Improving Yield and Reliability of Field Peas Under Water Deficit

EXTENSION

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Location: Minnipa Ag Centre

Rainfall
Av. Annual: 325 mm
Av. GSR: 250 mm
2010 Total: 410 mm
2010 GSR: 346 mm

Yield
Potential: 3.2 t/ha (Pulses)
Actual: 2.5 t/ha

Paddock History
2009: Wheat
2008: Wheat
2007: Wheat

Soil Type
Sandy clay loam

Plot size
5 m x 1.5 m x 3 reps

Yield Limiting Factors
Late moisture stress at filling

Key messages

- **This three year research project aims to increase the yield and reliability of field pea under water deficit and is a major pre-breeding target of Pulse Breeding Australia.**
- **Key traits being monitored include phenology, canopy and yield traits and the adaptive value of these traits will be explored.**
- **The trade-offs between adaptation to stress and yield in good environments will be investigated.**
- **Improving the reliability of yield of field pea in water limiting environments will help to provide a robust break crop option for growers in low rainfall regions.**
- **Preliminary results only from the first season of experiments are presented with more detailed trait data currently being analysed, with two more years from different seasons to follow.**
- **Correlations between yield and canopy traits such as greenness have been identified.**

Why do the trials?

Grain legumes are generally more sensitive to periods of drought than cereals and consequently their yield is more variable with production concentrated in the medium and high rainfall areas. By increasing the yield and reliability of field peas under water deficit we can increase their reliability and improve their value in dryland farming systems.

Background

Pulse crops provide a cereal disease break, weed management options, nitrogen benefit and alternative marketing opportunities. Field pea is the major pulse crop grown across southern Australia and is currently grown over 300,000 ha in Australia. Field pea production in recent seasons has been displaced in the higher rainfall areas by higher value crops such as lentil and chickpea and increased sowing area is occurring in the lower rainfall areas where it is considered the most reliable break crop option. Pulse Breeding Australia Field Peas aims to improve the reliability and adaptation of field peas in medium and low rainfall areas of Australia. These regions are dominated by large areas prone to periods of moisture stress and water deficit; hence a major breeding priority of the program is drought tolerance.

Currently PBA has no effective way of breeding for drought tolerance and relies on selecting varieties that perform well in breeding trials such as the one conducted annually at Minnipa. This method has made some improvements through varieties such as PBA Gunyah and PBA Twilight, however progress has been slow and the traits responsible for improved yield in these varieties are not well understood. Improvement of yield under stress can be achieved by direct selection for yield, or targeting adaptive traits, or a combination of both. In this project, we will focus on secondary adaptive traits – their value, how to measure them and how to implement them into the breeding program.

How was it done?

30 field pea accessions were sown – representing a range of flowering times, duration, maturity timings, pod number, pod size, leaf type and other plant characteristics.

Accessions sown in 2010 across 4 different sites that differed in average rainfall.

Minnipa (1 June), Mallala (8 and 22 June), Roseworthy (8 June) and Turretfield (15 June). These sites were chosen for their rainfall gradient with Minnipa being at the dry end of the scale and Turretfield the wettest. We also had two times of sowing at Mallala to increase the effects of terminal moisture stress.

Sowing density of 50 plants/m^2 (seed treated with PPT and Apron®).

80 kg/ha MAP was applied with seed.

Herbicide was a post-sowing pre-emergent application of metribuzin and then a group A grass spray pre flowering.

Insecticides applied were endosulphan at sowing, Karate® at flowering and fortnightly until the completion of pod fill.

Fungicides applied were chlorothalonil fortnightly 6-8 weeks after sowing in line with rain fronts.

Measurements taken

Plant development – timing of first and last flower, beginning of seed fill and pod set

Canopy traits – temperature, chlorophyll content, density, NDVI

Yield and yield components – harvest index, pods per plant, seed per plant, seed per pod

Senteck moisture probe was employed to measure soil moisture content in selected varieties. This is aimed at characterising the water balance of the different environments.

What happened?

Yield was affected, as expected, by location, variety and variety x location interaction, although the location effect was smaller than predicted due to the favourable season at all sites.

The differences between the environments are shown in Table 1.

The differences in performance of field pea varieties in different environments are illustrated in Figure 2.

We are currently analysing the results from the plant and yield component measurements to identify links between consistently high yielding varieties and plant and crop traits.

Table 1 Mean, minimum and maximum yield (kg/ha) of field peas in 2010

Environment	Mean	Standard Error	Minimum	Maximum
Mallala early sowing	3009	32.6	1641	3911
Mallala late sowing	3014	29.7	1759	3816
Minnipa	2501	26.3	1204	4232
Roseworthy	2763	34.8	1765	3985
Turretfield	3039	39.8	1439	4125
Accross all environments	2876	16.5	1204	4232

What does this mean?

By measuring the phenology, canopy traits and yield of field peas in a broad range of environments we aim to determine which common adaptive traits enhance crop's ability to produce reliable yield in dry environments whilst maintaining yield in good environments.

Once identified, these traits could be utilised by PBA field peas for enhanced pea varieties.

Once practical phenotyping techniques are established and tested, they can potentially be applied to other major Australian pulse species.

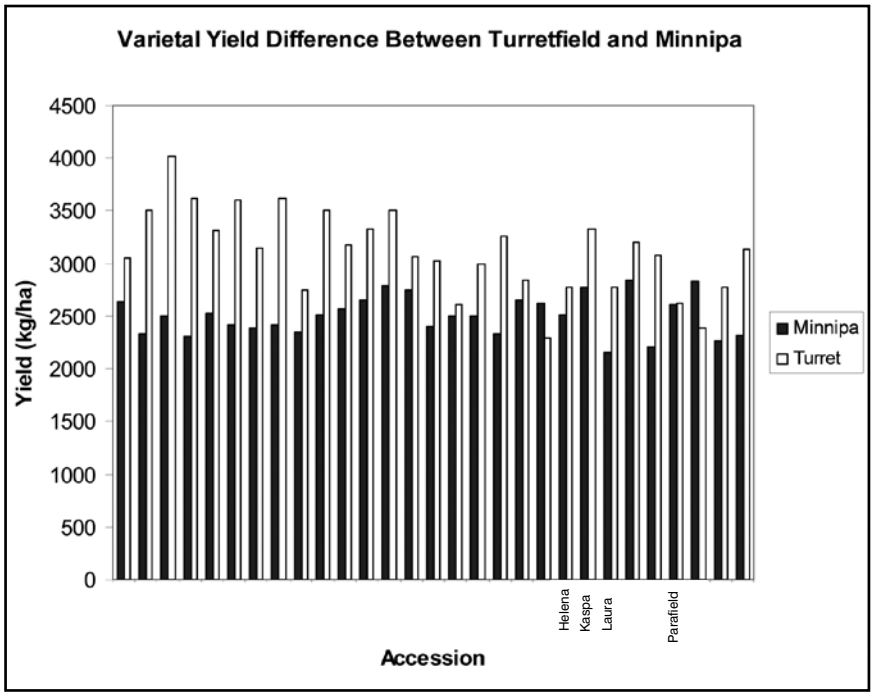

Figure 2 Difference in varietal yield between environments

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