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Published by NSW Department of Primary Industries,
a part of the Department of Regional New South Wales.

Soybean response to planting with Precision planter and cone seeder – Liverpool Plains 2013–14

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Introduction

The Northern Grains Region is characterised by zero till farming systems that include both summer and winter grain crops. Rapid, even crop establishment is a fundamental management objective in crop production. To achieve this, accurate seed placement is necessary. Investment in planting equipment is one of the largest expenditures a farm operation makes; hence selecting the best seeder is imperative.

The objective of this experiment is to compare two planter types, a small plot cone seeder with narrow tynes to simulate an airseeder and a Monosem disc precision planter. This experiment compared the effects of the two planters on crop establishment and the overall performance of Moonbi(ф) soybeans sown at 5 targeted populations.

Site details

Location:	**NSW DPI Liverpool Plains Field Station, Breeza**
Crop:	**Soybean**
Variety:	**Moonbi(ф)**
Planting date:	**11 December 2013**
Fertiliser:	**110 kg/ha Granulock Zn**
Row spacing:	**90 cm (on 1.8 m beds)**
Soil type:	**Black vertosol**
Irrigation:	**14 November 2013 (pre-water), 8 January 2014, 23 January 2014, 4 February 2014, 14 February 2014**
Harvest date:	**30 May 2014 (167 DAS)**

Key findings

There was a significant difference in the type of planter on soybean crop establishment ($p < 0.05$ L.S.D. 4.22), the Monosem disc seeder averaged 13 plants/m^2 and the cone seeder with the tyne assembly averaging almost double – 25.4 plants/m^2.

Sown on 90 cm row spacing, as target × populations increased, the percentage of seed that established progressively declined: achieving 95% establishment at the target population of 10 plants/m^2 to 55% of seed (or 27 plants/m^2) where 50 plants/m^2 were targeted.

Soybean yield was significantly impacted by the type of planter. Overall yield sown with the tyne planter was 2.54 t/ha, the disc planter averaging 2.12 t/ha ($p < 0.05$ L.S.D. 0.14). These differences are largely attributed to the interaction between planter and population, which was not statistically significant.

Crop population impacted significantly on yield. Highest yields were recorded where populations achieved by the tyne planter averaged 23, 31 and 35 plants/m^2. Yields were 2.64, 2.73 and 2.87 t/ha respectively ($p < 0.05$ L.S.D. 0.27).

Planting equipment and crop populations had no significant effect on soybean seed quality characteristics like seed size, oil or protein content.

***Table 1**. Starting soil nutrition: Breeza 2013–14*

Depth (cm)	Nitrate (mg/kg)	Colwell P (mg/kg)	BSES Phosphorus	Sulphur (mg/kg)	Organic carbon (%)	pH Level ($CaCl_2$)
0–10	13	26	717.04	5.5	1.0	7.9
10–30	9	16	711.45	10.8	0.79	7.9
30–60	7	11	-	8.1	0.64	8.0
60–90	5	18	-	9.6	0.53	8.1
90–120	6	25	-	9.3	0.44	8.2

Comments:

A fall of 10 mm rain was recorded at the site the day before planting, No further rainfall was received before irrigation on 8 January. Daily soil temperatures at 10 cm depth reached maximums exceeding 30 °C in the 16 days after planting, peaking at 38.9 °C. Seed viability was tested prior to planting, measuring 83% germination. The remaining 20% of the seed comprised 2% dead seed, 2% hard seed and 16% abnormal seeds that produced broken and split cotyledons and stunted roots. Seeding rates were calculated using this information.

Irrigations were applied, maintaining non-limiting PAW throughout the vegetative and reproductive growth phases of the crop.

Based on observations in other experiments sown on the same day, Moonbi(ɔ) began to flower around 28 January (52 DAS), 5 days after irrigation. The first 2 weeks of flowering saw daily temperatures reaching maximums of around the mid 30s with 4 days reaching 37 °C. Crop available soil water was maintained with irrigation applied every 10–14 days throughout flowering, pod development and pod fill. Early pod development coincided with daily maximum temperatures steadily declining from the low 30s to mid- to late 20s. By 11 March (94 DAS) plants had reached growth stage R6 where seeds had reached full size within the pod and were now filling as protein and oil were being accumulated.

***Table 2**. Site rainfall (mm) 2013–14*

December	January	February	March	April	Total
28 (5)	0	56 (4)	163 (9)	19 (3)	**119.3**

*[1]In-crop rainfall: 142 mm * Number of wet days in brackets*

[1]NOTE: In-crop rainfall refers to the sum of rainfall events from planting date to physiological maturity.

***Table 3**. Site temperature (°C)*

	December	January	February	March	April
Minimum	4.6	13	12.2	9.9	2.3
Minimum (mean)	*15.8*	*17.5*	*17*	*15*	*11.5*
Maximum	41.3	45.2	37.5	32	31.1
Maximum (mean)	*33.7*	*34.7*	*32.1*	*28.5*	*26.3*
Overall mean	26.7	26.1	24.6	21.8	18.9

Treatments

- Crop: Soybeans
- Variety: Moonbi[Φ]
- Planters: 1. Cone seeder – tyne assembly, 90 cm row spacing
  2. Monosem Precision disc planter – sown in a twin row configuration at 90 cm and 75 cm spacings; being 7.5 cm apart.
- Target crop populations: 10 plants/m^2, 20 plants/m^2, 30 plants/m^2, 40 plants/m^2, 50 plants/m^2

Results

Establishment

- Crop establishment was measured 34 days after sowing. The width of the raised beds from centre-to-centre was 1.8 m. Consequently with the tyne seeder set at 90 cm row spacings and the outside of the twin row of the Monosem precision planter, this created very little margin for error for seed placement into seedbed conditions for rapid germination and emergence. Consequently emergence was uneven where seed placement was on the margins of the bed that collapsed or slumped.
- There was a significant difference in the type of planter on crop establishment (p *<0.05* L.S.D. 4.22), the Monosem disc seeder averaged 13 plants/m^2 and the cone seeder with the tyne assembly averaging almost double – 25.4 plants/m^2 (Figure 1)
- Overall, crop establishment sown with the tyne planter was generally higher than establishment with the disc planter, but high variability within plots resulted in statistically no significant difference.
- There was a significant interaction between target populations and crop establishment (Table 4). The percentage of seed that successfully grew progressively declined with higher target populations, only 55% of seed or 27 plants/m^2 where 50 plants/m^2 were targeted.

***Table 4**. Comparison of soybean establishment and target populations at Breeza in 2013.*

Target plant population (/m^2)	10 plants	20 plants	30 plants	40 plants	50 plants
Site mean (plants/m^2)	9.5	17.3	18.4	23.4	27.4
Site mean as % of target population	95	87	61	59	55
L.S.D. (P <0.05)	7.45				

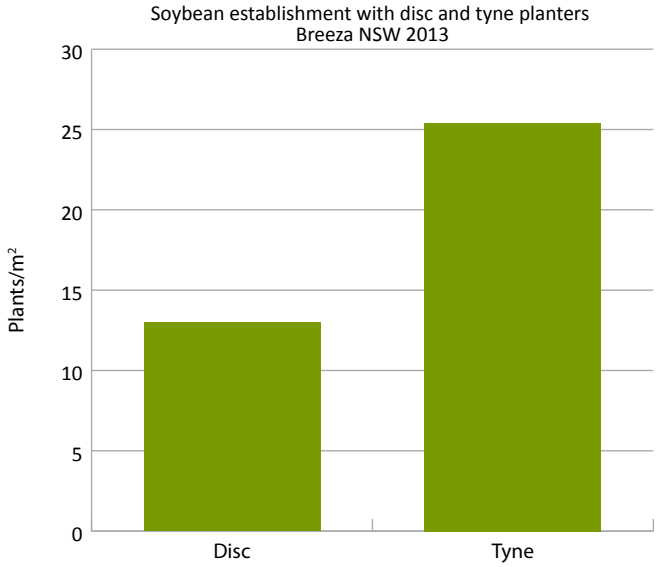

***Figure 1**. Comparison of planters on soybean establishment at Breeza in 2013*

Yield

- The type of planter had no significant impacts on soybean yield. Overall crop yield sown with the tyne planter was 2.54 t/ha. This is 8% above the overall site average yield. The average soybean yield sown with the disc planter was 2.12 t/ha ($p < 0.05$ L.S.D. 0.14), equivalent to 91% of the overall site yield. However, these differences are likely due to the interaction between planter and population, which was not statistically significant.
- Crop population impacted significantly on yield (Table 5). Highest yields were recorded with the target populations of 30, 40 and 50 plants/m^2. Yields were 2.50, 2.52 and 2.61 t/ha respectively ($p < 0.05$ L.S.D. 0.27) (Table 5). The 10 and 20 plants/m^2 treatments yielded significantly less.
- The interaction between planter type and population was not significant (Figure 2) with similar yields achieved by both planters at each target population.

***Table 5**. Effect of plant population on soybean yield across planter type at Breeza in 2013.*

Population (population /m^2)	10 plants	20 plants	30 plants	40 plants	50 plants
Yield (t/ha)	1.81c	2.21b	2.50a	2.52a	2.61a
L.S.D. (*P<0.05*)	0.27				

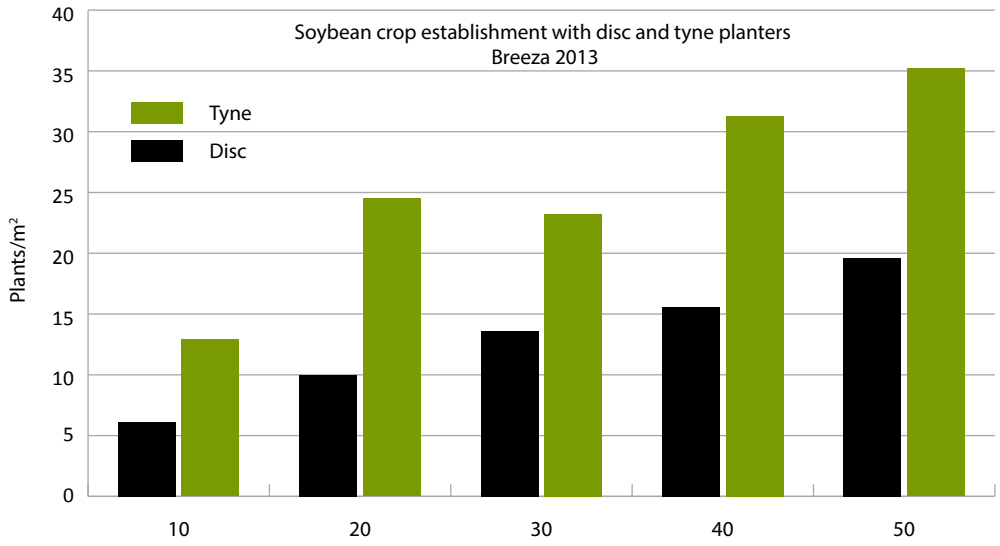

***Figure 2**. Comparison of planters on soybean yield at Breeza in 2013*

Seed size

- There was no significant effect on seed size of either type of planter alone or planter type × crop population interactions. Overall trial mean was 23.55 g/100 seeds.

Oil

- There was no significant effect on oil content of either type of planter alone or planter type × population interactions. Overall trial mean was 20.6%.

Protein

- There was no significant effect on protein content of either type of planter alone or planter type × population interactions. Overall trial mean was 41.28%.

Summary

Seed placement in this experiment was adversely affected by the uneven edges of the raised beds. The often poor seed:soil contact was further exacerbated by high soil and air temperatures in the days following planting that is known to be detrimental to the embryo and early germination process. While plant population and planter type had significant impacts on yield, there was no interaction between the two.

Acknowledgements

Project funding by NSW DPI and GRDC under the Northern Pulse Agronomy Initiative Project (DAN00171).

Experimental design: Steven Harden.

Technical support: Joe Morphew, Scott Goodworth, Steve Gengis, Rosie Holcombe, Jim Murphy, Joel Hargreaves and Dave Eglington.

Quality testing conducted by Futari Grain Technology Services – Narrabri.