Seeder comparison: can we improve plant establishment and spacing?

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Key findings

- Lentil plant establishment was consistent across all seeders trialed at Condowie. However, at Birchip the precision planters had a higher establishment percentage, but this did not translate to higher grain yield.
- Precision planters were able to space lentil and canola plants more evenly compared to the grower tyne and disc machines.
- Across a variety of seeders, it was found that seeder set up had a greater impact on establishment than seeder age or type. This highlights the importance of checking your seeder setup before seeding.

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 sometimes 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 competiveness of a plant is determined by a number of factors including seed vigour, proximity to neighbouring 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 barley, canola, lentils and faba beans. Benefits of using a precision planter could include reduced seed input/cost and increased yield.

Trials were conducted at Condowie (lentil) and Birchip (canola) using commercial scale airseeders and precision planters.

The trials aimed to compare a number of commercial scale air-seeders and precision planters for plant establishment, early growth, yield and quality.

Lentil demonstration trial, Condowie SA

How was it done?

Plot size	Varied for each seed bar width x 50 m long	**Fertiliser**	MAP (10:22) @ 50 kg/ha or Ammonium polyphosphate APP (15:22) @ 50 L/ha, depending on seeder setup
Seeding date	June 4, 2019		
Crop	Jumbo 2 lentil		
Seeding rate	77 and 154 plants/m^2		

The trial was a randomised complete block design. Four seeders were trialed including two conventional seeders and two precision planters (Table 1). Each seeder sowed two ot three passes in 50 m strips. Apart from the sowing rates and fertiliser rate no other specifications were given for how to sow the trial. Decisions on seeder set up and speed of sowing were made by each operator. Ideally, each seeder was operated under 'optimal' conditions.

No herbicides were applied before sowing to minimise the risk of any interaction with the different seeders. The trial was managed during the season as per the surrounding crop.

The trial was sown into marginal soil moisture. The crop was Jumbo 2 lentil at two target plant densities of 77 and 154 plant/m^2, equivalent to 30 kg/ha and 60 kg/ha. All plots were assessed for plant establishment, interplant distance and grain yield. Grain yield was assessed using a plot harvester which harvested a single 50 m strip from each plot.

Table 1. Seeding systems trialed in lentils at Condowie, SA 2019.

Seeder	Type	Row spacing cm (inches)	Fertiliser placement
Horwood Bagshaw	Knife-point press wheel system	22.2 cm (8.75")	MAP applied at seeding
John Deere 1980	Single disc, closer wheels and press wheels	30.0 cm (12.0")	MAP applied at seeding
Horsch Maestro precision planter	Double disc	30.0 cm (12.0")	Demo machine – MAP was broadcast prior to sowing
Spot On Ag precision planter	Double disc	30.0 cm (12.0")	Demo machine – liquid APP

Results and discussion

Plant establishment and interplant distance

The number of lentil plants established was not affected by seeder type averaging 88% across all seeder treatments (Table 2; Photos 1 and 2). As expected, seeding rate had an effect on plant establishment number. On average 70 plants/m^2 established in the 30 kg/ha rate (91%) and 130 plants/m^2 in the 60 kg/ha seeding rate (84%).

Seeder type also did not affect average interplant distance (the distance between two adjacent seedlings in a row) in this trial. This is not surprising given all seeders were establishing a similar number of plants and therefore when averaged the distance between those plants is likely to be similar. To understand if precision planters were able to improve seed singulation compared to conventional grower equipment the coefficient of variation (CV%) for interplant distance can be used. The CV values indicate how consistently the lentil interplant distance was for each seeder, with lower values indicating less variability.

Photos 1. (L-R) Precision planter 1; 30 kg/ha and 60 kg/ha, Precision planter 2; 30 kg/ha and 60 kg/ha.

Photos 2. (L-R) Grower disc; 30 kg/ha and 60 kg/ha, Grower knife-point; 30 kg/ha and 60 kg/ha.

Both precision planters were able to reduce the variability in interplant distance (Table 2). At the low seeding rate (where precision planters are intended to be used) these values were low at 1.4% and 7.1 % compared with the average of 33% for both grower seeders and seeding rates (Table 2). That is, the precision planters were able to consistently space the seeds (low CV%) compared to the conventional seeders. The only treatment to show similar results was the grower knife-point seeder at the higher seeding rate which was unexpected. At the higher seeding rate, the uniformity of seed placement of the precision planters deteriorated as indicated by the increase in the CV%.

Table 2. Summary of plant establishment (plants/m^2), interplant distance (cm and coefficient of variation) and grain yield (t/ha) for the Hart lentil seeder demonstration trial, 2019. Values in parenthesis for plant establishment are % of the target plants that established.

Seeder	Seeding rate*	Plant establishment plants/m^2	Interplant distance cm	Interplant distance CV%	Grain yield t/ha
Grower knife-point	30 kg/ha	73 (95)	6.8	51.5	0.70
	60 kg/ha	138 (89)	2.4	2.8	0.70
Grower disc	30 kg/ha	69 (89)	5.4	46.0	0.47
	60 kg/ha	125 (81)	2.2	30.7	0.57
Precision planter 1	30 kg/ha	75 (97)	4.2	1.4	0.57
	60 kg/ha	149 (97)	2.3	14.7	0.61
Precision planter 2	30 kg/ha	63 (82)	5.3	7.1	0.40
	60 kg/ha	110 (71)	3.5	11.7	0.44
	Seeding rate	12.2	1.3		ns
	Seeder	ns	ns		0.08
	Seeder x seeding rate	ns	ns		ns

*Seeding rate 30 kg/ha was equivalent to targeting 77 plants/m^2 and 60 kg/ha is equivalent to targeting 154 plants/m^2.

Grain yield

Lentil grain yields ranged from 0.4 – 0.7 t/ha. The highest yielding seeder type was the grower knife-point at 0.70 t/ha (paddock owner). The second highest yields come from precision planter 1 and grower disc averaging 0.59 and 0.52 t/ha, respectively. The lowest yields came from precision planter 2 at 0.42 t/ha.

Canola demonstration trial, Birchip Vic

How was it done?

Plot size	Varied for each seed bar width x 50 m long	**Fertiliser**	MAP (10:22) @ 40 kg/ha or Ammonium polyphosphate APP (15:22) to match depending on seeder setup
Seeding date	April 12, 2019		
Crop	ATR Stingray canola		
Seeding rate	55 and 105 plants/m^2		

A comparison of six commercial seeders was conducted at Birchip. The six seeders included four conventional air seeders and two precision planters (Table 3). Three of the seeders were tyned and three were disc systems.

The trial was sown into a dry seedbed on April 12 at two sowing rate, 3.5 kg/ha (grower practice) and 1.75 kg/ha, using grower retained seed (318,470 seeds/kg). Due to the small seed size this was equivalent to 109 and 55 plants/m$^{2.}$ As a demonstration, one precision planter also sowed canola at 35 plants/m^2 (1.1 kg/ha).

Each seeder sowed two passes of 50 m in a randomised complete block design with three replicates. The seeding depth specified to all operators was 2 cm. Apart from the sowing rates and fertiliser rates no other specifications were given for how to sow the trial. Decisions on seeder set up and speed of sowing were made by each operator, so ideally, each seeder was operated under ‘optimal’ conditions. No herbicides were applied before sowing to minimise the risk of any interaction with seeders. The trial was managed during the season along with the surrounding crop.

Assessments included establishment counts and interplant spacings. Interplant spacings were measured once the canola had fully established and grain yield was measured with a plot header.

Table 3. Seeder information for the six seeders used in the trial at Birchip, 2019.

Seeder	Type	Row spacing (cm)	Fertiliser placement
Flexicoil 820	Tyne	30.5	With seed
Horsch 18NT sprinter	Tyne with coulters	25.0	With seed
Horwood Bagshaw scaribar	Tyne with coulters	37.5	Below seed
Morris RAZR disc	Disc	25.0	Below seed
Precision Planter (Spot on Ag)	Disc precision planter	33.3	Liquid only
Horsch Maestro	Disc precision planter	25.0	Demo machine (fert was broadcast prior to sowing)

Results and discussion

Plant establishment and interplant distance

Canola plant establishment across the trial averaged 63% (range 41 to 93%). Unlike the lentil trial, there were differences in establishment among the seeders (Table 4). The precision planter sowing at 35 plants/m^2 achieved 100% establishment. This highlights that precision seeders have the ability to achieve high establishment at low plant densities.

The precision planters had smaller interplant distance (average 6.8 cm) than the conventional seeders (average 8.2 cm). The CV% of the interplant distance indicates how consistently canola plants were spaced for each seeder. Using precision planters resulted in more evenly spaced canola plants compared to the conventional air seeders: average CV% for the precision planters was 83% and the CV% for the conventional seeder was 91%.

Table 4. Canola plant establishment percent (%) and interplant distance (cm) and grain yield (t/ha) for the six seeders. Different letters indicate significant difference.

Seeder	Target plants/m^2	Plant establishment (plants/m^2)	Establishment (%)	Interplant distance (cm)	Grain yield (t/ha)
Conventional tyne 1	55	40^{bcd}	74	8.8	2.4^{cd}
	109	63^{bc}	58	5.4	2.3^{d}
Conventional disc 1	55	41^{bcd}	75	10.3	3.0^{a}
	109	47^{bcd}	43	5.6	2.9^{ab}
Conventional tyne 2	55	31^{cd}	56	10.2	2.4^{cd}
	109	101^{a}	93	3.6	2.3^{d}
Conventional tyne 3	55	26^{c}	47	14.7	2.4^{cd}
	109	46^{bcd}	42	7.0	2.5^{cd}
Precision planter 1	55	25^{d}	45	10.2	2.5^{cd}
	109	56^{bcd}	51	4.9	2.6^{bc}
Precision planter 2	35	36^{bcd}	103	7.7	2.3^{d}
	55	37^{bcd}	68	8.3	2.3^{d}
	109	67^{b}	61	4.3	2.3^{d}
	LSD	15		1.3	0.3
	CV (%)	18.1	26.3	19.1	6.9

Grain yield

Canola grain yields varied from 2.3 t/ha to 3.0 t /ha. The conventional disc seeder at the low sowing rate had the highest yield (Table 4), 0.4 t/ha higher than the next seeder, a precision planter. The average grain yield of the four conventional seeders was 0.1 t/ha higher than the two precision planters. The disc seeders in the trial yielded 0.2 t/ha more than the tyne seeders. The dry sowing conditions at sowing favoured disc systems this season. Under wet conditions sowing logistics may become more challenging with a disc.

Sowing density did not affect grain yield, averaging 2.5 t/ha for both the 55 plants/m^2 and 109 plants/m^2. The canola sown with the precision planter at 35 plants/m^2 had an establishment percent of 103 per cent and yielded 2.3 t/ha. This result highlights the potential for seed saving costs (particularly if using hybrid seed) while maintain grain yield of the other seeder types.

Implications

Investing time in seeder set up for particular crops can optimise establishment. The trial results indicated good establishment can be achieved using either conventional or precision equipment. There appears to be no strong relationship between plant establishment and final grain yield. This shows plant establishment percentage is not the only factor influencing grain yield. The large range in plant establishment percentage in these trials (particularly for canola) indicates there is room to improve crop establishment.

Acknowledgements

This research was funded by the GRDC as part of the 'Optimising plant establishment, density and spacings to maximise crop yield and profit in the southern and western regions' project (9176134). We would also like to acknowledge each grower or manufacturer who volunteered their time and equipment to conduct these trials.