# Precision planting in canola and lentil

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**Abstract**
Recent surveys of canola and lentil crops in the southern and western regions have shown that crop establishment percentage can be low and variable. The speed and evenness of establishment influences interplant competition and sometimes yield. Two experiments were conducted at Hart, South Australia and Birchip, Victoria to test the value of precision planting on crop establishment and yield. Experiments compared a conventional plot seeder and a precision planter over six plant densities and in narrow (23 cm) and wide (30 cm) row spacings. Crop establishment using a precision planter was similar to or worse than that with a conventional seeder. Nevertheless, there was a significant improvement in lentil and canola yields at Hart with precision planting; no differences were evident at Birchip. Canola yield was more sensitive to plant density than lentil. Achieving an adequate plant population in canola (greater than 30-40 plants/m$^2$) was more important to grain yield than in lentil.

**Key Words**
Emergence, crop establishment, crop density

**Introduction**
Crop establishment is an important phase of growth because it influences the level of interplant competition and competitiveness against weeds. A recent survey found establishment in canola and lentil crops in the southern region is often low highly variable (McDonald et al 2019). Early work on interplant competition showed seedlings that emerged first were generally more vigorous and outcompeted later-emerging seedlings. Earlier emergence can lead to higher yields (Soetono and Donald 1980, Gan et al. 1992) and combined with a regular planting arrangement, could reduce interplant competition (Kemp et al. 1983).

Precision planters have the ability to place seeds at precise distances along a row and at uniform seeding depths, which can contribute to rapid and even crop establishment. They are used widely in summer cropping and there is increasing interest in adapting the technology to winter crops, especially in crops such as hybrid canola where seed costs are high and growers are aiming to reduce sowing rates. Experiments in Canada found that canola yields can be improved with precision planting (Yang et al 2014). In Australia, trials with precision planting in lupin and canola in WA (Harries et al 2006, 2016) found sowing rates could be reduced without a yield penalty (canola) or increase yields (lupin). There are few reports of the effects of precision planting on growth and yield of winter crops in southern Australia. This study examined the merits of precision planting in canola and lentil at two sites in South Australia and Victoria.

**Methods**
Experiments were conducted at Birchip, Victoria and at Hart, South Australia to examine the effects of row spacing and plant density on the growth and yield of canola (cv 44Y89$^A$) and lentil (cv PBA Hurricane XT$^A$). The trials compared a tyned conventional seeder, with similar seed distribution to an airseeder and a disc vacuum-meter precision planter. The trials were a factorial of seeder type (2), row spacing (2) and plant density (6). The design was a split-plot, randomised complete block with 4 replicates. Each whole plot was a factorial arrangement of seeder type and row spacing, and plant density was the subplot. Row spacings were 23 cm and 30 cm and the sowing rates were designed to establish 15, 25, 35, 45, 55 and 65 plants/m$^2$ in canola and 40, 60, 80, 100, 120 and 140 plants/m$^2$ in lentil. Weeds were controlled by herbicides recommended for canola and lentil applied at the recommended times and rates. Weeds were controlled and weed competition was not a factor in the results. The same canola and lentil seed was used at both sites. Both trials were sown in the same week (10 – 17 May, 2018). Fertiliser (60 kg/ha DAP (18:20)) was spread prior to sowing and incorporated by the seeder. Crop emergence was measured regularly from two, 3-m lengths of row in each plot and biomass was assessed from quadrat samples at peak flowering. The whole plot was harvested for grain yield after the ends were trimmed.

## Results and discussion

*Seasonal rainfall*

Growing season rainfall was 160 mm at Hart and 128 mm at Birchip, equivalent to 53% and 60% respectively of long-term averages at the two sites. The site at Birchip was particularly dry leading up to sowing, with less than 5 mm in March and April, and seed bed moisture was low at sowing.

*Crop establishment*

At Birchip emergence of canola commenced 20 days after sowing and the rate of emergence was slower when planted with the precision planter compared with the conventional seeder (Figure 1). Final establishment was reached after 30 days with the conventional seeder and after 40 days with the precision planter. The slow emergence is likely a reflection of the dry seed bed at sowing. Final establishment was not significantly affected by seeder type and was approximately 60% of the target density. Lentil emergence was quicker and there was no difference between the two types of seeders in the speed of emergence or final establishment, which was close to 100%. Full emergence was reached after 40 days.

At Hart establishment was more rapid and full establishment occurred 21 days after sowing. Establishment was significantly lower with the precision planter in both crops. Close to 100% establishment occurred with the conventional seeder while establishment using the precision planter was approximately 60% in canola and 80% in lentil. In lentil, narrow row spacing resulted in a significantly lower establishment at Hart (93% *cf* 85%) and in canola there was a significant lower establishment in narrow rows with the precision planter (72% *cf* 58%) but not with the conventional seeder (Seeder x Row spacing *P*=0.009).

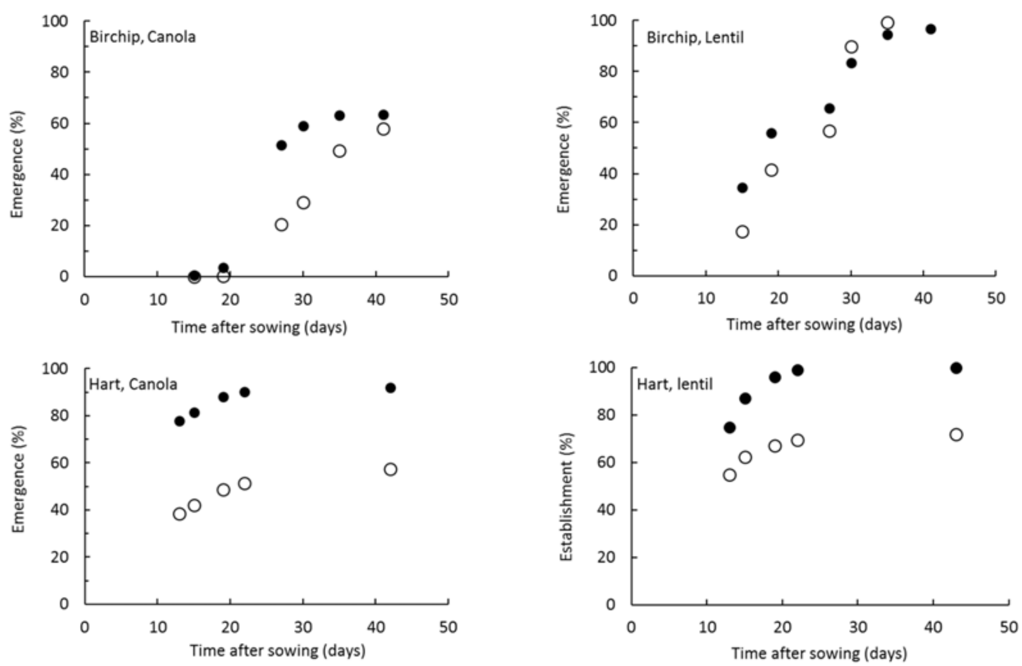


**Figure 1. The average rates of establishment for canola and lentil sown with a conventional seeder (●) or a precision planter (○). The values are the means over sowing rates and row spacings**.

The precision planter is a disc seeder while the conventional seeder is a tyned implement, and the slower and poorer establishment of the precision planter at the two sites may reflect this difference in seeding mechanism.

*Biomass*

There was little effect of treatments on biomass production at Birchip. In canola, there was no significant difference in biomass between the conventional seeder and the precision planter (3.38 t/ha *cf* 3.21 t/ha; P>0.05), nor among plant densities. The only significant effect was a 15% increase in biomass in wide rows compared to narrow rows (3.52 t/ha *cf* 3.07 t/ha, P=0.015). Similarly in lentil, there was no significant difference in the biomass production between the two types of seeders (conventional seeder: 1.50 t/ha;

precision planter: 1.68 t/ha). Biomass production was lowest at the lowest sowing rate (1.26 t/ha) and there was no significant difference in biomass among the higher densities (range 1.54 – 1.76 t/ha).

Despite the large difference in plant establishment between seeders at Hart, there was no significant difference in biomass at flowering in canola (conventional seeder: 2.80 t/ha; precision planter: 2.70 t/ha). Biomass was greater with narrow row spacing (narrow: 2.90 t/ha; wide: 2.60 t/ha, P = 0.003). There was a significant effect of plant density on biomass: highest biomass occurred at the lowest plant population (3.07 t/ha) and differences in biomass among the remaining densities were not significant (range: 2.53 – 2.80 t/ha).

In contrast to canola, lentil produced greater biomass at flowering when sown with the precision planter than when sown with the conventional seeder. This was driven by a large response in the narrow row spacing within precision planter (Table 1). There was no significant effect of plant density on biomass production. The similarity in biomass in canola and lentil despite large differences in seedling establishment between seeders illustrates the ability of these crops to compensate for variation in plant densities.

**Table 1. Effect of row spacing on flowering biomass in lentil sown with two types of seeders at Hart in 2018**

| Seeder type | Row spacing (cm) | |
|---|---|---|
| | 23 | 30 |
| | (t/ha) | |
| Conventional seeder | 2.64 | 2.59 |
| Precision planter | 3.51 | 2.89 |
| LSD (*P*=0.05) | 0.294 | |

*Grain yield*

The only factor influencing yields at Birchip was plant density (Fig 2). Grain yield of canola was more sensitive to changes in plants/m$^2$ than lentil. Canola yields were reduced as plants/m$^2$ declined below 40 plants/m$^2$ whereas lentil yields were not significantly affected until the plant population fell below 60 plants/m$^2$.

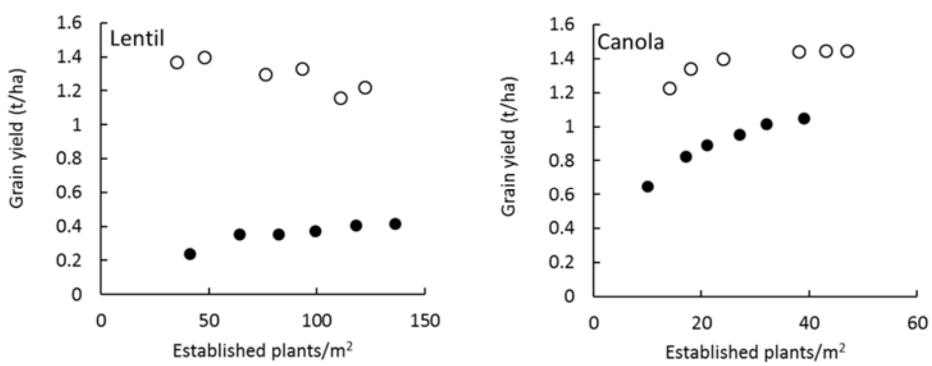


**Figure 2. The grain yield response to plant density in lentil and canola at Birchip (●) and Hart (○) in 2018. The values are the averages of two seeder types and two row spacings. The lsd (P=0.05) for canola is 0.073 t/ha (Birchip) and 0.078 t/ha (Hart) and the values for lentil are 0.079 t/ha (Birchip) and 0.070 t/ha (Hart).**

At Hart, lentils sown with the precision planter yielded 9% more than those sown with the conventional seeder (1.35 t/ha *cf* 1.24 t/ha P = 0.018), despite a much lower establishment. However, biomass at flowering was also higher (Table 1), which may have contributed to the response. The importance of interplant competition to this response requires further investigation. Lentil yield did not change significantly up to 100 plants/m$^2$ (Fig 2) beyond which yields were significantly reduced (*P*=0.008). The current recommendation is to sow lentils at between 100 and 120 plants/m$^2$ but these results suggest a lower plant population may be possible. Canola yields increased up to 25 plants/m$^2$ after which there was no further significant change. The type of seeder only affected yield of canola significantly at Hart in the narrow row spacing (Table 2). Canola yield sown with a precision planter was 6% higher than the yield with the conventional seeder.

Grain yield increased with biomass at flowering in lentil, both within and between sites, but especially at Birchip (Fig 3). The relationship was less clear in canola: there is an indication at Hart that high biomass at

**Table 2. Effect of row spacing on the grain yield of canola sown with two types of seeders at Hart in 2018**

| Seeder type | Row spacing (cm) | |
|---|---|---|
| | 23 | 30 |
| | (t/ha) | |
| Conventional seeder | 1.43 | 1.32 |
| Precision planter | 1.51 | 1.28 |
| LSD (*P*=0.05) | 0.066 | |

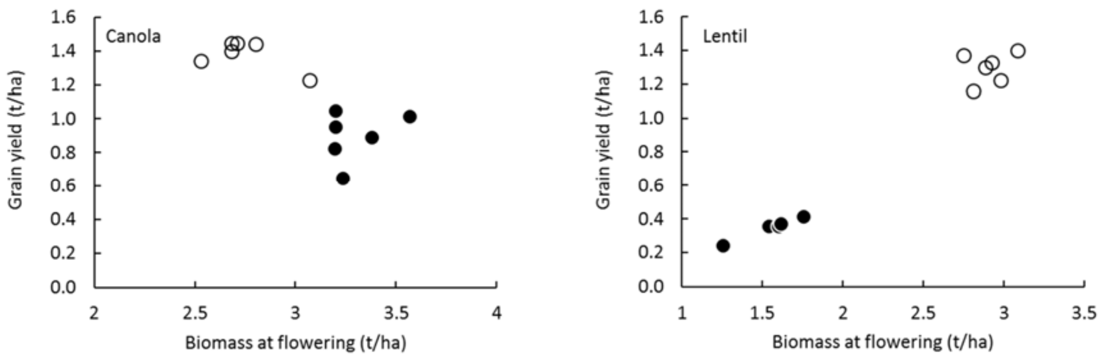


**Figure 3. The relationships between biomass at the start of flowering and grain yield for canola and lentil at Birchip (●) and Hart (○) in 2018.**

the lowest plant density may have limited yield, but at Birchip there was no clear relationship.

## Conclusion

While precision planting has the potential to improve crop establishment, the results from these experiments are inconclusive. Precision planting did not improve speed of emergence or final establishment, but increased yield of canola and lentil at Hart. However, this effect was confounded by the large difference in plants/m$^2$ between the two types of seeders. Responses to density were unaffected by seeder type. The two experiments highlighted that plasticity in growth can compensate for differences in plant establishment. Despite a large range in plants/m$^2$ among treatments, there was little variation in biomass in canola and lentil and lentil grain yields changed little in response to plant population. Grain yield of canola was more sensitive than lentil to changes in plant population which suggests that even under dry conditions poor establishment leading to low plant numbers can be a penalty to yield. The results from the two sites suggest that a plant population of at least 30 - 40 plants/m$^2$ may be needed for optimum yields in canola cv 44Y89[A].

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## References

Gan Y, Stobbe E H and Moes J (1992) Relative Date of Wheat Seedling Emergence and Its Impact on Grain Yield. Crop Science 32, 1275-1281.

Harries M, Walker J and Blyth M 2006 Wide row spacing and seeding rate of lupins with conventional and precision seeding machines. GRDC Lupin and Pulses Update. pp 28-32. Department of Agriculture, WA, Burswood Convention Centre, Perth, WA.

Harries M and Seymour M 2016 Precision placement of canola seed, can we get the same or better yield from less seed? GRDC Grains Research Update, Perth, WA.

Kemp D R, Auld B A and Medd R W (1983) Does optimizing plant arrangements reduce interference or improve the utilization of space? Agricultural Systems 12, 31-36

Soetono and Donald C M (1980) Emergence, growth and dominance in drilled and square planted barley crops. Australian Journal of Agricultural Research 31, 455-470.

Yang C, Gan Y, Harker N K, Kutcher H R, Gulden R, Irvine B and May W (2014) Up to 32% yield increase with optimised spatial patterns of canola plant establishment in western Canada. Agronomy of Sustainable Development 34, 793-801.