Faba bean disease tolerance – Breeza 2016

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Key findings

- In a year with high rust pressure, fungicide application provided beneficial to all genotypes, even those with a good level of rust resistance.
- Several advanced breeding lines from the northern breeding program show promise, with high yield and large seed size combined with rust and chocolate spot resistance equal to or better than the current northern varieties.

Introduction

Rust is considered to be the most important faba bean disease in the northern region; breeding for rust resistance has been a high priority for the breeding program. No complete rust resistance is available within the faba bean germplasm pool, and although recently released varieties have improved rust resistance, they will still show disease under high inoculum pressure. Yield losses do not solely depend on the level of disease, but will also be influenced by the level of tolerance (the ability to compensate for the effect of the disease) of each genotype.

The experiment aimed to compare the performance of faba bean varieties and advanced breeding lines under different levels of rust pressure. Inoculations with greenhouse produced rust spores were applied early in the season to generate a high level of disease. Two fungicides registered for rust control in faba bean, mancozeb and tebuconazole, were used to provide low-disease level controls.

Site details

Location	Liverpool Plains Field Research Station, Breeza
Co-operator	Scott Goodworth
Soil type and nutrition	Self–mulching heavy clay
Rainfall	A total of 495 mm rainfall was recorded at the experiment site between sowing and harvest, which encouraged foliar disease development.
Experiment design	A split-plot design with three replicates was used with the two fungicides and control treatments as main plots and 12 faba bean genotypes as sub-plots.
Sowing date	27 April
Fertiliser	Nil
Plant population	Target 20 plants/m^2
Weed management	Post-sowing/pre-emergent Terbyne® 1 kg/ha (terbuthylazine 750 g/kg) applied on 27 April
Insect management	Insect pressure was low and no insecticide was used.
Harvest date	21 November

Treatments

Varieties (12)

- Doza$^{\phi}$ – released in 2008, classified MR–R (moderately resistant to resistant) to rust
- PBA Warda$^{\phi}$ – released in 2012 and classified MR–R to rust

- PBA Nasma(ф) – released in 2015, large seeded and classified MR–R to rust
- IX474/4-12, IX486/7-6 and IX561f/4-2 and11NF001a-10 – advanced lines from the northern breeding program
- Fiesta VF– an old southern variety classified as S (susceptible) to rust
- PBA Samira(ф) – released in 2014, a southern variety, MS (moderately susceptible) to rust
- PBA Zahra(ф) – released in 2015 for southern regions, large seed and MS to rust
- AF09169 and AF11212 are both advanced lines from the southern breeding program

Fungicides

Either mancozeb 1 kg/ha (750 g/kg mancozeb) or tebuconozole 350 ml/ha (430 g/L tebuconazole) applied on 16 June, 1 August, 18 August and 9 September. NSW DPI research is covered under a permit to use off-label crop protection products and application rates on experimental plots (PER7250) and the applied rate was higher than the 145 ml/ha permit rate for tebuconazole on faba bean.

Table 1. Faba bean disease tolerance experiment, Liverpool Plains Field Station, 2016.
Genotype averages for disease scores (values within a column followed by same letter do not differ significantly, l.s.d. 5%).

Variety	Rust August	Stemphylium August	Rust (leaf) September	Rust (stem) September	Chocolate spot September	Leaf retention September
Doza	7.2^{cd}	3.7^{abc}	4.4^{a}	4.1^{a}	17.2^{bc}	3.2^{bcd}
PBA Warda	5.5^{abc}	12.3^{d}	5.2^{ab}	5.7^{ab}	17.1^{bc}	3.3^{de}
PBA Nasma	7.7^{cd}	6.5^{c}	6.6^{abcd}	5.5^{ab}	19.7^{cde}	3.3^{cd}
IX474/4-12	6.0^{bcd}	4.0^{abc}	5.8^{abc}	5.3^{ab}	18.4^{cd}	2.9^{abc}
IX486/7-6	4.1^{ab}	3.7^{abc}	4.8^{ab}	4.2^{a}	17.6^{bcd}	2.8^{a}
IX561f/4-2	10.7^{ef}	14.3^{d}	8.6^{de}	7.4^{bc}	20.0^{cde}	3.3^{cd}
11NF001a-10	2.8^{a}	4.1^{abc}	5.1^{ab}	3.7^{a}	13.0^{a}	2.8^{a}
Fiesta	17.4^{g}	4.3^{bc}	9.7^{e}	9.3^{c}	21.7^{e}	3.7^{e}
PBA Samira	12.4^{f}	0.4^{a}	7.1^{bcd}	6.5^{ab}	14.1^{a}	2.9^{ab}
PBA Zahra	8.7^{de}	1.9^{ab}	4.3^{a}	4.6^{a}	15.4^{ab}	3.1^{abcd}
AF09169	6.0^{bcd}	0.7^{ab}	6.6^{abcd}	4.0^{a}	21.6^{e}	2.8^{a}
AF11212	6.2^{bcd}	29.6^{e}	7.8^{cde}	7.6^{bc}	15.3^{ab}	3.2^{bcd}
Average	7.9	7.1	6.3	5.7	17.6	3.1
l.s.d. (5%)	2.9	4.0	2.2	2.3	2.8	0.4

Results

On 10 August plots were scored (% leaf coverage) for both rust (*Uromyces viciae-fabae*) and Stemphylium blight (*Stemphylium* spp.). On 27 September, plots were scored (% leaf coverage) for rust on stem, rust on leaf and chocolate spot (*Botrytis fabae*). On 30 September, plots were scored for leaf retention using a 1–5 scale (1 = no leaves dropped; 3 = 50% of the leaves dropped; 5 = >90 % of the leaves dropped).

Differences in rust resistance were clear among the genotypes with PBA Warda(ф) and the advanced breeding lines IX486/7-6 and 11NF001a-10 showing the highest level of resistance (Table 1). Tebuconazole was clearly superior to mancozeb in controlling rust (Table 2).

Table 2. Faba bean disease tolerance experiment, Liverpool Plains Field Station, 2016.
Treatment averages for disease scores (values within a column followed by same letter do not differ significantly, l.s.d. 5%).

Treatment	Rust August	Stemphylium August	Rust (leaf) September	Rust (stem) September	Chocolate spot September	Leaf retention September
Control	20.1^{b}	10.0^{b}	15.7^{b}	14.1^{b}	20.8	4.0^{a}
Mancozeb	2.9^{a}	8.1^{b}	1.8^{a}	0.8^{a}	15.5	3.0^{b}
Tebuconazole	0.7^{a}	3.3^{a}	1.4^{a}	2.1^{a}	16.5	2.2^{c}
Average	7.9	7.1	6.3	5.7	17.6	3.1
l.s.d. (5%)	5.8	3.8	4.8	3.0	n.s.	0.5

The level of rust reduction from fungicide application was more successful with the rust susceptible lines than with the more resistant ones, resulting in a highly significant (P<0.001) genotype*treatment interaction (Figure 1). The fungicide application efficacy, ,especially tebuconazole, in controlling rust was demonstrated on highly susceptible lines such as Fiesta with rust severity reduced to very low levels.

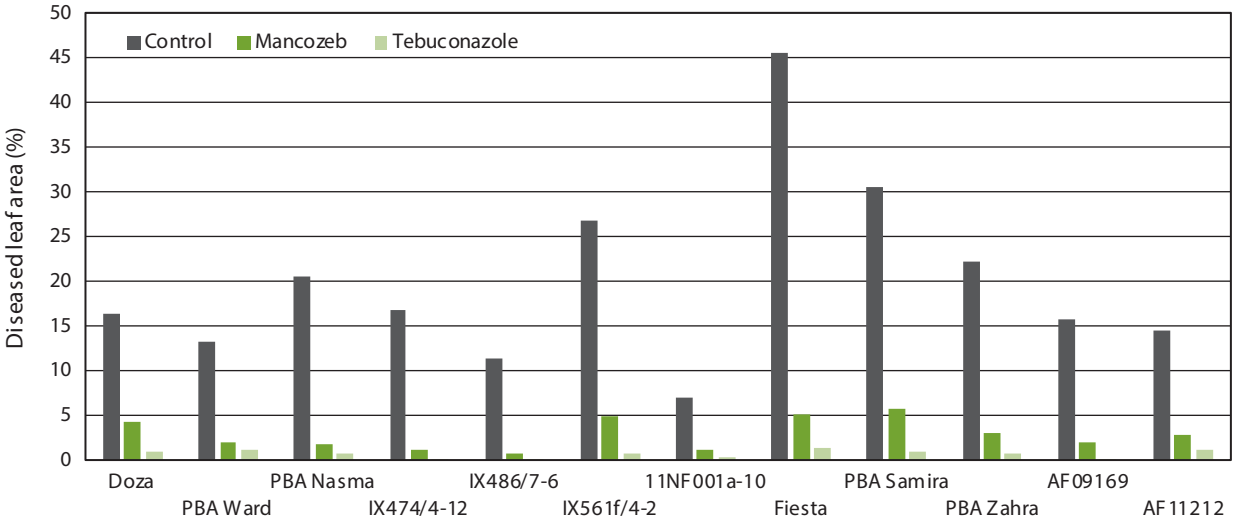

Figure 1. Faba bean disease tolerance experiment. Rust severity on 12 genotypes, control versus two fungicide applications, August 2016. l.s.d. (5%) for genotype*treatment averages = 5.0%.

The 2016 season was the first year in which high incidences of Stemphylium blight were noted in experimental plots and commercial fields of faba bean throughout the northern region. An unexpected high variation for Stemphylium blight severity was found among genotypes with PBA Warda(Φ), IX561f/4-2 and, especially, AF11212, showing a high degree of susceptibility (Table 1). Tebuconazole application resulted in a highly significant (P<0.001) reduction in severity (Table 2). As with rust, a significant interaction between fungicide applications and genotypes was found, as the reduction in blight severity was particularly visible in the highly susceptible genotypes (Figure 2).

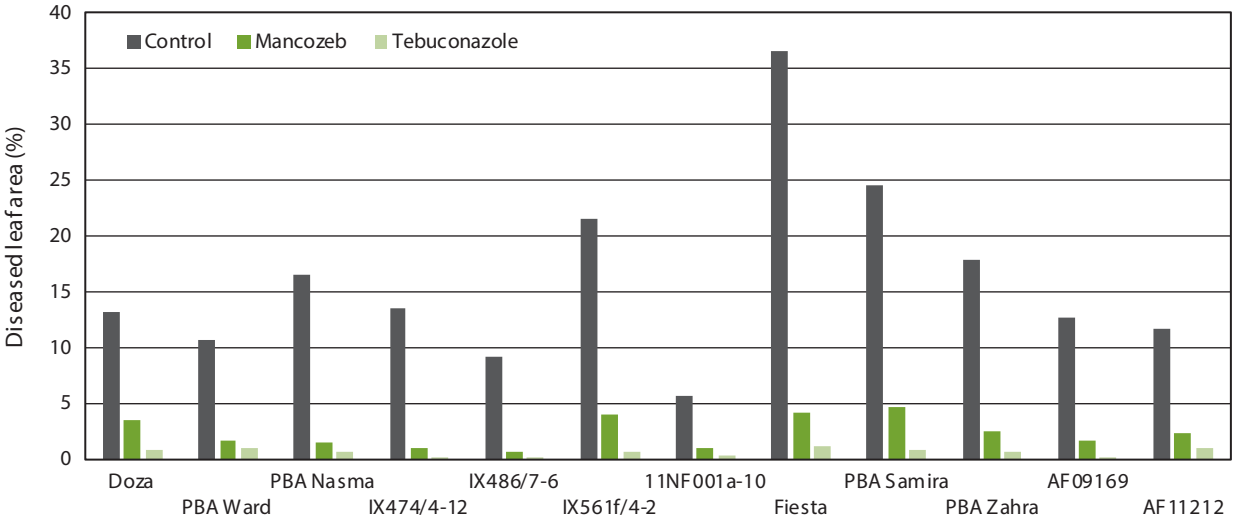

Figure 2. Faba bean disease tolerance experiment. Stemphylium blight severity on 12 genotypes, control versus two fungicide applications, August 2016. l.s.d. (5%) for genotype*treatment averages = 6.9%.

The late September rust scores show a similar pattern to the earlier readings with near complete protection from the disease from either mancozeb or tebuconazole, even in the most susceptible lines (Figure 3).

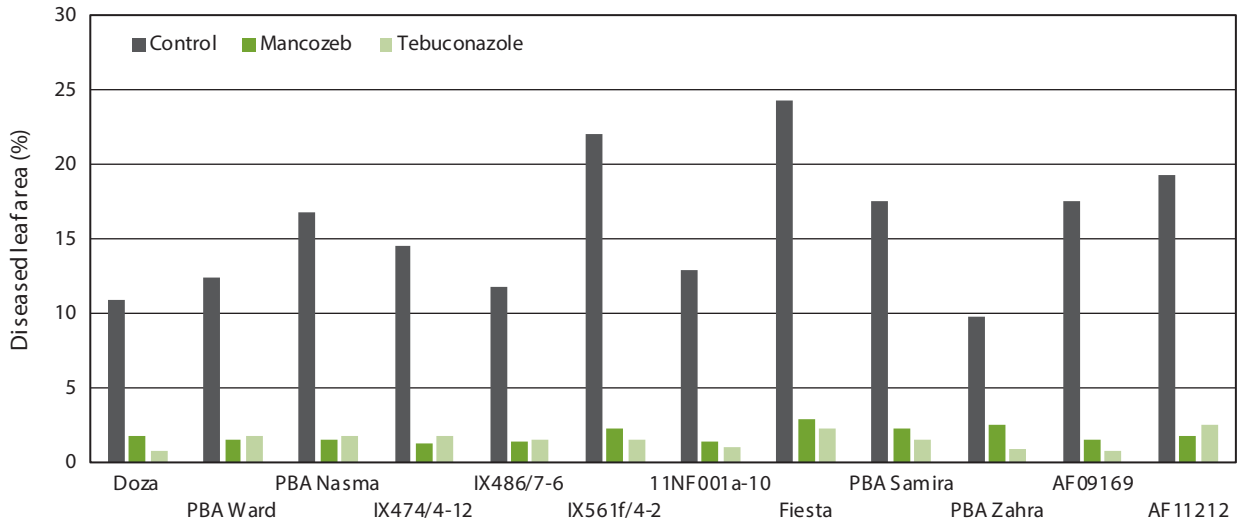

Figure 3. Faba bean disease tolerance experiment. Rust severity on the top leaves of 12 genotypes, control versus two fungicide applications, September 2016. l.s.d. (5%) for genotype*treatment averages = 3.9%.

Genotypes differed in chocolate spot scores with the northern advanced breeding line 11NF001a-10 showing a similar level of resistance as the best southern material (Table 1). Surprisingly, the difference between the control and the fungicide applications was not significant (Table 2) and no interaction between fungicide applications and genotypes was found.

Fungicide application, especially tebuconazole, had a positive effect on leaf retention (Table 2). The genotype ranking for leaf retention indicated the effect of rust on this trait (Table 1): As with rust, the fungicide effect was largest for the rust susceptible genotypes Fiesta and IX561f/4-2 (Figure 4).

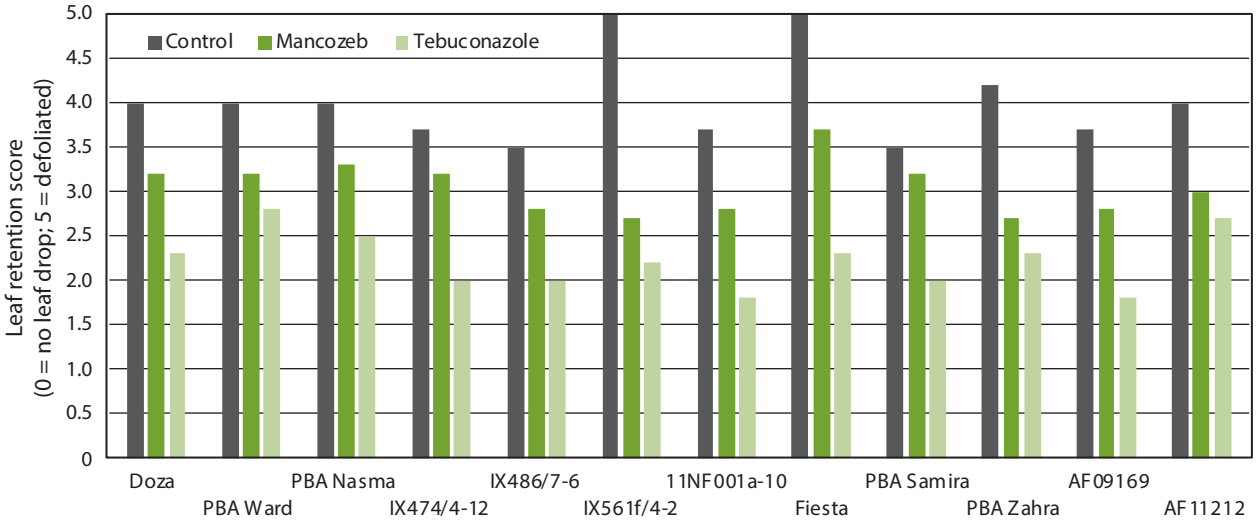

Figure 4. Faba bean disease tolerance experiment. Leaf retention score on 12 genotypes, control versus two fungicide applications, September 2016. l.s.d. (5%) for genotype*treatment averages = 0.6

Grain yield and seed size

The mancozeb and tebuconazole applications resulted in a yield increase over the control of 47% and 88% averaged over varieties respectively (Table 4). Genotypes differed greatly in yield with IF474/412, AF09169 and 11NF001a-10 the best performers (Table 3). The relatively good performance of the highly Stemphylium blight susceptible AF11212 was unexpected and could be an indication that the impact of Stemphylium blight on yield was relatively small.

No significant interaction was found between fungicide application and varieties for yield, which was surprising given the highly significant interactions found for rust severity scores. It appears that even highly rust resistant varieties benefit from fungicide applications. Phytotonic

effects of fungicide applications in the absence of disease have been reported and might require further investigations.

The absence of an increase of seed weight after fungicide applications (Table 4) was equally surprising, given earlier experiments in which substantial seed weight increases were recorded when rust was controlled.

Conclusions

Genotypes differed in their susceptibility to rust, chocolate spot and Stemphylium blight, with one of the northern breeding lines (11NF001a-10) showing a level of chocolate spot and rust resistance equal to the best current commercial varieties. Fungicides were highly effective in reducing rust symptoms and improving leaf retention, but in this experiment had no effect on chocolate spot severity. Note that the permit for tebuconazole allows for only three applications of 145 ml/ha in commercial crops.

Table 3. Faba bean genotype tolerance experiment, Liverpool Plains Field Station, 2016
Genotype averages for yield components (values within a column followed by same letter do not differ significantly, l.s.d. 5%).

Variety	Yield (t/ha)	100 seed weight (g)
Doza	2.5^{d}	54.7^{a}
PBA Warda	2.4^{cd}	60.1^{bc}
PBA Nasma	2.4^{cd}	67.5^{f}
IX474/4-12	3.2^{f}	66.4^{ef}
IX486/7-6	2.9^{ef}	63.0^{cd}
IX561f/4-2	2.6^{de}	63.9^{de}
11NF001a-10	2.9^{f}	60.7^{bc}
Fiesta	1.3^{a}	59.2^{b}
PBA Samira	1.7^{b}	69.3^{f}
PBA Zahra	2.1^{c}	76.4^{g}
AF09169	3.0^{f}	67.4^{f}
AF11212	2.5^{d}	64.1^{de}
Average	2.5	64.4
l.s.d. (5%)	0.4	3.1

Table 4. Faba bean genotype tolerance experiment, Liverpool Plains Field Station, 2016.
Treatment averages for yield components (values within a column followed by same letter do not differ significantly, l.s.d. 5%).

Treatment	Yield (t/ha)	100 seed weight (g)
Control	1.7^{a}	63.0
Mancozeb	2.5^{b}	65.5
Tebuconazole	3.2^{c}	64.7
Average	2.5	64.4
l.s.d. (5%)	0.3	ns

Acknowledgements

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