Optimising plant establishment – seeder comparison: precision planter & conventional seeder in canola and lentils

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Key findings

- Lower plant establishment numbers were observed from the precision planter compared to the conventional seeder. However, this did not result in a yield penalty.
- In general, the precision planter was able to reduce the variation in distance between plants compared to the conventional seeder.
- The precision planter was able to maintain, and in some cases improve, grain yields in lentils and canola.

Why do the trial?

Currently there is little information on plant establishment from new and existing seeder types in winter crops across Australia. Crop patchiness and variability is commonly observed in paddocks and can be attributed to both seeding conditions (e.g. soil temperature, moisture, pest pressure) and seeder setup (e.g. seeding depth).

Emerging plants compete against each other for resources to grow. The competitiveness of a plant is determined by a number of factors including seed vigour, proximity to neighbouring seeds/plants and the speed to germination and full emergence. Uniformity in seed placement could be beneficial to crop emergence and yield by reducing competitiveness between plants whilst retaining high plant densities and improving canopy architecture. This uniformity could be achieved by using a precision planter (seed singulation) at seeding time.

There is limited research into the use of precision planters in Australian winter crops, such as wheat, canola, lentils and faba beans. Benefits of using a precision planter could include seed input/cost reductions and increased yield.

This research has been funded by GRDC and will span over four years, beginning in 2018. It aims to investigate our current seeding systems and review if precision planters have a fit in the southern and western winter grain growing regions of Australia. Before recommendations can be made we need to understand the variation in crop establishment across various seeder types, and if this variation has an impact on grain yield and quality.

How was it done?

Plot size	1.37 m or 1.52 m x 12 m	**Fertiliser**	DAP @ 60 kg/ha at seeding
Row spacing	Narrow = 22.9 cm (9”)		UAN (42:0) @ 95 L/ha on 5th July – canola only
	Wide = 30.5 cm (12”)		UAN (42:0) @ 55 L/ha on 2nd August - canola only
Seeding date	10th May 2018 (17th May for wide precision planter)		

Two crop types we evaluated; 44Y89 (CL) canola and PBA Hurricane XT lentil. Each trial was a split-plot randomised design, blocked by seeder type (conventional tyne seeder and a disc precision planter) and row spacing (narrow 9" (22.9 cm) and wide 12" (30.5 cm)). The two trials were sown at six different seeding rates outlined in Table 1. The trial was sown on the 10th May 2018, except for the precision planter wide treatment which was sown on the 17th May 2018 due to rainfall and technical issues.

All plots were assessed for plant establishment number, distance between plants, seedling depth, biomass and harvest index during the season. Grain yield and quality was assessed at harvest. Statistical analysis was performed on the data in Genstat using ANOVA.

Table 1. Seeding rate, target plant densities and actual plant number measured in the field (averaged across seeders and row spacing).

	Canola			Lentils		
Plant density	Seeding rate kg/ha	Target plants/m^2	Actual plant number/m^2	Seeding rate kg/ha	Target plants/m^2	Actual plant number/m^2
1	0.7	15	14	14	40	36
2	1.1	25	18	20	60	48
3	1.6	35	24	27	80	78
4	2.0	45	38	34	100	95
5	2.5	55	43	40	120	116
6	2.9	65	47	47	140	124

Canola plant establishment

Results and discussion

Plant establishment was greater for canola sown with a conventional seeder compared to the precision planter (Figure 1). Across all seeding rates, the conventional seeder averaged 35 plants/m^2 compared to 26 plants/m^2 in the precision planter. The precision planter used in this trial was a double disc opener setup. At seeding time, the disc struggled to penetrate into clay-loam soil, and this may have contributed to the lower plant establishment. A number of skips (missed seeds) and multiples (more than one seed) were observed when emergence counts were measured. Plant establishment did not differ between the two row spacing treatments when sown with the conventional seeder (Figure 1).

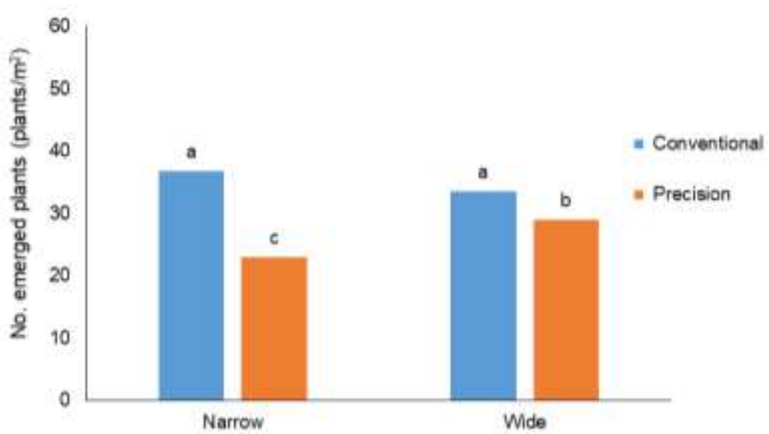

Figure 1. Average number of canola plants emerged (plants/m^2) in both the conventional seeder and precision planter at two different row spacing treatments (narrow – 9" and wide – 12"). (LSD=4 at P≤0.05).

Distance between plants

The distance between plants was greater in canola sown with the precision planter (17.3 cm) compared to the conventional seeder (13.8 cm). Although the distance between plants was greater for the precision planter, it was more consistent (Table 2). This is in contrast to the conventional seeder which often clumped three of four plants close together.

Table 2. The average distance between plants (cm) and variation (CV%) in both the conventional seeder and precision planter plots in the canola trial. (LSD= 1.75 at P≤0.05).

	Average (cm)	CV (%)
Conventional	13.8	108
Precision	17.3	88

Grain yield

There was no overall difference in canola grain yield between the two seeders averaging 1.39 t/ha (precision planter) and 1.33 t/ha (conventional). The narrower row spacing (9”) contained a small yield advantage over the wide (12”) row spacing (Table 3). This first year of data has shown the precision planter was able to maintain canola grain yield similar to the conventional seeder.

While there was no interaction between seeder type and plant density, grain yield did vary between plant densities (Table 3). A plant density of 38 plants/m^2 (equivalent to 2 kg/ha seeding rate) was required to produce the highest average grain yield at 1.44 t/ha. Reducing the plant establishment number below 38 plants/m^2 resulted in a yield penalty of up to 0.21 t/ha.

Table 3. Canola grain yield for plant establishment, seeder and row spacing treatments at Hart, 2018.

Average establishment (plants/m^2)	Precision		Conventional	
	Wide (12")		Narrow (9")	
14	1.12	1.22	1.32	1.26
18	1.21	1.29	1.50	1.09
24	1.29	1.09	1.54	1.41
38	1.34	1.09	1.56	1.50
43	1.36	1.36	1.56	1.49
47	1.32	1.32	1.57	1.57
LSD(P≤0.05) row spacing = 0.07; average establishment = 0.13				

Lentil plant establishment

Seeder type had a significant effect on lentil plant establishment. The conventional seeder resulted in higher plant establishment compared to the precision planter across three of the target densities (Figure 2). The conventional seeder had an average plant number of 91 plants/m^2, higher than 70 plants/m^2 from the precision planter. The precision planter did not achieve the target plant densities and in general established 20 plants/m^2 less than the target. Soil-seed contact and achieving good seeding depth was an issue for the precision planter at Hart and may have reduced the plant establishment. In 2019 the disc seeder will be used to sow both the precision planter and conventional seeder treatments to remove this difference in seeder setup.

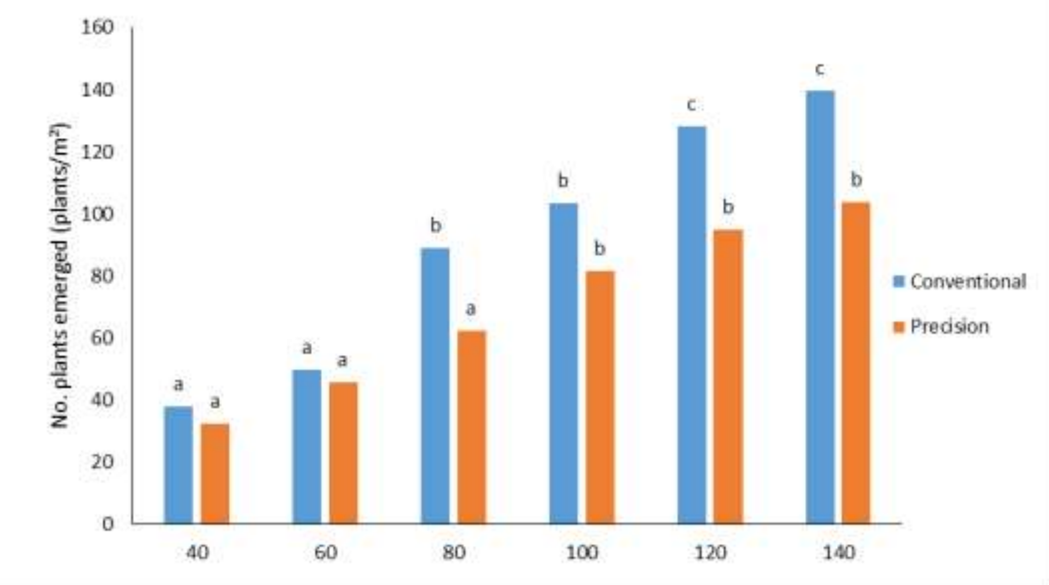

Figure 2. Average number of lentil plants emerged (plants/m^2) across the six different target densities in both the conventional seeder and the precision planter. (LSD=23.7 at P≤0.05).

The precision planter had a higher average distance between plants (6.9 cm) compared to the conventional seeder (Table 4). Similar to canola, the variation in the distance between plants was lower in the precision planter (71%) compared to the conventional seeder (Table 4). A lower variance indicates that, in this trial, the precision planter was able to better singulate lentil seeds to keep a consistent distance between. Photo 1. shows the difference in seed placement between the conventional seeder and the precision planter.

Table 4. The average distance between plants (cm) and variation (CV%) in both the conventional seeder and precision planter plots in the lentil trial. (LSD= 0.65 at P≤0.05).

	Average (cm)	CV (%)
Conventional	5.7	107
Precision	6.9	71

Photo 1. Hurricane lentils sown with a conventional seeder (left) and a precision planter (right). Both sown on narrow row spacing (9") and a target density of 100 plants/m^2.

Lentil grain yield was higher in precision planter plots compared to the conventional seeder (Figure 3). The precision planter averaged 1.4 t/ha, compared to 1.2 t/ha in the conventional seeder. Despite having reduced plant establishment number, there was no yield penalty in the precision planter.

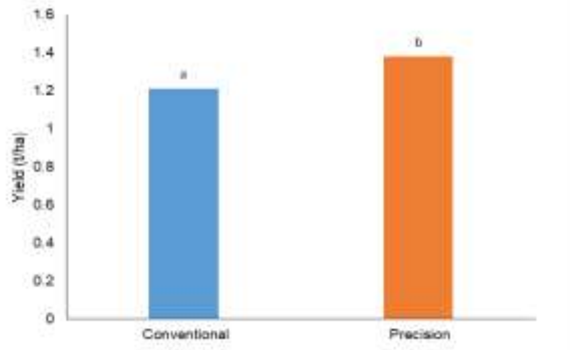

Figure 3. Average lentil yield (t/ha) in both the conventional seeder and precision planter. (LSD=0.1 at P≤0.05).

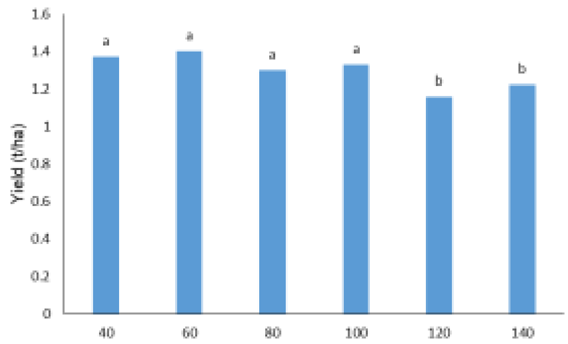

Figure 4. Combined average lentil yield across the six different target densities in both the conventional seeder and the precision planter. (LSD=0.14 at P≤0.05).

Interestingly lentil yields were higher at lower target planting densities. The average yield for plant densities 40 – 100 plants/m^2 ranged from 1.3-1.4 t/ha (Figure 4). Lentil varieties are recommended to be sown at 100 – 120 plants/m^2 (GRDC 2017) however, in this trial sowing at 40 – 100 plants/m^2 maintained the highest yields (Figure 8). With lower plant numbers will come lower competition for resources between the seedlings, reducing competition and potentially leading to increased plant growth and maintain high yields. It should be noted that this trial was managed under low weed and disease pressure.

Summary

In the first year of research we've found:

- Better plant establishment, in both canola and lentil trials, was achieved by sowing with the conventional seeder. In particular the precision planter failed to hit any of the lentil target plant densities due to difficulties with singulation and seed-soil contact.
- The precision planter was able to maintain, and in some cases improve grain yields in lentils and canola.
- Lentil grain yields were maintained at lower than recommended target seeding densities. It should be noted that the trial was managed under low weed and pest pressure and this may not be observed under all paddock conditions.
- In general, the precision planter was able to reduce the variation in the distance between plants compared to the conventional seeder.

Acknowledgements

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References

GRDC, 2017, *GrowNotes Lentil* available from: https://grdc.com.au/resources-and-publications/grownotes/crop-agronomy/lentil-southern-region-grownotes [24 January 2019].