Importance of Seed discolouration in Faba Beans *(Vicia fabae)* grown in Southern Australia

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ABSTRACT

Discolouration of faba bean seed was common in grain samples from crops grown in southern Australia in 1999, particularly in the cultivar Fiord. Seed from a commercial seed lot of the cultivar Fiord, containing a high proportion of discoloured seed, was sorted into 6 categories based on visual assessment of the seed coat (0, 0<5, 6<25, 26<50, 51<75, 76<100 % discoloured). The different categories of seed were then compared in laboratory and field experiments. Seed health tests showed that most seed discolouration was caused by the fungal disease ascochyta blight. *Ascochyta fabae* was isolated from over 70% of the discoloured seeds. Field studies showed there was a significant reduction in germination and seedling emergence where more than 5% of the seed coat was discoloured. There were no significant differences between seed categories in the amount of disease on young plants. However, reduced early growth was observed where seed discolouration was greater than 25%.

KEY WORDS

Faba bean, disease, seed infection, ascochyta blight.

INTRODUCTION

Ascochyta blight, caused by *Ascochyta fabae* Speg. and chocolate spot caused by *Botrytis fabae* Sardina and *B. cinerea* Fr. are the two most important diseases of faba bean (*Vicia fabae* L.) in southern Australia. All of the cultivars currently grown in Australia are susceptible to at least one of these diseases. Both diseases can cause significant crop losses and discolouration of grain, which reduces its market value. In 1999, both diseases were present in most crops at low levels and were not expected to cause major losses. However, grain harvested from many crops had a high proportion of discoloured seed. From visual inspection of the grain it was unclear whether the discolouration was caused by weather damage following rainfall just prior to harvest or by disease.

The studies reported here were undertaken to establish the cause of seed coat discolouration in faba beans and to determine the health of discoloured seed.

MATERIAL AND METHODS

Seed source

A 100 kg sample was taken from a commercial seed lot of faba bean cv Fiord, harvested from a crop grown at Drung (near Horsham) in the Wimmera region of Victoria in 1999.

Seed from the sample was sorted into 6 categories according to Madeira *et al.* (3) based on the percentage of the surface area of each seed that was discoloured.

Seed testing in the laboratory

An agar plate method was used to determine the presence of fungi on faba bean seed. For each category of discoloured seed, 200 seeds were taken at random for testing. Seeds were surface sterilised (5 min in 0.5% NaOCl) before being placed in Petri dishes (5 per dish) containing potato dextrose agar (Merck 1.1030 39 g/L). Seeded dishes were then incubated for 14 days at 21 ? 2 ?C in alternating 12 h cycles of near ultra-violet light (320-420 nm) and darkness. After incubation, seeds were examined and seed-borne fungi were identified.

The standard blotter test recommended by the International Seed Testing Association (2) was used to determine the percentage germination of each seed lot. For each category of discoloured seed, 100 seeds were taken at random, laid out on moistened absorbent paper, which was then wrapped up in a wet cotton towel and placed inside a plastic bag. The paper was kept moist for 21 days at 17.5 ? 2.5 ?C. Following incubation for 21 days the numbers of germinated seeds were counted.

Glasshouse experiment

A glasshouse experiment was conducted to determine the effect of seed discolouration on seedling emergence under controlled conditions. For each category of seed, 50 seeds were planted (5 seeds per pot) in 20 cm diameter plastic pots containing a composted pine bark potting mix. Pots were placed in a glasshouse with a temperature range of 15-25 ?C and watered to field capacity daily. The numbers of fully emerged seedlings were counted at weekly intervals with a final count taken after 5 weeks.

Field experiment

All categories of infected seed were sown at 100 kg/ha in 6-row plots, 7 m long with a row spacing of 15 cm, at Horsham (friable grey clay, pH 7.9 in $CaCl_2$) on 23 May 2000. Experimental design was a randomised block with 4 replicates. Emergence counts were made 3 weeks after sowing and plants were assessed for disease on 23 June and 25 August. Plants were assessed for the severity of ascochyta blight infection on leaves according to Bernier *et al.* (1).

RESULTS

Seed testing in laboratory

The fungus most commonly isolated from the seed was *A. fabae*. Low levels of *Alternaria* spp., *Stemphylium* spp. and common moulds were sometimes isolated, however no *Botrytis* spp. were detected in any seed lot. The level of *A. fabae* was highest on discoloured seed but was also detected at low levels on seed with no discolouration (Table 1).

The germination percentage of seed decreased significantly where the level of seed discolouration was greater than 25% (Table 1).

Table 1. Frequency of isolation of *Ascochyta fabae* and germination of faba bean seed with different levels of seed discolouration.

Seed Category	Extent of seed coat discolouration	Seed-borne *A. fabae* (% seeds)[A]	Germination (%)[B]
0	No discolouration	18	100
1	Less than 5%	77	100
2	6-25%	79	99
3	26-50%	82	79

4	51-75%	72	63
5	Greater than 75%, under sized, cracked or shrivelled	92	68

[A] Results of agar plate test.

[B] Results of blotter test.

Glasshouse experiment

There were large differences between seed lots in their emergence percentages. Emergence appeared to be quicker from seed lots having low levels of seed discolouration. After 5 weeks, the emergence percentages of seed were lowest where the level of seed discolouration was greater than 25% (Table 2).

Table 2. Germination of faba bean seed with different levels of seed discolouration.

Category	Emergence (%) after:				
	1 week	2 weeks	3 weeks	4 weeks	5 weeks
0	66	81	100	100	100
1	65	74	80	100	100
2	38	49	55	80	100
3	21	39	45	50	80
4	15	25	25	25	25
5	25	39	75	75	75

Field experiment

There was a large reduction in emergence and plant vigour where the level of seed discolouration exceeded 25% (Table 3). The severity of ascochyta blight was relatively low in all plots and did not appear to be associated with seed quality.

Table 3. The effect of discolouration of faba bean seed on emergence, seedling vigour and disease severity in plots sown at Horsham in 2000.

Category	Emergence		Vigour	Severity of ascochyta blight (1-9)[B]	
	(plants/m^2)	(%)	(1-9)[A]	23 June	25 August

0	20	100	1	1	3
1	16	80	1	2	3
2	11	55	1	2	3
3	9	45	5	2.5	4
4	5	25	5	3	4
5	15	75	4	3	4

[A] A visual assessment of plant vigour (1 =very good growth; 9 = very poor growth)
[B] Disease score based on disease incidence and severity (1 = no disease; 9 = plant dead)

DISCUSSION

Results of these studies show that discolouration of faba bean seed, in addition to reducing its market value, can also reduce seedling emergence and plant vigour which is expected to reduce grain yields.

Ascochyta blight appears to have been the main cause of seed discolouration in faba beans grown in 1999 despite the relatively dry conditions in many regions during spring. Seed infection is likely to have occurred late in the growing season, following heavy rains just prior to harvest. In the future, if there are heavy rains forecast late in the growing season, faba bean growers may be able to avoid seed discolouration by applying fungicides just prior to the rain. A fungicide trial conducted at Frances, South Australia, in 1999 demonstrated a significant reduction in seed staining due to ascochyta blight when an intensive spray regime was followed from the commencement of flowering (W. Hawthorne, pers. comm.). Further research is required to establish the optimum rates and timing of fungicide sprays required to prevent ascochyta blight staining and to determine the association between seed staining and seasonal conditions. In the past, faba bean producers have usually applied foliar fungicides to their crops early in the season to control ascochyta blight and have obtained little benefit from applications of foliar fungicides late in the season.

CONCLUSION

The high frequency of isolations of *A. fabae* from discoloured faba bean seed harvested in 1999, suggests that infection by ascochyta blight was the main cause of the discolouration. Where more than 25% of the seed coat was discoloured, germination, seedling emergence and plant vigour were significantly reduced, however, low levels of seed discolouration did not appear to have an adverse affect. Faba bean producers are advised not to use discoloured seed, particularly seed with over 25% discolouration, as it may seriously reduce the grain yield of their faba bean crops.

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