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DISEASE PROBLEMS IN THE PRODUCTION OF BROAD BEAN SEED

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SUMMARY

A recent survey showed that *Ascochyta fabae* Speg., the causal organism of leaf, stem and pod spot was the most severe disease of broad bean (*Vicia faba*) seed production crops in New Zealand, causing yield losses of up to 40% in some cases. Several fungicides were evaluated for their effectiveness in disease control as foliar and seed treatments. Chlorothalonil and benomyl/captan gave effective control. Sprays applied at the early flowering stage gave better disease control than late sprays. However, the best control strategy was shown to be the selection of seed lines with a low level of seed infection based on laboratory tests, with seed treatment as a secondary precaution.

INTRODUCTION

To meet the demand for seed used for processing crops and crops harvested as dry beans for export for human consumption, about 300 ha. of broad beans are grown in the Blenheim area where the climate favours seed production. The best of these crops are harvested for seed.

Leaf, stem and pod spot, caused by *Ascochyta fabae* Speg., is one of the most important fungal diseases of broad beans. Infected seeds are considered to be the major source of inoculum (Hewett 1973). Other sources such as alternative host weed plants and host materials from previous crops buried in the soil are of minor importance (Wallen and Galway 1977). Infected seedlings develop dark brown circular lesions on which many spores are produced within pycnidia. The spores act as a secondary spread mechanism within crops when splashed by rain or overhead irrigation.

For seed production crops, losses due to disease in the weight of seed harvested is only one aspect of yield, and it is more important to ensure that the harvested seed has a low level of infection by *A. fabae*. Surveys of field bean crops in New Zealand indicated that *A. fabae* was present at high levels in some seed lines (Gaunt *et al* 1978). The significance of *A. fabae* in broad bean seed production crops and the effect on yield (both quantity and quality) was studied in the 1979-80 season. The results are reported in this paper.

MATERIALS AND METHODS

Broad bean seeds (cv Coles Early Dwarf) with 8.4% seed infection were selected for a trial at Lincoln College. A high level of seed infection was chosen to provide a severe test of control methods, which were based on previous experience with field beans (Liew and Gaunt 1980). Untreated seed or seed treated with benomyl/captan or RH 2161 (Table 2) were sown in 12 x 6 m plots with a row spacing of 75 cm and with 15 cm between plants in the row. Three plots of each seed treatment were sown in each of four replicated blocks. During crop growth, the plants were sprayed with chlorothalonil either early at appearance of first flower, late at pod setting or received no spray treatment to give a 3 x 3 factorial experimental design (Table 2). Before the first fungicide spray application and at several times subsequently, six 1 m² quadrats were sampled randomly for the levels of disease incidence, disease severity on the lower six

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flowering nodes and the level of pod infection. At harvest, yield and yield components were determined by hand sampling of the whole plot area except for the two outer rows. A 200 seed sub-sample was laboratory tested for the level of seed infection.

Two commercial broad bean seed crops with a moderate level of infection were selected for trials in the Blenheim area. At each location, areas of uniform plants were selected, and four replicate blocks were marked out for the application of separate foliar sprays of benomyl and chlorothalonil (Table 3). Two spray applications were applied, on 1 October at the early flowering stage and again 40 days later. Before the first spray was applied, and at subsequent intervals, disease levels were assessed in both the treated and untreated plots. Twenty plants were selected at random, and disease incidence, severity on the lower six flowering nodes, and pod infection were assessed. At harvest, 50 plants were randomly selected from each plot and the total seed yield and yield components were determined. The percentage seed infection was determined by laboratory testing of a sub-sample of 200 harvested seeds.

RESULTS

A survey of eight crops at the early flowering stage indicated that disease incidence on the flowering nodes ranged from less than 1.0 to 30% and that the disease severity of the first flowering node range from ≤ 0.1 to 10% (Table 1). Experience from similar surveys in field bean crops (Gaunt *et al* 1978) lead us to conclude that the disease levels represented a significant potential for the production of seed with final infection levels unacceptable for subsequent crop establishment.

TABLE 1: Level of *A. fabae* infection in broad bean seed production crops surveyed in Blenheim, 1979-80.

Cultivar	Growth stage*	% Incidence on flowering nodes	% Severity at 1st flowering node
Evergreen	52	20	5.0
Coles Early Dwarf	54	30	10.0
Extra Early Saville	52	1.0	0.2
Exhibition Long Pod	52	≤ 1.0	≤ 0.1
Coles Early Dwarf	53	10	3.0
Exhibition Long Pod	52	5	4.0
Extra Early Saville	51	≤ 1.0	≤ 0.1
Exhibition Long Pod	54	10	5.0

* GS 5 — flowers open; second digit indicates number of nodes at which flowers are open.

In all treatment combinations in the Lincoln College trial, benomyl/captan was the best of the seed treatments. Early sprays were more effective than either nil or late sprays in reducing the level of disease (Table 2). Seed yield was increased significantly with greatest effects in the benomyl/captan plus early spray plots. Similarly, the infection level of harvested seeds was significantly lower in these plots.

At both locations in the Blenheim area, chlorothalonil applied at a rate of 2.5 kg/ha was effective in reducing disease severity on leaves at the lower six flowering nodes. The effectiveness of benomyl was similar to that of chlorothalonil (Table 3). At one location chlorothalonil at the rate of 1.25 kg/ha had no significant effect on disease severity but 1.75 kg/ha was as effective as the high rate. The effectiveness of foliar sprays in protecting the pods from infection was also clearly demonstrated in the two trials. Chlorothalonil at the high and medium rates, and benomyl reduced the amount of infection on the pods significantly when compared to the control and to the low rate of chlorothalonil. The amount of pod infection was reflected in the amount of seed infection at harvest (Table 3). At location 1, chlorothalonil at the rate of 2.5 kg/ha reduced seed infection from 22.3% to 7.4%. Similarly, chlorolathonil at location 2

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TABLE 2: Effects of spray and seed treatment on disease development in broad beans at Lincoln College, New Zealand.

Seed	Foliar Spray	Disease Severity on lower 6 flowering nodes %			Pod infection %		Harvest	
		5/10	29/11	19/12	29/11	19/12	Yield g/m ²	Seed infection %
Nil	Nil	2.9 a	16.7 a	37 a	40 a	73 a	167 c	20.3 a
benomyl/captan ¹	Nil	1.5 bc	6.4 cd	24 cd	21 c	41 bc	226 ab	11.8 bc
RH 2161 ²	Nil	2.0 abc	12.0 b	34 a	31 b	47 b	206 b	14.8 b
Nil	Early ³	1.5 bc	3.9 de	20 d	14 cd	24 d	217 b	10.1 bc
benomyl/captan	Early	1.1 c	1.9 e	12 e	10 d	14 e	246 a	4.1 d
RH 2161	Early	1.5 bc	4.1 cde	20 d	17 cd	22 d	225 ab	8.5 cd
Nil	Late ⁴	2.2 ab	6.5 cd	30 ab	29 b	39 c	199 b	13.3 bc
benomyl/captan	Late	1.3 bc	6.4 cd	22 cd	15 cd	30 cd	234 ab	9.6 bc
RH 2161	Late	1.8 bc	7.8 c	26 bcd	26 bc	36 c	212 b	12.3 bc

1. benomyl/captan at 50 g and 80 g/100 kg seed respectively.
2. RH 2161 at 25 g/100 kg seed.
3. chlorothalonil at rate of 2.5 kg/ha applied on 24 September at the early flowering stage.
4. chlorothalonil at rate 2.5 kg/ha applied on 12 November at pod setting.

TABLE 3: Control of *A. fabae* by foliar sprays in broad bean seed production crops at two locations at Blenheim, New Zealand.

Treatment	Disease severity on lower 6 flowering nodes %		Pod infection %	Harvest yield		Seed infection %
	13/11	20/11	30/11	g/m ²	seed/m ²	%
<i>Location 1:</i>						
chlorothalonil 2.5 kg/ha	4.4 c	27 b	0.0 b	293 a	271 a	7.4 d
chlorothalonil 1.75 kg/ha	5.4 bc	34 b	0.4 b	277 ab	227 bc	11.6 cd
chlorothalonil 1.25 kg/ha	8.3 a	54 a	2.0 a	268 ab	224 bc	14.9 bc
benomyl 0.5 kg/ha	6.2 b	33 b	0.5 b	264 ab	250 ab	19.5 ab
Nil	9.4 a	49 a	3.1 a	232 b	219 c	22.3 a
<i>Location 2:</i>						
chlorothalonil 2.5 kg/ha	2.5 b	17 b	0.0 b	223 a	257 a	9.5 c
benomyl 0.5 kg/ha	3.4 b	22 b	0.6 b	186 ab	211 ab	17.3 b
Nil	6.3 a	31 a	2.1 a	169 b	210 b	20.9 a

reduced seed infection from 20.9% to 9.5%. Benomyl had little effect in reducing seed infection.

Yield losses of 24% and 20% were recorded at location 1 and 2 respectively. The number of seed per unit area was also increased significantly by chlorothalonil (2.5 kg/ha) and benomyl treatments.

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DISCUSSION

Studies on yield losses due to *A. fabae* in field beans showed that the initial level of seed infection was one of the main determinants of yield at harvest. Gaunt and Liew (1981) showed a significant yield reduction of 44% in plots grown from seed with a 12% level of seed infection compared to a seed line with only 0.2% seed infection. It was also shown that the disease multiplied markedly during crop growth, resulting in high levels of seed infection at final harvest. In the untreated plots of the broad bean trial conducted at Lincoln College reported here, disease increased from an initial seed infection level of 8.4% to 20% at final harvest.

A sound knowledge of the disease cycle of *A. fabae* is essential in assessing the relative effectiveness of control strategies. The use of healthy seed lines based on standard agar tests is the cheapest and most efficient form of control as this strategy operates at a weak point in the disease cycle. In New Zealand, the Ministry of Agriculture and Fisheries charges \$13 for a standard health test and some commercial firms have their own testing facilities. Seeds used for crops grown for the processing industries or as dried beans should have less than 1% seed infection. To maintain a continuous supply of good seed, there must be an on going selection as practiced in Britain (Hewett 1973) and other countries. As an insurance against build up of the disease over several seasons during seed multiplication, a recommended fungicide should be used to treat these seed lines. Seed treatment currently costs approximately \$10/ha for broad beans based on our recommendations of the use of an MBC chemical plus captan.

After crop emergence, regular surveillance should be kept to detect any sign or symptom of the disease. If disease is present foliar sprays should be applied at the early and late pod formation stages to prevent disease lesions forming on pods. Chlorothalonil at the recommended rates costs between \$40-\$50/ha for each spray application; therefore foliar sprays can only be justified in crops that are grown for high cash return and even then only as a back up control measure should the other methods fail.

Two other fungal diseases of broad beans present in the trials at Blenheim were rust (*Uromyces viciae-fabae* (Pers.) Schroet.) and chocolate spot (*Botrytis fabae* Sardina). It may be possible to integrate their control with the control programme for *A. fabae*, since chlorothalonil appeared to reduce the level of these diseases. However, neither disease built up to levels which were considered to be causing yield losses.

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