Reducing management inputs and maximising seed quality in faba beans through improved varieties

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Abstract

Faba beans (*Vicia faba* L.) are a valuable break crop in southern Australia and the most profitable pulse on heavy soils prone to transient waterlogging in medium to high rainfall areas. Previous research indicates faba beans require early sowing to maximise yields and hence they are often dry sown before the season break. This increases crop exposure to disease infection, particularly ascochyta blight (*Ascochyta fabae),* chocolate spot *(Botrytis fabae)* and cercospora leaf spot *(Cercospora zonata)*. Older cultivars (cv Fiord and Fiesta VF) have only low to moderate resistance to these diseases. Fungicides are expensive and not always entirely effective for disease control, resulting in reduced profitability through yield loss and quality downgrading. To improve yield stability and productivity the National Faba Bean Improvement Program has developed varieties with improved disease resistance and seed quality. Field experiments were conducted at two sites in South Australia to develop cost-effective disease management strategies for the new cultivars Farah and Nura. Disease levels were low to moderate in these experiments. Both new cultivars had lower levels of ascochyta blight foliar disease and seed staining than Fiesta VF, while Nura also had lower chocolate spot infection. Fungicide sprays generally reduced disease levels, particularly in Fiesta VF, roughly in relation to the total number of sprays applied. Fungicides gave a modest yield increase at one site only, but markedly reduced ascochyta seed stain in Fiesta VF and caused a small reduction in Farah at one site. The very low seed stain levels of Nura were not affected by fungicides. Varieties with improved disease resistance will provide low input, low risk options for early sowing practices of faba bean in southern Australia.

Key Words

Faba bean, disease management, fungicides, cultivars, seed quality

Introduction

Faba beans (*Vicia faba* L.) are a valuable break crop in southern Australia and the most profitable pulse on heavy soils prone to transient waterlogging in medium to high rainfall areas. Faba beans respond well to early sowing and are often dry sown before the season break (Craddock 2004). This increases crop exposure to disease infection, particularly ascochyta blight (*Ascochyta fabae),* chocolate spot *(Botrytis fabae)* and cercospora leaf spot *(Cercospora zonata)*. Older cultivars (cv Fiord and Fiesta VF) have only low to moderate resistance to these diseases, so growers have relied on fungicides for protection.

Managing diseases in faba bean crops is complex. It requires accurate diagnosis of the diseases present, an understanding of disease epidemiology, varietal resistances and fungicide efficacy, and information on recent and forecast weather conditions. Management guidelines have been developed to assist growers to make informed strategic and tactical fungicide spray decisions (Hawthorne *et al.* 2004).

The National Faba Bean Improvement Program has developed cultivars with improved disease resistance. Farah is a selection from Fiesta VF with improved ascochyta resistance (Anon. 2003), while Nura is a crossbred line with Icarus and Ascot as parents, having better resistance to ascochyta,

chocolate spot and rust than Fiesta VF. Field experiments were conducted in two major faba bean producing regions of South Australia during 2005 to develop disease management guidelines for the new cultivars Farah and Nura, to take advantage of their improved disease resistances.

Methods

Field trials were located at Cockaleechie on Lower Eyre Peninsula on a lateritic red-brown earth, and at Saddleworth in the Mid North of SA on black clay. The cultivars Fiesta VF, Farah and Nura were compared under four fungicide spray regimes at Cockaleechie and eight at Saddleworth. These spray regimes were designed to provide a range of combinations and application times of the fungicides mancozeb, carbendazim and chlorothalonil, to match the specific efficacy of each against ascochyta and chocolate spot. Results presented and discussed in this paper are for a subset of five of the spray treatments only at Saddleworth, to match the four treatments at Cockaleechie. Details of the fungicides applied and spray timings in each of the spray treatments are given in Table 1.

Table 1. Timetable of fungicide spray treatment applications in Cockaleechie and Saddleworth experiments.

Spray Treatment	**Application date and days after sowing** **Early flowering spray dates indicated by (F)**							**Total no. of sprays**
Cockaleechie Sown June 28	Aug 17 52	Sep 2 67	Sep 15 80 (F)	Sep 27 92				
Control (unsprayed)								0
Flowering spray only			C					1
Standard	M	M	C					3
Complete (fortnightly)	Ch	Ch	Ch+C	Ch+C				4
Saddleworth Sown June 7 (dry)	Jul 29 52	Aug 12 66	Aug 26 80	Sep 8 93 (F)	Sep 22 107	Oct 6 121	Oct 17 132	
Control (unsprayed)								0
Flowering spray only				C				1
Standard without early				C			M+C	2
Standard	M			C			M+C	3
Complete (fortnightly)	Ch	Ch	Ch	Ch+C	Ch+C	Ch+C	Ch+C	7

M = Mancozeb (750 g/kg) at 2.2.kg/ha (1650 gai/ha); C = Carbendazim (500 g/L) at 500 ml/ha (250 gai/ha);
Ch = Chlorothalonil (720 g/L) at 2.3 L/ha (432 gai/ha).

Trials were designed as factorial treatments in randomised blocks, replicated in four bays. Buffer plots of cv Cairo were sown at either end and within each bay, using seed carrying a moderate level of ascochyta infection, to produce more uniform disease infection through the trial. Plot size was 10m long x 8 rows (1.5m) wide. All varieties were sown at 24 viable seeds/m^2, on the basis of seed size and germination percentage. Mono-ammonium phosphate enriched with 2.5% Zn was drilled with the seed at 100 kg/ha. Herbicide regimes varied between trials, based on accepted district practice.

Spray treatments were applied to individual plots using a backpack sprayer attached to a 1.5m wide boom which was either hand-held, with an output of 125 L/ha (Saddleworth), or mounted on a shielded spray trolley, with an output of 266 L/ha (Cockaleechie).

Plots were rated for foliar disease symptoms at early to mid-podding. A proportional disease index was used at Cockaleechie to score the low levels of ascochyta and chocolate spot, and proportional defoliation was used to score for cercospora, on October 11. The Saddleworth trial was scored on October 27, using a 1-9 scale (1 = nil disease and 9 = dead plants) for ascochyta and chocolate spot, and presence or absence of cercospora leaf spot.

Plot grain yields were recorded at harvest, and seed samples retained for seed size (hundred seed weight) measurement and ascochyta disease stain scores (weighted percentage of stained seed). All trial data were analysed by ANOVA, for cultivar and spray treatment effects and interactions.

Results

Despite later than average opening rains at both sites, resulting in later than optimum sowing times, seasonal conditions were very favourable for faba bean growth. Growing season rainfall (April 1 to October 31) was 355 mm at Cockaleechie (c.f. long-term mean of 330 mm) and 365 mm at Saddleworth (c.f. long-term mean of 375 mm). Mild spring temperatures and a continuation of useful rainfall into November gave crops an extended growing season, resulting in trial yields of 4-6 t/ha. Foliar disease levels were generally only low to moderate in these trials, which may have limited responses to fungicide treatments.

At Cockaleechie, tall, rank growth and wind damage made spraying of individual plots impractical after early October. Hence planned late spray applications (from early podding on) were not made, giving rise to differences in the spray treatment regimes at the two sites, and the omission of the *Standard without early spray* treatment from the Cockaleechie experiment.

Chocolate spot infection levels were significantly influenced by variety and fungicide treatments at both sites (Figure 1). Without fungicide, Nura had lower chocolate spot than Farah and Fiesta VF, and the infection levels in all varieties were generally reduced to very low levels with 2 or more fungicide sprays.

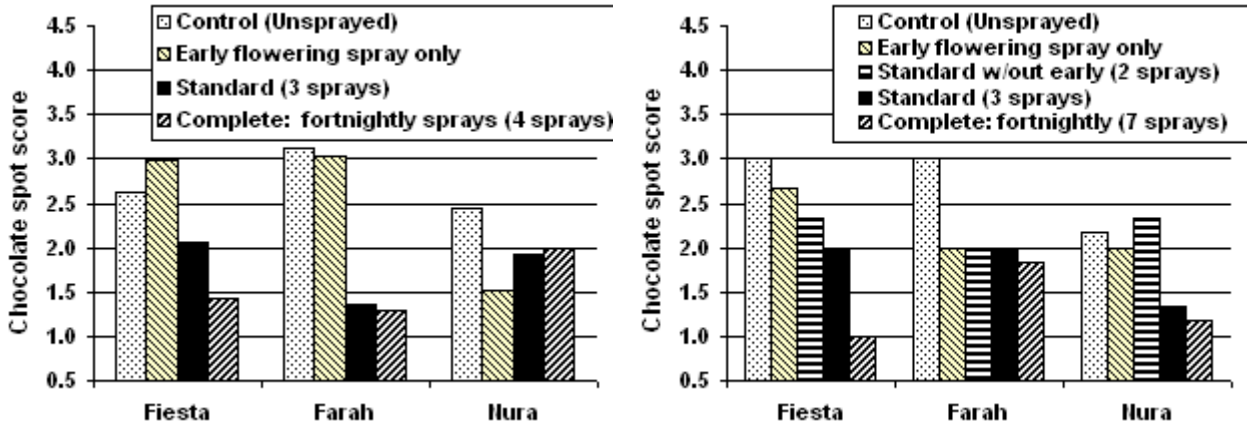

Figure 1. Effect of fungicide treatments on chocolate spot in bean cultivars at Cockaleechie (left) and Saddleworth (right). (Significance of effects: Cockaleechie – Variety p<0.05, Fungicide p<0.001, Interaction p<0.05. Saddleworth - Variety p<0.001, Fungicide p<0.001, Interaction p<0.001)

Ascochyta infection was at very low levels in all cultivars at Cockaleechie, with no significant treatment differences. The moderate ascochyta levels at Saddleworth (Figure 2) showed a strong varietal effect, being most prevalent in Fiesta VF, lower in Farah and negligible in Nura. The *complete* (fortnightly) spray treatment significantly reduced ascochyta in both Fiesta VF and Farah, while the *standard* treatment (3 sprays total) and the single *early flowering* spray gave a lesser reduction in Fiesta VF and Farah respectively.

Although cercospora lesions are often difficult to distinguish from ascochyta and chocolate spot in the field, previous field observations have shown premature defoliation in faba beans to often be associated with cercospora leaf spot infection (Rohan Kimber, *pers. comm.*). High levels of defoliation around mid pod-fill were recorded in the Cockaleechie trial (Figure 2), with a marked reduction in the level of defoliation in response to fungicide sprays. The *complete* (fortnightly) spray regime gave best protection in all cultivars, while Farah showed less defoliation than Fiesta VF and Nura. Fresh leaf litter collected from the trial was incubated in the laboratory, and *Cercospora zonata* spores were identified from this.

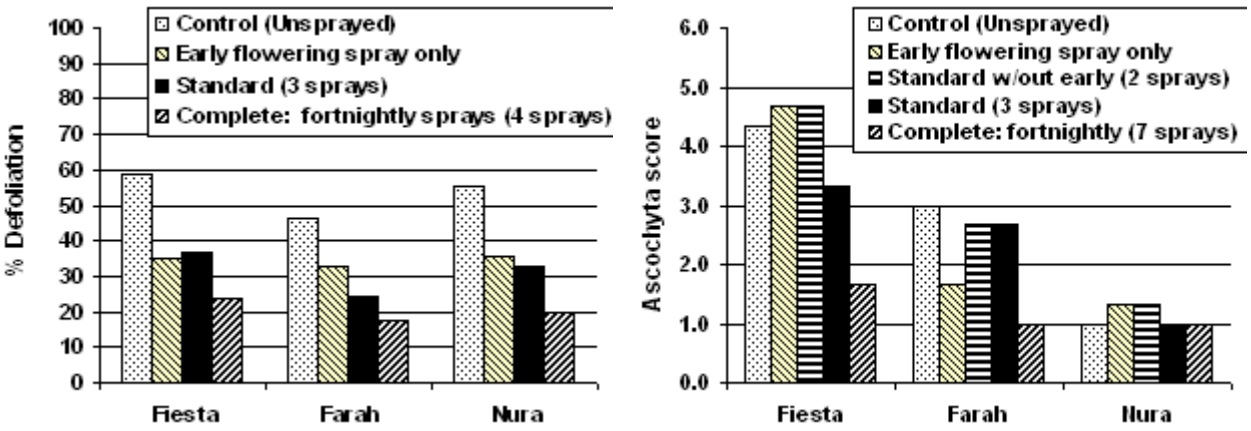

Figure 2. Effect of fungicide treatments on defoliation (cercospora leaf spot infection) at Cockaleechie (left) and ascochyta leaf damage at Saddleworth (right). (Significance of effects: Cockaleechie – Variety p<0.05, Fungicide p<0.001, Interaction NS. Saddleworth - Variety p<0.001, Fungicide p<0.001, Interaction p<0.01)

Disease reduction with fungicide sprays was not closely linked to grain yields. Control of ascochyta and chocolate spot with fungicides at Saddleworth (Figs 1 and 2) did not increase yields (Figure 3). Nura yields (4.4 t/ha mean) were significantly below Fiesta VF (5.6 t/ha) and Farah (5.9 t/ha) in this trial. Yield increases were observed at Cockaleechie in response to fungicide spray treatments, most notably in Farah.

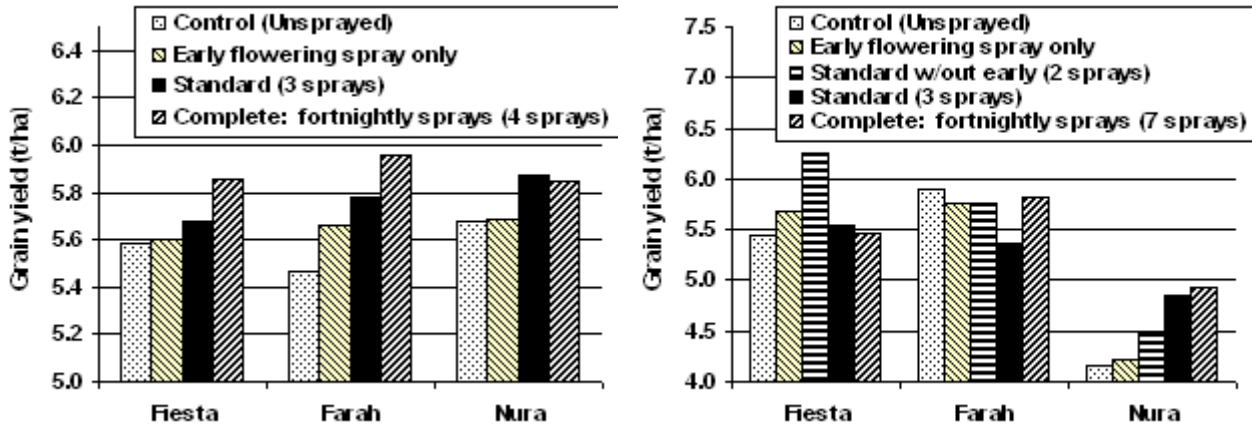

Figure 3. Effect of fungicide treatments on grain yields at Cockaleechie (left) and Saddleworth (right). (Significance of effects: Cockaleechie – Variety NS, Fungicide p<0.01, Interaction NS. Saddleworth - Variety p<0.001, Fungicide NS, Interaction NS)

The proportion of ascochyta stained seed differed markedly between cultivars at both sites (Nura very low and Fiesta VF the highest), but was reduced significantly with fungicide sprays at Saddleworth only (Figure 4). Our inability to apply late fungicide sprays at Cockaleechie may have lead to the higher levels of stained seed in Fiesta VF with the *complete* treatment there (3.7%) than at Saddleworth (1.9%).

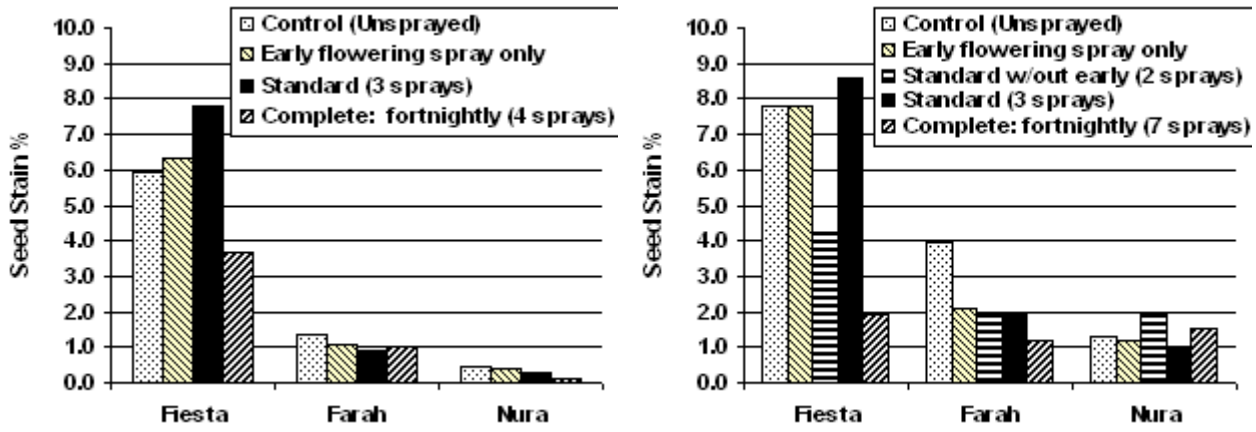

Figure 4. Effect of fungicide treatments on ascochyta seed staining at Cockaleechie (left) and Saddleworth (right). (Significance of effects: Cockaleechie – Variety p<0.001, Fungicide NS, Interaction NS. Saddleworth - Variety p<0.001, Fungicide p<0.05, Interaction NS)

Conclusions

Nura demonstrated much better resistance to both foliar infection and seed staining from ascochyta than Fiesta VF, while Farah showed intermediate infection and staining. Nura's chocolate spot resistance was

also better than Farah and Fiesta VF. Fungicide sprays generally reduced infection levels, particularly in Fiesta VF, roughly in relation to the total number of sprays applied. Fungicide sprays gave a modest yield increase at Cockaleechie, but no response at Saddleworth. Nura produced seed with minimum disease stain without the protection of fungicide in these trials, while Fiesta VF required fungicide to reduce stained seed to the 3% level for acceptance into first grade.

References

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