# Optimising plant establishment – seeder comparison

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**Key findings**

- Plant establishment for canola and lentil was low at Hart this season regardless of seeder type. This was largely due to marginal soil moisture at and after seeding.
- Across multiple sites and seasons the precision planter generally had more uniform interplant distances compared to the conventional seeder.
- The biggest yield gains observed for the precision planter have been at low seeding rates in 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 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 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. 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.

**How was it done?**

| | | | |
|---|---|---|---|
| **Plot size** | 2.0 m x 10 m | **Fertiliser** | APP (15:22) @ 50 L/ha + 4.0 L/ha trace element mix |
| **Row spacing** | Narrow = 22.9 cm (9”)<br>Wide = 30.5 cm (12”) | | Easy N (42.5:0) @ 93 L/ha on June 28 - Canola only |
| **Seeding date** | May 14, 2019 | | |
| **Location** | Hart, SA | | |

Two crop types we evaluated; Hyola 559TT canola and Hurricane XT lentil. Each trial was a split-plot randomised design, blocked by seeder type (conventional and precision planter) and row spacing (narrow-22.9 cm (9”) and wide-30.5 cm (12”)). Both the conventional and precision planter seeder used the same double disc opening system. The only difference was the delivery of the seed where the conventional seeder mimicked an airseeding systems and the precision planter used a vacuum and singulation plates. The two trials were sown at six different seeding rates outlined in Table 1.

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

*Table 1. The six target plant densities (plants/m²) used in both the canola and lentil trials at Hart, 2019.*

| Plant density | Canola plants/m² | Equivalent seeding rate kg/ha | Lentil plants/m² | Equivalent seeding rate kg/ha |
|---|---|---|---|---|
| 1 | 15 | 1.0 | 40 | 15 |
| 2 | 25 | 1.7 | 60 | 23 |
| 3 | 35 | 2.4 | 80 | 31 |
| 4 | 45 | 3.0 | 100 | 38 |
| 5 | 55 | 3.7 | 120 | 46 |
| 6 | 65 | 4.4 | 140 | 53 |

**Results and discussion – Canola**

*Plant establishment and interplant distance*

Seeder type did not affect the number of canola plants which established within the trial. Generally, there was only 1-5 plants/m² difference between the conventional and precision planter (Figure 1). However, both seeding rate and row spacing effected crop establishment. At low seeding rates (less than 25 plant/m²) crop establishment averaged 71%. This dropped to 60% for the higher seeding rates indicating a large portion of seed did not germinate or died back. These canola establishment rates are similar to those reported in the 2018 southern region paddock survey (McDonald 2019). In a separate study conducted at Birchip (Browne and McDonald 2020) canola establishment was higher, averaging 105% and 82% for the conventional and precision planter, respectively. This trial was sown into a moist seedbed and is likely to have contributed to the higher plant establishment compared to Hart.

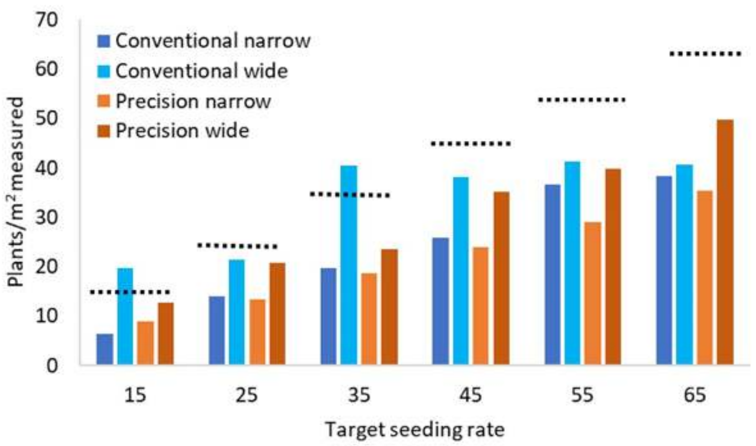



*Figure 1. Average number of canola plants established (plants/m²) across the six different target densities in both the conventional seeder (blue) and precision planter (orange) for wide (12') and narrow (9') row spacings. Dashed black lines represent the target seeding rate. LSD (P≤0.05) seeder = ns, seeding rate = 7 and row spacing = 5.*

The interplant distance coefficient of variation (CV%) indicates how consistently individual canola plants were spaced within crop rows. The interplant distance CV was affected by seeder type this season (data not shown). The conventional seeder had a lower CV of 80.5% compared to the precision planter 90.8%. This result was unexpected as the precision planter should achieve more uniform plant spacing. It is less than the variation measured in canola at Hart in 2018 (Pearse et al 2018) but, these CV% values are high and indicate there was a high degree of variability for both seeders. At seeding time, the disc struggled to penetrate into clay-loam soil and through the previous year's stubble rows (trial was sown perpendicular to oat stubble). This may have contributed to less uniform plant establishment. A number of skips (missed seeds) and multiples (more than one seed) were encountered when emergence counts were assessed.

*Grain yield*

The trial average canola grain yield was 0.6 t/ha. There was no interaction observed among the factors (seeder, row spacing and seeding rate) however, individually there were differences. Establishing at least 25 plants/m$^2$ was required to achieve highest grain yields and after this grain yield plateaued (that is, there was no yield benefit of having more than 25 plants/m$^2$). There was a 0.1 t/ha yield advantage from wide row spacing over narrow. The precision planter yielded 0.1 t/ha higher (a 17% yield difference in a dry season) compared to the conventional seeder.

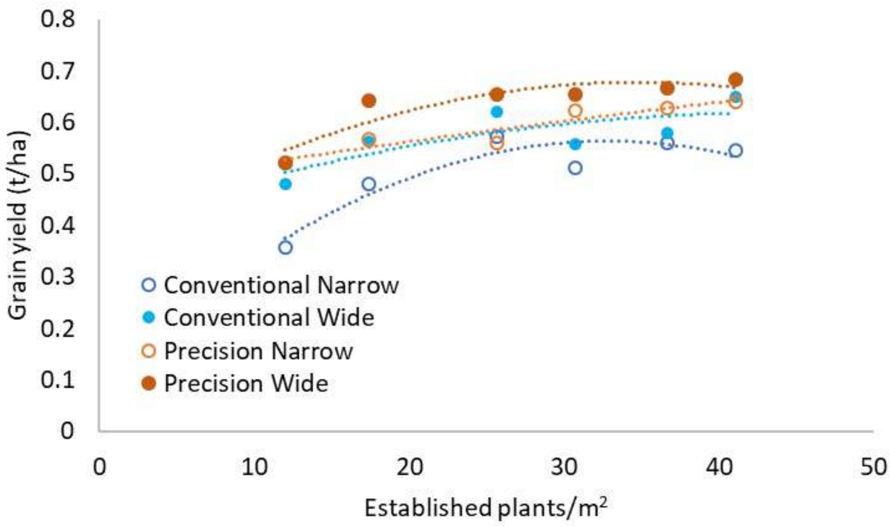



*Figure 2. Average Hyola 559TT canola grain yield for the seeder, row spacing and seeding rate combinations at Hart, 2019. LSD (P≤0.05) seeder 0.04; seeding rate 0.06 and row spacing 0.04.*

**Lentil**

*Plant establishment and interplant distance*

All trial factors seeder, seeding rate and row spacing effected the number of lentil plants which established. While these differences were significant, they were of little consequence in practical terms. For example, the conventional seeder on average had 10 plants/m$^2$ more compared to the precision planter. There were slightly more plants in the wide rows and plant number increased with seeding density. At the 40 plants/m$^2$ seeding rate, establishment percentage peaked at 80%. This dropped to 40 – 50% with increasing seeding which is often measured as sowing rate is increased. This is in contrast to similar research at Birchip where lentil plant establishment was generally greater than 90% across the trial (Browne and McDonald 2020). This also does not reflect observations at Hart in 2018 where lentils were achieving their target densities. Seeding into marginal soil moisture and achieving good soil-seed contact was an issue for both seeder treatments at Hart and may have reduced the plant establishment.

Similar to canola, the CV for lentil interplant distance was affected by seeder type. The precision planter had a lower CV of 70% compared to the conventional seeder 95%. However, similar to the lentils these values are high and indicate there was a large degree of variability for both seeders. In general, the lower CV% indicates the precision planter was able to evenly space lentil seeds to maintain a consistent distance between individual plants. This is in line with previous research which has shown the precision planter can more accurately singulate seed.

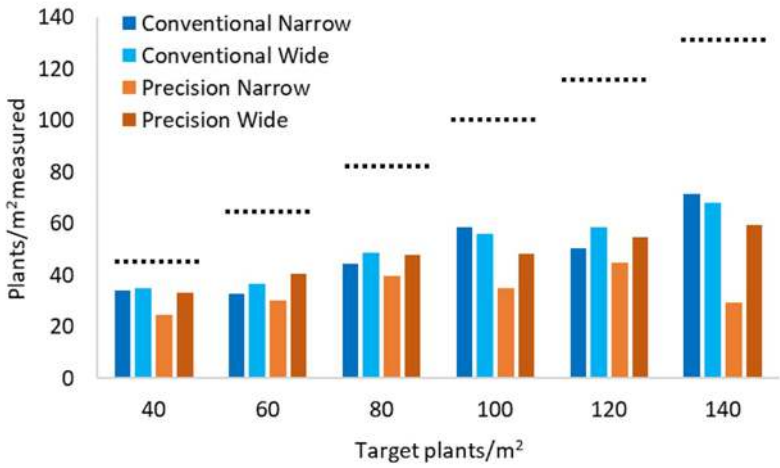



*Figure 3. Average number of Hurricane XT lentil plants established (plants/m$^2$) across the six different target densities in both the conventional seeder (blue) and precision planter (orange) for wide and narrow row spacings. Dashed black lines represent the target seeding rate. LSD (P≤0.05) seeder × row spacing × seeding rate = 11 plants/m$^2$*

*Grain yield*

Lentil grain yields averaged 0.7 t/ha (Figure 4) and were 0.1 t/ha higher for the precision planter compared to the conventional seeder. This was also observed in 2018, where the precision planter averaged 1.4 t/ha, compared to 1.2 t/ha in the conventional seeder. Row spacing also had a small effect with wide row spacing resulting in a 0.1 t/ha higher yield compared to narrow.

Where less than 45 plant/m$^2$ had established there was a reduction in grain yield. There was little effect of increasing target population above 45 plant/m$^2$ this season in yield gain. This result was similar at Hart in 2018. The average yield for plant densities 40 – 100 plants/m$^2$ ranged from 1.3 – 1.4 t/ha. Lentil varieties are recommended to be sown at 100 – 120 plants/m$^2$ (GRDC 2017) however, in two seasons trials establishing more than 40 – 45 plants/m$^2$ maintained the highest yields. 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.

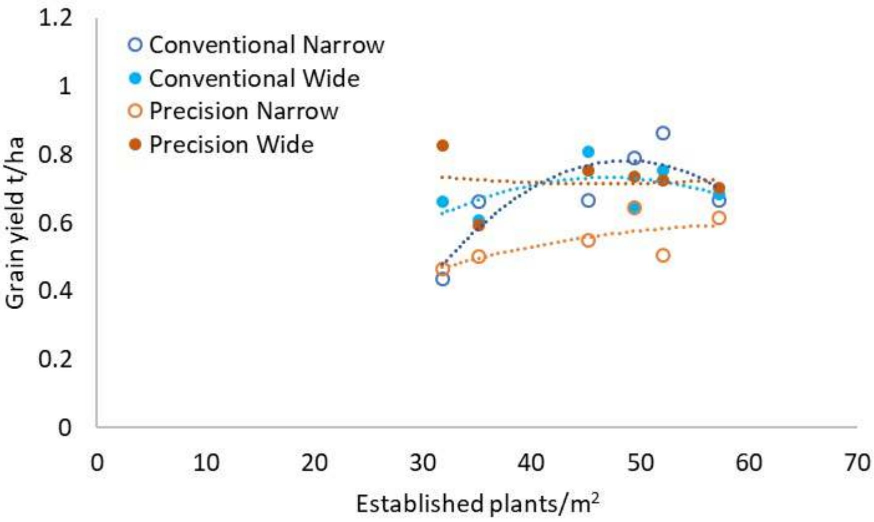
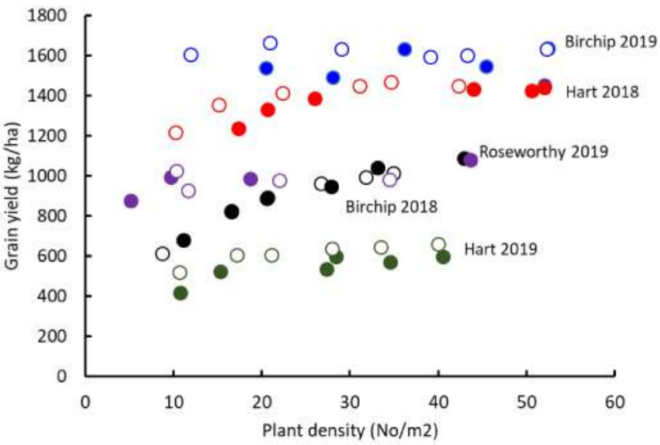



*Figure 4. Average Hurricane XT lentil grain yield for the seeder, row spacing and seeding rate combinations at Hart, 2019. LSD P≤0.05 seeder 0.06 seeding rate 0.10 and row spacing 0.06.*

**Multi-site and season comparison of seeders**

In the last two seasons a precision planter has been compared to a conventional seeder in a range of yield environments (Hart, Brichip and Roseworthy). The biggest gains observed for the precision planter have been at low seeding rates in canola (Figure 5). This is not unexpected, given one of the benefits outlined by growers using precision planters is a reduction in seeding rates due to better singulation / spacing of individual plants. As plant density increased (above 25 – 30 plants/m$^2$) there is a lack of consistent yield improvement but, the precision planter was able to maintain yield of the conventional seeder.

Within the lentil trials there have been two out of four trials where the precision planter resulted in a small yield improvement over the conventional seeder. In the other two trials lentil grain yields were the same. In contrast to canola, there was not a consistent response at low seeding rates. The shape of lentil seed has proven problematic for some of the precision planter seed plates. This is due to previous research and manufacturing focusing on corn, soybean and canola. Poor establishment in some of the lentil trials shows there are improvements to be made to the precision planter to accurately singulate this crop.



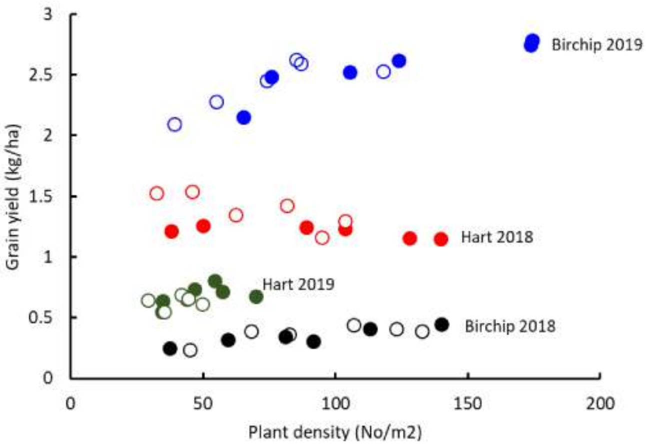




*Figure 5. Grain yield for all precision planter and conventional seeder trials conducted across 2018 and 2019 (left) canola and (right) lentil. Closed symbols = conventional seeder; open symbols = precision planter.*

**Summary**

Some of the key findings from this research so far have been:

- The precision planter was able to maintain and, in some cases, improve grain yields in lentils and canola at low seeding rates.
- Lentil grain yields were maintained at lower than recommended target seeding densities across a range of yield potentials. 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 has been able to reduce the variation in interplant distance compared to the conventional seeder. However, there is still improvement to be made to the precision planter to achieve optimum singulation.

**Acknowledgements**

The authors gratefully acknowledge GRDC for funding this project 'Optimising plant establishment, density and spacings to maximise crop yield and profit in the southern and western regions' (9176134).

**References**

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*Photo: Jade Rose & Sarah Noack; Hart Field-Site Group and Stefan Schmitt; Ag Consulting Co.*