozoline has greater activity on *Sclerotinia* species than thiophanate-methyl or benomyl. Dichloboline was also highly effective in preventing formation of apothecia on soil along the plant rows. Significant yield increases were also obtained.

INTRODUCTION

Sclerotinia species have long been recorded as fungus diseases of economic significance on a wide range of crops all over the world. In New Zealand economic losses have occurred in vegetable crops, stone fruits and a variety of ornamental plants. *Sclerotinia sclerotiorum* (= *S. "major"*) *S. minor* and *Botrytis cinerea* (= *S. fuckeliana*, asexual state) have been recorded in New Zealand on French beans (*Phaseolus vulgaris*) since 1927 (Dingley, 1969).

Prior to the introduction of "systemic" fungicides, variable control of these diseases had been achieved. Wide row spacing to allow maximum air circulation and light penetration, combined with an intensive spray programme using a range of contact fungicides of which thiram, dichlone, zineb and captan alone or in combination, were the most effective control methods (Brien *et al.*, 1955; Brandon, 1958).

Rainbow (1970) discussed conditions of infection, methods of entry into the plant and the main features of *S. sclerotiorum* infection. Infection can occur early in plant growth but maximum damage and plant collapse is generally not serious until after flowering. This can be very rapid under warm, moist conditions.

Commercial yield losses of over 20%, due to these diseases, are common in process beans. Furthermore, the process industry may not accept infected crops, or else crops must be hand picked to avoid diseased beans, which are difficult to separate at processing.

Four trials were laid in the Hastings area during 1970 and 1971 to evaluate several new chemicals for *Sclerotinia* and *Botrytis* control, and to determine treatment times to establish a programme for commercial recommendations.

EXPERIMENTAL

Details and general conditions under which the trials were conducted are presented in Table 1. Trials Nos. 011 and 012 have been summarized elsewhere by Corbin and Woon (1970) and Woon and Corbin (1970).

The treatments were applied using a 6-nozzle boom with spraying systems D7/45 disc and core, hollow cone nozzles at 14 in. spacings, held 12 in. above the plants and applying the equivalent of 100 gal of spray mix per acre, at 40 lb/sq.in. and 2 mph. In Trial 046, the speed was doubled to apply 50 gal/acre. The randomized plots consisted of 3 rows of beans at 24 in. spacing and 30 ft long, containing about 400 plants per 20 ft of row. At application the weather was fine and warm, and good growth conditions occurred for most of the trial periods, though limited periods of soil moisture deficiency were experienced in both seasons.

TABLE 1: TRIAL APPLICATION DATA

			<i>Trial No.</i>			
			011	012	045	046
Planting date			14/1/70	15/1/70	28/12/70	1/1/71
Replicates			4	4	6	4
Treatment Dates and Stage of Crop						
a. Early flower			12/3/70	12/3/70	—	—
b. Full flower			23/3/70	23/3/70	12/2/71	23/2/71
c. Late flower			—	31/3/70	19/2/71	2/3/71
Final evaluation and yield						
assessment			15/4/70	16/4/70	4/3/71	9/3/71

Assessment of apothecia present on the soil surface over 5 sq.ft of plant row was made at harvesting, to evaluate the effect of treatments on the soil stage of the fungi. Assessments of yield and disease control were made on the centre row only, counts being taken of the number of infected plants. After destructive harvest, beans were separated into "clean" or "infected" groups. The "clean" pods were weighed after harvest, then stored and assessed for re-infection.

RESULTS AND DISCUSSION

The data obtained from the four trials are presented in Table 2 (all rates expressed as lb active ingredient per acre).

All treatments gave significant disease control, but with dichlozoline only giving a significant yield increase. The 1970-1 season trials were designed to test rates and times of application of dichlozoline. In these two trials, the 0.5 lb rate proved similar in activity to the 1.0 lb rate, in yield increase, apothecia reduction and prevention of infection during storage.

It is clear from these results that timing of applications is critical for the maximum degree of disease control. Treatments must be applied soon after flowering begins and preferably before 50% of flowers are fully open. A second application at late flower—i.e., in about 10 to 14 days—may increase the level of disease control. A single late treatment was consistently poorer for overall disease control.

TABLE 2: TRIAL RESULTS

TRIAL No. 011	Treatment and Treatment Stages									
	dichlozoline 1.0 lb			thiophanate-methyl 1.0 lb			benomyl 1.0 lb			Control
	a	b	a+b	a	b	a+b	a	b	a+b	
No. of infected pods of marketable size per 20 ft of row:										
<i>Botrytis</i>	33	7	5	30	17	5	8	22	8	94
<i>Sclerotinia</i>	11 b	0 c	0 c	36 b	11 b	6 c	6 c	6 c	6 c	41 a
Yield of disease free beans (tons/ac)	4.6	4.0	4.6	4.0	4.0	3.9	4.0	4.0	4.7	4.4 NS
% Pods infected (after storage) ...	—	—	3.5 c	—	—	5.2 c	—	—	19.4 b	71.5 a
Total apothecia per 5 sq. ft of row cover	—	—	0.1 b	—	—	2.7 b	—	—	3.0 a	4.6 a
TRIAL No. 012										
	dichlozoline 1.0 lb			thiophanate-methyl 1.0 lb			benomyl 1.0 lb			Control
	a+b+c	b+c	c	a+b+c	b+c	c	a+b+c	b+c	c	
No. of infected plants per 20 ft row (at first appn.)	29	17	32	24	23	26	24	17	28	26 NS
No. of infected plants per 20 ft row (at harvest)	29 c	26 c	42 bc	50 ab	42 bc	92 ab	44 bc	42 bc	85 ab	129 a
No. of infected pods of marketable size per 20 ft of row	—	0	—	—	22	—	—	20	—	183
Yield disease free beans (tons/ac)	—	5 a	—	—	4.7 ab	—	—	4.7 ab	—	4.3 b
% Pods infected (after storage):	—	0 b	—	—	1 b	—	—	7 b	—	25 a
<i>Botrytis</i>	—	4 b	—	—	53 a	—	—	104 a	—	175 a
<i>Sclerotinia</i>	—	—	—	—	—	—	—	—	—	—

TRIAL No. 045					Grower's Control	
	dichlozoline		thiophanate-methyl 1.0 lb	Control		
	0.5 lb b+c	1.0 lb b+c	b+c			
No. of infected plants per 20 ft row (at harvest)	0.1 cC	0.0 cC	3.7 bB	29.0 aA	56.0	
No. of pods infected (at harvest)	0.1 cC	0.1 cC	1.5 bAB	18.0 aA	30.3	
Yield: Disease-free pods (tons/ac)	6.05 aAB	6.45 aA	6.3 abAB	5.4 bB	2.65	
Total apothecia per 5 sq. ft of row	1.1 cC	0 cC	7.7 bB	26.3 aA	—	

TRIAL No. 046					Control	
	dichlozoline 0.5 lb					
	b	b+c	c			
No. of infected plants per 20 ft row (at harvest)	14.3 c	6.0 d	27 b	42.3 a		
No. of pods infected (at harvest)	2.3 cC	0 cC	15.8 bB	26.3 aA		
Yield: Disease-free pods (tons/ac)	6.3 aA	5.9 aAB	4.9 bBC	4.8 bC		
% Pods infected (after storage):						
<i>Sclerotinia</i>	1.5	1.0	0.5	12.5		
<i>Botrytis</i>	0	0	0.5	6.0		
Total apothecia per 5 sq. ft of row	3.8 b	4.8 b	20.8 a	17.3 a		

Key to treatment stages: a = Early flower, b = Full flower, c = Late flower.

It was very evident, from visual observation, that infection of the control plots was considerably reduced compared with the remaining untreated crop. This is a common problem of small plot trials. On trial 045 an indication of this small plot effect was gained by harvesting six equivalent plots from the paddock immediately adjacent to the trial. Results from this are included in Table 2 to give a more realistic indication of field losses typically experienced. This correlates well with two commercial scale field assessment trials, where a single treatment of dichlozoline 0.5 lb, was applied at full flower. Early symptoms of infection were apparent in flowers, leaves and stems. Five groups of 100 plants, in both treated and untreated areas, were rated for *Sclerotinia* infection and three 20 ft lengths of row were harvested for yield comparison. In the first area, 2 acres were treated, plant infection was 18% and yield 4.2 tons per acre compared with the untreated area where plant infection was 97% and yield 2.8 tons per acre. In the second area, 1.5 acres were treated yielding 5.6 tons per acre with 11% plant infection while untreated area yielded 1.9 tons per acre with 100% infection. A second application at late flower would probably have further reduced the percentage of pod infection.

CONCLUSIONS

In this series of trials dichlozoline gave the highest degree of disease control. Two applications at 10 to 14-day intervals with the first at early to full bloom appear the most reliable.

The reduction in the number of diseased pods at harvest is of utmost importance to the grower as even a relatively low degree of infection may result in rejection of the crop, or hand picking, with the associated labour problems. In the majority of cases reduction of infection results in significant yield increases, and obvious economic advantages.

Commercial experience confirms the yield losses recorded on trial 045 and clearly demonstrates the value of an efficient fungicide for *Sclerotinia* and *Botrytis* control.

Lower rates of dichlozoline should be evaluated and critical examination should be made of the relative efficiency of single versus double applications, especially where ideal conditions for fungal infection occur for a prolonged period after the first application.

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