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Evaluation of new soybean varieties for the Macquarie Valley – Trangie Agricultural Research Centre, 2013–2016

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Key findings

- Soybean yield potential ranged from a low of 1.01 t/ha up to a high of 2.94 t/ha in two years of harvested irrigated variety evaluation experiments at Trangie in the Macquarie Valley.
- Delayed sowing of a soybean crop in the Macquarie Valley can increase the likelihood of delayed maturity, potentially running into prolonged periods of wet autumn weather at harvest time; the 2015–16 experiment was not able to be harvested for this reason.
- Moonbi$^{\phi}$ (released 2010) is the recommended variety for Macquarie Valley soybean growers under fully irrigated conditions. It has high yield potential, maturity adaptation, excellent grain quality to meet human consumption markets, and resistance to powdery mildew.
- Djakal (southern NSW variety) is recommended for partial irrigation or dryland situations. Its earlier maturity and lodging resistance due to shorter height and reduced biomass enables it to achieve high yields and human consumption quality under less favourable growing conditions.

Introduction

The Northern Pulse Agronomy Initiative (NPAI) was established as a joint project between NSW DPI and GRDC in 2013. A key outcome from this project is to develop management packages that lead to greater adoption, productivity and profitability of both winter and summer pulses in the northern grains region of NSW. Identifying and understanding the constraints that limit potential productivity will lead to more reliable pulse crops, allowing seasonal yield potential and quality characteristics to be achieved.

Soybean is a versatile summer-growing rotation crop with dual benefits: being a legume plant that can contribute nitrogen to the soil profile; and also producing an oilseed grain crop. It has a longer growing season than mungbean and is traditionally grown in rotation with either winter cereals (double-cropped) or summer cereals (sorghum and maize).

Soybean crops are particularly profitable where the quality standards for human consumption markets are attained. Developing improved Australian varieties with better grain quality has led to improved profitability of soybean as a stand-alone crop, in addition to its rotational benefits as a pulse crop. However, production in the Macquarie Valley region (central west NSW) is limited by competition from other summer crops (particularly cotton) and a lack of current knowledge regarding best management practice for new varieties.

Through the support of the NPAI project, NSW DPI conducted soybean variety evaluation experiments (in collaboration with more variety-specific agronomy experiments) at Trangie Agricultural Research Centre (Trangie ARC) for three consecutive summer seasons (2013–14, 2014–15 and 2015–16), to assess if new soybean varieties for the Macquarie Valley under irrigated conditions were a suitable option for growers.

Soybean seed for these experiments was sourced from two separate NSW DPI breeding and evaluation programs. The northern program (based at Grafton) selects lines suited to the North Coast, Northern Tablelands and northern inland regions of NSW. Released lines include Moonbi$^{\phi}$, Richmond$^{\phi}$ and Hayman$^{\phi}$: these round-leaf varieties tend to have a more vigorous growth pattern and longer maturity. The southern program (based at Yanco) selects lines more suited to southern NSW regions, particularly the Riverina and Lachlan Valley irrigation regions. Released lines include Djakal, Snowy$^{\phi}$ and Bidgee$^{\phi}$. Characteristics include a more oval-shaped leaf, shorter plant height, reduced biomass and much quicker maturity when compared with northern lines.

Varieties from both programs tend to display different adaptation patterns (such as flowering, biomass, height, and maturity) when grown in the central NSW Macquarie Valley region. All recently released varieties target human consumption markets.

Site details

Location	All three experiments were conducted at Trangie ARC.
Soil type	Grey vertosol.
Irrigation	Full flood irrigation schedules, including pre-irrigation before planting and in-crop irrigation as required during the growing season.
Row spacing	These experiments were all planted on standard row spacing of 33 cm.
Plant population	Sowing rates were adjusted for each variety's individual seed size to achieve a consistent plant density of 40 plants/m^2 for all varieties.
Trial design	Randomised complete block design with three replications.

Treatments

Table 1. Soybean trial treatment list 2013 -2016.

Treatment	2013–14 season	2014–15 season	2015–16 season
Variety	12 varieties: Bidgee Cowrie Djakal M056-9 Moonbi N005A-29 N005A-80 P168-5 P176-14 Richmond Snowy Soya 791	14 varieties: Bidgee Bowrie Djakal M094-15 Moonbi N116C-3 N258A-4 N005A-80 P168-9 P176-1 P176-14 P176-2 Snowy T176A-4	18 varieties: Bidgee Bowyer Djakal M094-15 Moonbi N005A-80 P176-1 P176-14 P176-2 P213-41 P213-44 Snowy T171C-3 T171C-4 T176A-4 T257C-1 T257C-32 T257C-6
Sowing date	25 Nov 2013	16 Dec 2014	16 Dec 2015
Harvest date (days after sowing – DAS)	9 April 2014 (135 DAS)	6 May 2015 (141 DAS)	not harvested due to wet weather for six weeks

Results

2013–14 season

- The mean yield in 2013–14 was 1.58 t/ha (1.01–2.06 t/ha).
- Moonbi$^{\phi}$ (northern line released 2010) was the highest yielding variety (2.06 t/ha) but was not significantly different from Djakal (southern industry standard) or two experimental lines P168-5 and P176-14.
- Richmond$^{\phi}$ (northern line released 2013) was significantly lower yielding than Moonbi$^{\phi}$ and was found to be too late in maturity for the Macquarie Valley region; this variety was subsequently not evaluated in the next two season's experiments.
- Snowy$^{\phi}$ and Bidgee$^{\phi}$ (named southern varieties) were both significantly lower yielding than the southern industry standard variety Djakal.
- Cowrie and Soya 791 were included as traditional Macquarie Valley standards. Cowrie was outclassed by both Moonbi and Djakal, while Soya 791 was not harvested due to extremely late maturity and hence was also not included in the next two season's experiments.
- The mean seed size (measured as 100-seed weight) was 14.25 g (11.44–16.31 g).

- In this experiment, all the experimental lines showed significant improvement in seed size compared with most of the released (named) varieties.
- The grain quality attributes, including oil and protein content, were assessed by commercial laboratory techniques for this experiment (data not included).

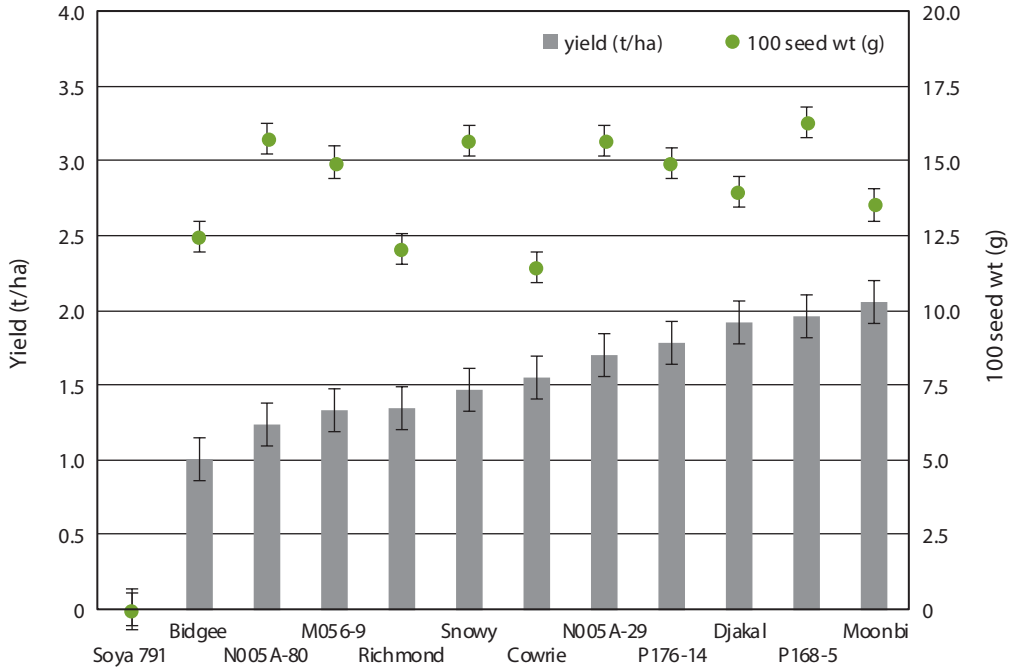

Figure 1. Grain yield (t/ha) and 100-seed weight (g) for 12 varieties of soybean at Trangie ARC, 2013–2014 season. l.s.d. yield ($P<0.001$) = 0.29 t/ha; l.s.d. 100-SW ($P<0.001$) = 1.06 g.

2014–15 season

- The mean yield in 2014–15 was 1.93 t/ha (1.23–2.94 t/ha).
- Moonbi$^{\phi}$ (2.94 t/ha) was significantly higher yielding than 12 of the other 13 varieties, the exception being one experimental line M094-15 from the northern breeding program, which was not evaluated in the previous season.
- While Snowy$^{\phi}$ and Djakal were not significantly different for yield in this experiment, Bidgee$^{\phi}$ was significantly lower yielding than 12 other varieties including Snowy$^{\phi}$ and Djakal.
- Bowyer was included as a superseded variety from southern NSW, now outclassed due to lower yield potential and lower human consumption quality.
- The mean seed size (measured as 100-seed weight) was 19.80 g (16.54–26.71 g).
- In this experiment, seed size was considerably larger compared with the previous season's results.
- T176A-4 (an experimental line from northern breeding program) had significantly larger seed size than all other 13 varieties.
- Flowering dates were recorded for the 2014–15 experiment. For southern varieties F50% dates were Bidgee$^{\phi}$ – 22 January (37 DAS), Snowy$^{\phi}$ – 25 January (40 DAS), and Djakal – 26 January (41 DAS); the northern variety Moonbi$^{\phi}$ was at F50% on 5 February (51 DAS).
- Peak biomass was measured by quadrant cuts on 30 March (37 days pre-harvest) with a mean biomass of 2700 kg/ha for all varieties. Moonbi$^{\phi}$ had the highest mean biomass of all varieties (4100 kg/ha), but otherwise in this experiment there was a very poor correlation (data not shown) between peak biomass and harvested yield.
- The grain quality attributes, including oil and protein content, were assessed by commercial laboratory techniques for this experiment (data not included).

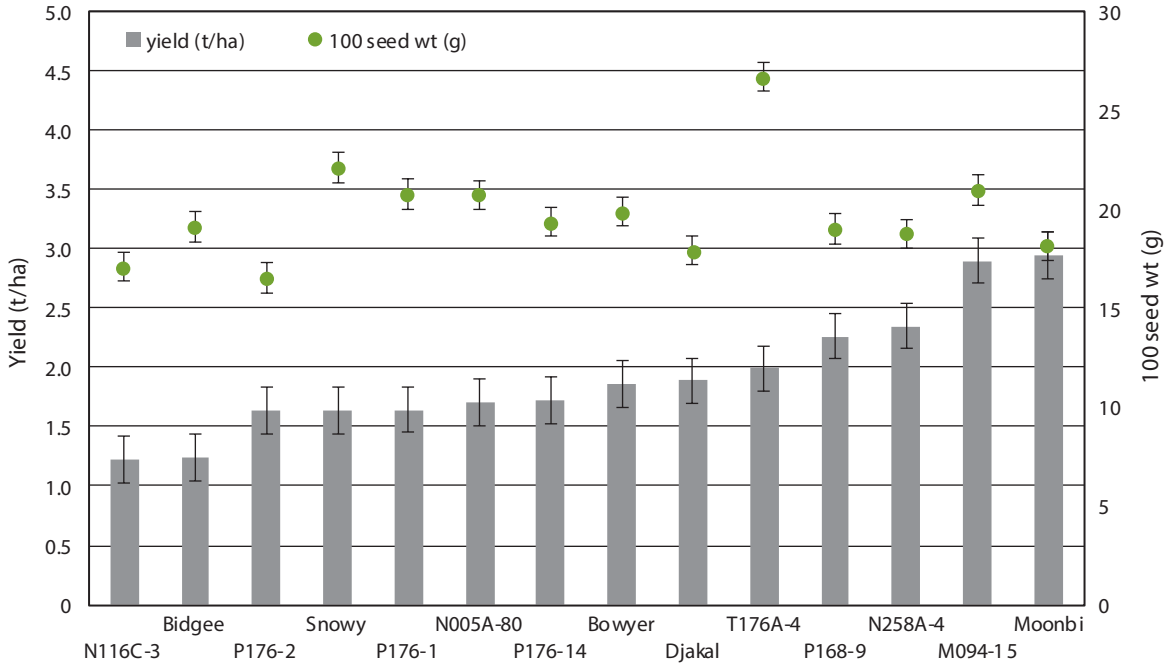

Figure 2. Grain yield (t/ha) and 100-seed weight (g) for 14 varieties of soybean at Trangie ARC, 2014–2015 season. l.s.d. yield (P<0.001) = 0.39 t/ha; l.s.d. 100-SW (P<0.001) = 1.48 g

2015–16 season

- This experiment was not harvested, however, F50 flowering dates, P95 (physiological maturity) dates and seed size data were recorded.
- Varieties from the southern-based program (Bidgee[Φ], Snowy[Φ] and Djakal) were at F50% flowering on or about 1 February (47 DAS), whereas varieties from the northern-based program (Moonbi[Φ] and other northern experimental lines) were at F50% flowering on or about 10 February (56 DAS).
- The southern lines started to mature (based on P95 data) from 11 April to 22 April, whereas the northern lines succumbed to wet weather before reaching P95 (physiological maturity) on about 25 May.
- The grain samples were collected from pods in the field to assess seed size. Mean seed size (measured as 100-seed weight) was 20.37 g (17.69–23.19 g), but in this experiment no single variety was largely different in seed size; T176A-4 was at the lower end of the range in contrast to the previous season's results (data not shown).
- The other grain quality attributes (oil and protein content) were not able to be assessed for this experiment.
- Heavy rain at the end of April and early–mid May 2016 caused significant seed loss due to shattering in the almost-mature southern lines, and failure to mature in the northern lines. The experiment was abandoned as un-harvestable following 75 mm rain on 1–7 June 2016.
- This experiment (despite not being harvested) confirmed district field crop observations that an earlier sowing date (on or about 1 December) is preferable to avoid wet weather at harvest if longer season lines, such as Moonbi[Φ], are to achieve their expected higher yield potential in the Macquarie Valley.

Conclusions

- Under fully irrigated conditions on a grey vertosol in the Macquarie Valley, soybean yield potential ranged from a low of 1.01 t/ha up to a high of 2.94 t/ha across two years of harvested variety evaluation experiments (third season not harvested).
- Under full irrigation scheduling (100% allocation) in the Macquarie Valley, Moonbi[Φ] (released 2010) is recommended as the preferred soybean variety for high yield potential, maturity adaptation, excellent grain quality to meet human consumption markets, and

resistance to powdery mildew if maturity is delayed until late autumn. Early season sowing (on or about 1 December) is recommended for this variety to achieve its yield potential.

- Under partial irrigation scheduling (reduced allocations), later sowing window opportunities or for dryland situations, the Djakal soybean variety would be more suited with consistent high yields, earlier maturity, lodging resistance due to shorter height and reduced biomass, and an ability to achieve human consumption quality under less favourable growing conditions.
- In the Macquarie Valley region, delayed sowing of a soybean crop can increase the likelihood of delayed maturity running into prolonged periods of wet autumn weather at harvest time – the 2015–16 experiment could not be harvested for this reason.

Acknowledgements

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