THE SIGNIFICANCE OF ASCOCHYTA LEAF AND POD SPOT DISEASE IN FIELD BEAN (VICIA FABA L) CROPS IN CANTERBURY, 1977-78

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ABSTRACT

In the 1977-78 season, 23 field bean *(Vicia faba)* crops in the Canterbury area were inspected and the incidence of leaf and pod spot disease, caused by *Ascochyta fabae,* was recorded. Yield losses due to *Ascochyta fabae* were estimated to be in excess of 15% in many crops. This estimate was based on harvest data from a field trial in which there was varying amounts of disease. Infection in seed samples from the surveyed crops ranged from 0.2 to 12% in incubation tests. Disease control recommendations are discussed in relation to agronomic practices and seed production.

INTRODUCTION

Crops of field (or tick, horse or faba) beans (*Vicia faba* L.), a high protein grain legume, have been grown on a small scale in Canterbury for several years. In 1977, plants in field trials at Lincoln College were observed to be infected by the fungal pathogen *Ascochyta fabae* Speg., causing characteristic leaf spots (Beaumont, 1950).

Ascochyta fabae is a seed-borne pathogen of all types of *Vicia faba,* including broad beans. It is considered that other primary sources of inoculum, such as host material buried in the soil, are of minor significance in the establishment of the disease (Wallen and Galway, 1977). Infected seed in the field leads to the production of infected seedlings, at a ratio of between 2 and 15 percent of infected seed (Hewett, 1973; Wallen and Galway, 1977). Infected seedlings develop dark, target lesions on which many spores are produced from pycnidia. The spores act as a means of secondary spread within a crop when splashed by rain, or over-head irrigation, to other plant parts. The pathogen spreads to the developing plant and may eventually infect the pods, and the seeds within the pods, thus producing infected seed. Hewett (1973) claimed that, under British climatic conditions, the pathogen may spread from a single infected seedling to plants over an area of 10m diameter. During the growth of infected plants, leaves may be killed prematurely, pods if severely attacked may be shed, and plants with stem lesions may lodge.

In other countries, *A. fabae* has caused serious concern in recent years. In Britain Hewett, (1966, 1973) described the reduction of *A. fabae* incidence in seed lots by careful choice of clean seed lines. This action was prompted by the presence of the disease in commercial crops in 1966-70. Sundheim (1973) reported the presence of *A. fabae* in broad bean crops in Norway, while Gourley and Delbridge (1973) noted its occurrence in Nova Scotia, Canada. In both of these reports, it was suggested that the infection levels were not severe enough to cause yield losses. In South Australia, imported seed samples were found to be infected by *A. fabae,* in addition to several virus diseases (Randles and Dube, 1977). In 1976 all commercial crops were destroyed to eliminate what were considered to be dangerous sources of inoculum (Dube, pers. comm.). In 1977, quarantine regulations were promulgated to restrict the entry of *Vicia faba* into South Australia, and at present this crop is not being grown in that State (Anon., 1977). In view of these considerations, and increased interest in the crop in Canterbury, it was decided that the diseases of field bean crops in Canterbury should be investigated, with special reference to *A. fabae.*

METHODS

The significance of *A. fabae* in the Canterbury crop during the 1977-78 season was studied by means of a survey and a spray trial.

Spray Trial

In October 1977, a commercial crop of Field beans at Tai Tapu, Canterbury, was selected for further investigation. The paddock had been sown in May, at an established density of 50 plants m^{-2} with a large seeded cultivar of unknown genetic origin. Areas of uniform plants were selected, and four replicate blocks, each of four plots (5m x 3m) were marked out. The following treatments were applied:

a: untreated.
b: one pre-flowering spray with captafol (Ortho Difolaton 4F) and three subsequent sprays.
c: one spray with captafol at pod-setting, and two subsequent sprays.
d: one spray with captafol at pod-filling and one subsequent spray.

The captafol spray was used at 80 g a.i. per 100 litres and applied till complete coverage was obtained. Subsequent spray treatments were applied at approximately fourteen day intervals. Before the first spray application, and at each subsequent one, disease levels were assessed in the treated and untreated plots, using *Botrytis fabae* standard area diagrams as a guide (Griffiths and Amin, pers. comm.; Williams, 1975). At harvest two randomly selected sub-plots (1 metre square) were cut from the central area of each treament plot, and seed yield and yield components

were determined. Pod and seed numbers were counted, and the 100 seed weight determined. A five-hundred seed sub-sample was examined visually for the presence of symptoms of *A. fabae.*

RESULTS

Disease Survey

In Table 1, disease assessments by three methods, and final yield are presented for the twenty-three different sites surveyed by Newton and Hill (1978). *Ascochyta fabae* was present in all crops, and the levels of disease varied markedly. The two visual assessment methods were reasonable estimates of the absolute amounts of pathogen present in the seed, as detected by the plate test (Table 1). The latter test is the more accurate and objective of the methods employed, and the values are a realistic measure of the degree of seed infection. There was no significant relationship in the survey between the level of disease and the yield of the crops (Table 1). In view of the large number of genetic and cultural variables between the different sites (Newton and Hill, 1978), the low degree of correlation is not unexpected.

TABLE 1: Yield and levels of *Ascochyta* leaf spot in paddocks surveyed in Canterbury in 1977-8.

Field No.	Visual Assessment		Laboratory Agar Test	Yield
	% Seed Infected	% Plants Infected	% Seed Infected	tonnes ha^{-1}
1	6	33	0.3	0.06
2	7	22	1.3	1.14
3	45	83	5.2	1.65
4	21	100	6.0	1.72
5	5	50	0.5	1.79
6	8	30	2.8	1.85
7	0.4	8	0.2	1.96
8	4	43	0.7	1.96
9	23	71	7.3	2.19
10	25	72	6.7	2.20
11	7	27	3.5	2.54
12	7	60	3.3	2.57
13	4	25	2.0	2.75
14	2	20	2.1	3.09
15	14	67	2.7	3.12
16	31	85	7.3	3.13
17	13	65	3.7	3.20
18	55	95	12.0	3.34
19	55	100	5.2	3.65
20	11	62	4.0	4.41
21	5	80	1.6	4.53
22	15	81	4.6	5.36
23	26	100	6.7	5.56
Simple Correlation with Agar Test	r = 0.821	r = 0.759	–	–

Spray Trial

Contrary to published data (Kharbanda and Bernier, 1975), captafol appeared to have little effect in controlling *A. fabae.* Indeed, sprayed plots had increased disease severities, which may be explained in terms of enhanced spread of the pathogen due to splash dispersal by spraying. However, a range of disease severities was observed among treatments.

There was a significant difference between the plots with the highest and lowest yields ($P \leqslant 0.05$) (Table 2). Pod number per unit area was the main determinant of differences in yield. See number per pod and seed weight were not affected by different disease levels. Each of the disease assessment methods (Table 2) indicated that the lowest yielding plots had the highest levels of disease. However, in assessment by per cent leaf infection and per cent harvested seeds infected the differences were not significant. The range of disease levels between the extreme treatments, visually measured by the percentage of infected seeds at harvest, was much narrower than in the same plots at pod-filling. The most significant differences were recorded at pod-filling, especially if the data was expressed as the number of nodes at which the leaves were either 100 per cent diseased or senescent (Column 7, Table 2).

DISCUSSION

Differences in seed yield in the spray trial were largely accounted for by differences in the levels of disease caused by *A. fabae.* Other diseases (chocolate spot and rust) were present in the plots, but at very low levels which were assumed to have no effect on yield. The highest yielding plot (untreated) was moderately infected, but yielded twenty per cent more seed (647 versus 554 g m^{-2}) than the more severely infected plots. From the data obtained in this preliminary fungicide trial, it is not possible to predict possible increases in yield which may result from total control of the disease. Of the crops included in the agronomic survey, approximately one quarter had infection levels similar to or greater than those found in the spraying experiment. It would appear, therefore, that in the survey area, the pathogen is capable of causing significant reductions in yield, and steps should be taken to attempt to control the disease.

A programme has been initiated to ensure that the healthiest seed available is sown commercially for the 1978-79 season. Hewett (1973) recommended that seed samples for commercial crops in Britain should have an incidence of less than one per cent (based on an agar plate test). The majority of seed sown in 1978 has been sampled and tested at Lincoln College prior to sowing. Samples with from 0.2 to 0.7 per cent infection were suggested as suitable material for further use. For seed production, a sample with an infection level of less than 0.1 per cent is desirable. Continued surveillance will be necessary if this disease is to be kept at a level which causes little or no economic loss.

Further investigations have been initiated to describe more accurately the relationship between disease levels and yield losses, and to determine whether there are any fungicides or seed treatments which may be useful as supplementary methods of control for this disease. Since *A. fabae* may also infect broad beans, a survey is also being carried out on this crop. Seed hygiene is all the more important as the pathogen is seed-borne and the disease can be expected to increase with successive seasons if no control is adopted.

TABLE 2: Harvest and disease assessment data from field plots of field beans sprayed with captafol.

Treatments (see Text)	Harvest Data				Disease Assessment			
					Pod Filling			
	Seed Dry Wt yield g.m^{-2}	Pods m^{-2}	Seeds/ Pods	100 seed wt (g)	Leaf Infection* %	Nodes with 100% disease or senescent	Nodes with > 20% Disease or senescent	Harvest seed Infection %
Untreated	646.6 a	428.8 a	2.69	55.3	5.60	26.8 a	52.9 a	26.8
2 Sprays	595.4 ab	390.0 ab	2.76	55.4	4.50	29.8 a	54.8 a	26.1
3 Sprays	573.0 ab	359.1 b	2.92	54.3	6.43	40.0 b	58.9 ab	29.9
4 Sprays	534.4 b	373.0 b	2.74	52.9	9.55	50.7 c	60.5 b	32.9

* % Leaf infection calculated as the mean % area of disease on all leaves.

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