Field pea canopy management in the Mid-North

Jade Rose[1], Sarah Day[2] and Penny Roberts[2]
[1]Hart Field-Site Group, [2]South Australian Research and Development Institute

Key findings

- Variety mixtures have the potential to improve the ability of field pea crops to suppress and compete with weeds, maintain yields and reduce airborne disease spread.
- Canopy structure was successfully manipulated using mixtures of field pea varieties.
- Incorporating 75% PBA Oura + 25% PBA Percy reduced lodging at both sites compared to 100% PBA Percy.
- Grain yield was not affected by mixing varieties and yielded similarly to varieties sown alone.

Why do the trial?

Lodging in field peas is still an issue despite breeding advances in newer varieties to improve harvestability. Ascochyta blight (commonly known as blackspot) also remains an issue for field pea management. Currently there are no resistant field pea varieties commercially available for growers. Management options for blackspot include fungicide sprays, hygiene, and crop rotation. Breeding resistance into varieties is a slow process due to the complex nature of resistance and low investment in this area. There is a need for improved management tools to reduce yield losses from lodging and blackspot.

Individual field pea varieties have different characteristices (e.g. plant height, growth habit and lodging resistance) and a mixture of varieties at seeding may improve the harvestability while maintaining grain yield. In South Australia both conventional and semi-leafless field pea varieties are grown (Figure 1). Conventional field pea varieties have many leaflets on the tendrils (e.g. PBA Percy) and are known for their weed suppression, and yield stability. Semi-leafless field pea varieties have fewer leaflets and more tendrils (e.g. PBA Wharton). They are known for their high yield potential in the absence of weeds, and lodging resistance due to lower biomass production.

Figure 1. (L-R) PBA Wharton (semi-leafless) and PBA Percy (conventional). Photo source: Pulse Breeding Australia.

The aim of these trials was to utilise field pea variety mixtures to open up the crop canopy, reduce blackspot disease spread and lodging and maintain grain yield. A second component to the Hart trials investigated if variety mixtures with differing disease resistance levels could help manage blackspot in terms of reducing fungicide inputs.

How was it done?

Location: Hart

Plot size	2.0 m x 10.0 m	**Fertiliser**	MAP 80 kg/ha at seeding
Seeding date	May 16, 2019		

Location: Willowie (Annual rainfall: 156 mm, growing season: 126 mm)

Plot size	2.0 m x 10.0 m	**Fertiliser**	MAP 75 kg/ha at seeding
Seeding date	May 16, 2019		

This season at Hart and Willowie, field pea varieties were sown alone and mixed in different seeding rate combinations. The trial was a randomised complete block design with four replicates and included PBA Oura, PBA Percy, PBA Wharton, a breeding line (Hart) and Parafield (Willowie) (Table 1). Variety mixes included a conventional with a semi-leafless variety mix for a 'Kaspa type' field pea and a conventional with a semi-leafless variety for a 'dun type' field pea. The addition of canola was used in some treatments to assess if field pea varieties would use the canola as a trellis. The Hart and Willowie trials were both sown on May 16, targeting a plant population of 45 plants per m^2 for conventional field pea and 55 plants per m^2 for semi-leafless field pea. All seed was treated with P-Pickle T.

This trial was naturally infected with blackspot from adjacent blackspot trials. Throughout the season, fortnightly fungicide sprays were applied to half the trial (Hart only) in order to assess the level of disease infection in different field pea canopy structures. These sprays commenced on June 5, before blackspot infection had occurred. A number of measurements were taken for both sites in-season, such as plant establishment counts, lodging, normalised difference vegetation index (NDVI), grain yield, and disease scores as per Banninza et al. 2005.

Table 1. Field pea variety combinations (treatments) at Hart and Willowie, 2019. C = conventional, SL = semi-leafless

	Treatments
1	50% PBA Oura (SL) + 50% PBA Percy (C)
2	25% PBA Oura (SL) + 75% PBA Percy (C)
3	75% PBA Oura (SL) + 25% PBA Percy (C)
4	100% PBA Oura (SL)
5	100% PBA Percy (C)
6	50% PBA Wharton (SL) + 50% breeding line (C)
7	25% PBA Wharton (SL) + 75% breeding line (C)
8	75% PBA Wharton (SL) + 25% breeding line (C)
9	100% PBA Wharton (SL)
10	100% breeding line (C)
11	PBA Percy (C) + canola x2
12	PBA Oura (SL) + canola x2

Results and discussion

Manipulating field pea canopy

Plant establishment counts showed the trial achieved the target seeding rates and mixtures in most treatments (data not shown). However, due to poor establishment the canola was below the target seeding plant.

Using a Green Seeker, normalised difference vegetation index (NDVI) results showed differences between variety mixtures at a number of growth stages. On June 24, 100% PBA Percy (C) had higher vigour compared to 100% PBA Oura (SL). This was not surprising given conventional varieties produce more biomass. However, by August 20 (Figure 2), growth was the same for both PBA Percy (C) and PBA Oura (SL). By late August, 100% PBA Wharton had better canopy structure (higher NDVI) and ground cover compared to the 100% breeding line. It should be noted that a low to medium NDVI could beneficial for reducing disease spread, as these treatments may have less biomass and a more open canopy.

The Willowie site (data not shown) had similar results on the same sampling dates, where 100% Percy had higher NDVI values than all mixtures except 50% PBA Oura + 50% PBA Percy on June 26. On this date, the 75% PBA Oura + 25% PBA Percy mix also had higher NDVI than all PBA Wharton/Parafield mixtures.

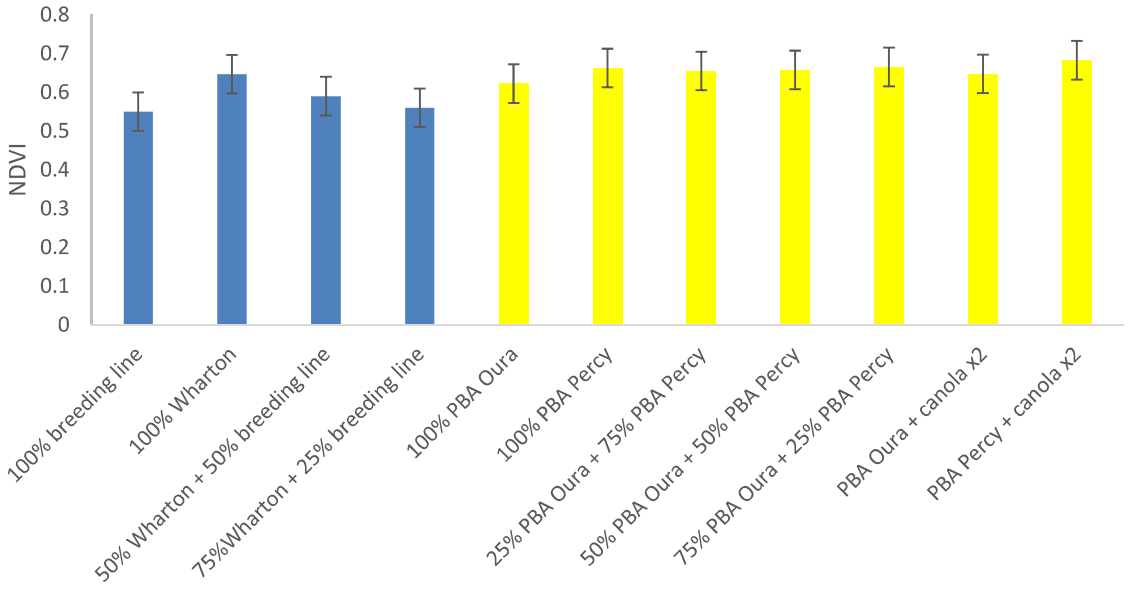

Figure 2. Field pea variety mixtures (Hart) with corresponding NDVI values on 20/8/19 (LSD=0.049 at P≤0.001). Error bars represent least significant difference.
Blue bars = 'Kaspa type' field pea. Yellow bars = 'dun type' field pea.

Lodging data showed 100% PBA Percy lodged more than 100% PBA Oura at Hart (Figure 3). However, the addition of canola had no effect on lodging due to poor establishment and therefore the field pea could not trellis up the canola. Incorporating a mix of 75% PBA Oura + 25% PBA Percy reduced lodging compared to 100% PBA Percy, and a 25% PBA Oura + 75% PBA Percy mix. A 50% PBA Percy + 50% PBA Oura had no reduction in lodging compared to 100% Percy. No differences were observed in treatments including the conventional breeding line, however increasing the breeding line to 75% and decreasing Wharton (SL) to 25%, increased lodging. Ascochyta blight severity can increase as the degree of lodging increases, therefore a reduction in lodging is desired (Banninza et al. 2005).

At the Willowie site, results showed 100% PBA Percy had higher lodging compared to 100% Oura. A mixture of 50% PBA Oura + 50% PBA Percy reduced lodging compared to 100% PBA Percy (data not shown). Increasing PBA Oura to 75% with 25% PBA Percy further reduced lodging compared to the 50% PBA Oura + 50% PBA Percy and 100% PBA Percy mix. The 100% PBA Oura and PBA Oura and canola mix showed similar results, and better lodging resistance to all other mixtures at Willowie. This site did not have a treatment including the breeding line.

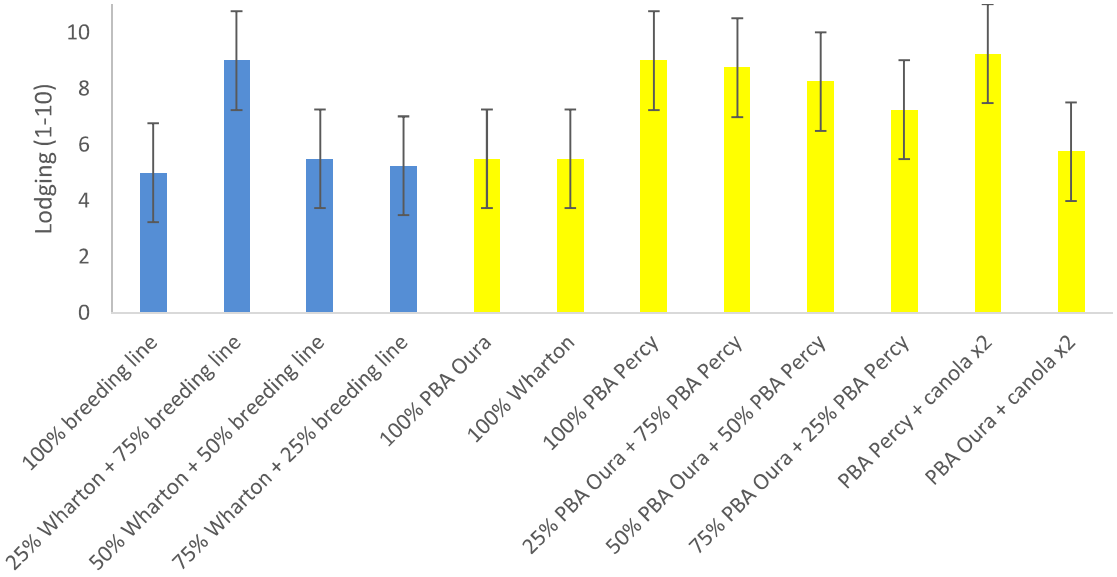

Figure 3. Field pea variety mixtures (Hart) with corresponding lodging values (1 = not lodged, 10 = lodged (LSD = 1.726 at P≤0.001). Error bars represent least significant difference. Blue bars = 'Kaspa type' field pea. Yellow bars = 'dun type' field pea.

Blackspot infection

Early in the season (June 21, 2019) blackspot infection was observed in the trial. However, the progression of blackspot in the canopy was low with minimal rainfall later in the growing season. Disease ratings showed no differences in the percentage of leaf or stem infection from blackspot between varieties and mixtures trialed.

Grain yield

Grain yields at Hart range from 1.16 t/ha to 1.48 t/ha (Figure 4). The highest yielding variety at Hart was the 100% breeding line (1.48 t/ha), which was 16% higher yielding than 100% PBA Wharton (1.27 t/ha). This season, variety mixtures did not improve or reduce grain yield. Long-term yield data will determine if mixing a conventional and semi-leafless field pea will have an effect on grain yield. At Willowie, all treatments yielded an average of 0.25 t/ha, due to drought conditions.

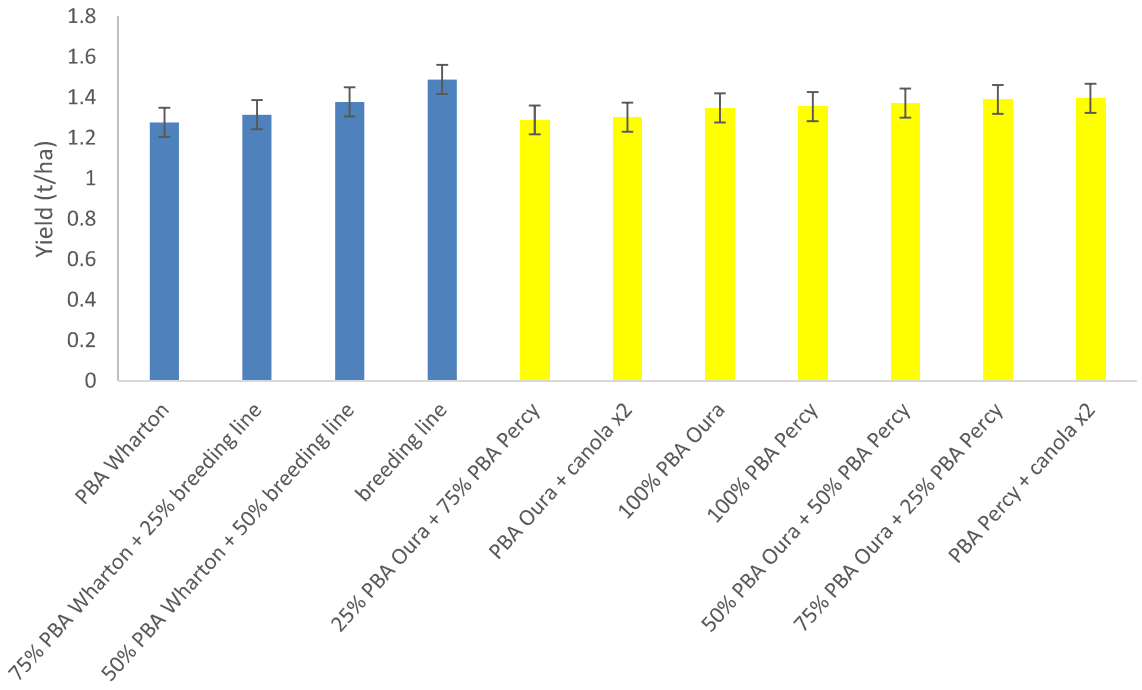

Figure 4. Field pea variety mixtures (Hart) with average grain yield (t/ha) (LSD=0.14 at P≤0.001). Error bars represent least significant difference. Blue bars = 'Kaspa type' field pea. Yellow bars = 'dun type' field pea.

Summary / implications

There is potential to manage blackspot infection through canopy or variety architectural traits. Previous research has shown mixing field pea varieties can minimise lodging, reduce blackspot severity and increase or improve yield stability. The trials at Hart and Willowie showed mixing field pea varieties can manipulate canopy structure (e.g. NDVI, lodging) compared to growing pure conventional and semi-leafless varieties alone. However, the benefit of these canopy differences was unable to be assessed under blackspot pressure due to the dry seasonal conditions.

In terms of grain yield there was no benefit from growing a field pea variety mixture. However, mixtures generally maintained the grain yield of the semi-leaf less and conventional field pea varieties sown on their own at both Hart and Willowie.

These trials were one season of data. To make accurate recommendations on the ability of field pea variety mixtures to suppress blackspot they need to be assess under high disease pressure in future seasons.

References

Banniza, S., P. Hashemi, T. D. Warkentin, A. Vandenberg, and A. R. Davis. 2005. The relationships among lodging, stem anatomy, degree of lignification, and resistance to mycosphaerella blight in field pea (*Pisum sativum*). Can. J. Bot. 83:954–967.

Acknowledgements

Funding for this work was provided through GRDC Southern Pulse Agronomy project DAV00150. We acknowledge the support of the Clare SARDI team for assistance with trial management.