NORTHERN

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GRDC GROWNOTES™

GRDC™ GRAINS RESEARCH & DEVELOPMENT CORPORATION

CANOLA

SECTION 3

PLANTING

SEED TREATMENTS | TIME OF SOWING | NSW DPI RESEARCH. IMPROVING CANOLA PROFIT IN CENTRAL NSW: EFFECT OF TIME OF SOWING AND VARIETY CHOICE | TARGETED PLANT POPULATION | SOWING DEPTH | SOWING EQUIPMENT

Planting

3.1 Seed treatments

3.1.1 Insecticide treatments

Insecticide treatments are important for the proactive control of insect pests in canola.

Imidacloprid products, such as Gaucho® 600 or Picus, are registered for use on canola seed, for protection against redlegged earth mite, blue oat mite and aphids.

These chemicals work through repellency and anti-feeding action, rather than by directly killing earth mites or aphids. They will protect emerging seedlings for 3–4 weeks after sowing. As well as the direct effects of controlling aphids, the use of imidacloprid may also reduce the incidence and spread of aphid-transmitted virus diseases during this period. This product can be applied only by registered operators. All seed companies can supply seed pre-treated with imidacloprid. Fipronil (e.g. Cosmos®) is registered for control of redlegged earth mite in canola. It should be used as part of an integrated pest management approach to redlegged earth mite.

Fipronil can be applied either on-farm or off-farm by a contractor or seed company. [1]

APVMA Pubcris

Winter crop variety sowing guide 2016

MORE INFORMATION

Assessment of fungicide efficacy against blackleg disease

Evaluation of fungicides for the control of downy mildew

GRDC Update papers:
Turning sowing times on their head with winter habit canola and wheat

Early sowing of canola in southern NSW

3.1.2 Fungicide treatments

Fungicide treatments can be used in high disease risk situations, however depending on level of risk may not be required.

Fluquinconazole products (e.g. Jockey®) can be used in high-risk situations as a seed dressing to help minimise the effects of blackleg disease. These products may shorten the hypocotyl length of canola. To avoid the possibility of reduced emergence, do not sow treated seed deeper than 20 mm or in soils prone to crusting. Ensure that treated seed is sown in the season of treatment.

Fludioxonil + metalaxyl-M (Maxim® XL) is a fungicidal seed dressing that provides suppression of blackleg as well as protection against seedling diseases caused by *Pythium* spp. and *Rhizoctonia solani*. It will not cause shortening of the hypocotyl or affect seed viability.

Flutriafol products (Impact®) are in-furrow fungicide treatments that are mixed and sown with the fertiliser to assist in minimising the effects of blackleg disease. In situations of high blackleg pressure, research has shown flutriafol products to be superior to other fungicides for controlling blackleg disease. [2]

3.2 Time of sowing

Early sowings maximise yield potential and oil content (Figure 1). Traditionally ANZAC day (25 April) has been a commonly accepted ideal sowing date but growers can make adjustments from this date in response to the maturity rating of the variety grown, the respective frost risk of that paddock or climate of that location. For

1 L Jenkins (2009) Crop establishment. Ch. 5 In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

2 L Jenkins (2009) Crop establishment. Ch. 5 In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

example, longer season varieties could be planted earlier than this date, shorter ones after. Warmer locations with less frost risk or greater chance of shorter springs might see midseason maturities sown earlier than this date, or cold frosty climates may see mid seasons sown later than this. Growers should seek local advice on variety choice and sowing date. One thing for sure, delayed or late sowing of canola will have severe yield penalties.

Frosting can occur in canola and can be quite severe in many cases but frosting in canola is different to that experienced in wheat. Frost can destroy/damage canola flowers but canola flowers over extended periods of up to 6 weeks or more so any lost flowers from single frost events are easily replaced. Missing podding sites in many cases will not have equated to much, if any, yield loss. Very little energy has been spent to get to this stage and the future requirement is just redirected to newer or remaining pods.

This is in contrast to wheat which flowers over 1–5 days across a paddock. One or 2 severe frosts can destroy up to 20–30% of kernels and this damage cannot be compensated by remaining grains. Manipulating the sowing date of canola to avoid flower frosts is not worthwhile unlike wheat. However canola is most sensitive to frost during early pod fill. Heavy frosts at this stage can freeze the entire pod destroying all the seed embryos. At this crop stage flowering is either finished or very close to finishing and as such there is little chance for the crop to compensate for this loss. Because this sensitive stage of the crop is later in the season the risk or such frosts is reduced.

Frost damage in canola is often very severe and growers can have little direct influence over their crops' frost susceptibility because moisture availability (weeds, fallow management, time of sowing), row spacing, stubble cover can all play a part.

Figure 1: *Early-stage canola in central west NSW.*

Photo: Penny Heuston

In paddocks known to have high frost risk, sowing should be delayed further. Seek guidance from experienced agronomists in your district, but in general, finish sowings by about 1 June around Moree and 15 June south of Gunnedah at the very latest. Within these guidelines, consider sowing several varieties with different maturities and even several sowing times to spread the risks of unforeseen seasonal factors such as moisture stress or frost.

Canola usually flowers for 3–5 weeks, and frost damage is greatest if it occurs towards the end of flowering and through pod filling. Early-maturing varieties sown at the beginning of May would be subject to frosts in the late flowering and pod-filling stages, whereas midseason varieties will flower and fill pods later, reducing the risk of frost damage.

The small seeds of canola need to be sown ideally no more than 5 cm deep in self-mulching clays (2–3 cm in red soils) into well-prepared, moist seedbeds.

Good seed–soil contact, to help ensure uniform establishment, is aided by the use of rollers, cultipackers and press-wheels. The crop is suited to conventional and no-till systems.

Heavy stubble loads may reduce emergence, and should not be left over the sowing row. Triazine-tolerant (TT) varieties are less vigorous; therefore, planting methods are more critical for even establishment.

Aim to establish 30–50 plants/m in northern NSW (Table 1, Figure 2). This can be achieved with 2–4 kg/ha of seed (provided it is good-quality seed). [3] Recent work by DPI has seen them revise this number back to 20 plants, but stands with as few as 10 plants have shown little negative yield impact.

Table 1: *Recommended sowing times for canola in NSW.* [4]

Region	Week	April				May				June			
		1	2	3	4	1	2	3	4	1	2	3	4
Northern	West			Earlier/later	Best	Best	Best	Earlier/later	Too late				
	East				Earlier/later	Best	Best	Best	Best	Earlier/later	Too late		
Central	West		Earlier/later	Best	Best	Best	Earlier/later	Too late					
	East			Earlier/later	Best	Best	Best	Earlier/later	Earlier/later	Too late			
Southern	West			Earlier/later	Best	Best	Earlier/later	Earlier/later	Too late				
	East			Earlier/later	Best	Best	Best	Best	Earlier/later	Earlier/later	Too late		
	Irrigation			Earlier/later	Best	Best	Best	Earlier/later	Too late				

1–4 are weeks of the month. ■, Best sowing time; ■, earlier or later than desirable (earlier—too vegetative, lodging, disease and/or frost risk; later—spring moisture and heat stress); ■, too late for good yields unless favourable spring

3 L Serafin, J Holland, R Bambach, D McCaffery (2005) Canola: northern NSW planting guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/148300/canola-northern-NSW-planting-guide.pdf

4 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

Figure 2: *Cropping regions of NSW. Canola needs to be planted early to maximise grain potential. See Table 1 for regional planting time recommendations.*

Information regarding the plant-available water (PAW) at a point in time, particularly at planting, can be useful in a range of crop management decisions. Estimating PAW, whether through use of a soil water monitoring device or a push probe, requires knowledge of the plant-available water capacity (PAWC) and/or the Crop Lower Limit (CLL). [5]

- Soil properties (bulk soil and surface conditions) affect fallow efficiency through their effects on the different water balance terms.
- Rainfall patterns affect fallow efficiency as well as the effectiveness of stubble cover to reduce evaporation losses.
- The more limited effect of stubble retention on evaporation does not take away the benefits stubble cover provides in protecting the soil surface, increasing infiltration and reducing runoff and erosion. [6]

5 K Verburg, B Cocks, T Webster, J Whish (2016) Methods and tools to characterise soils for plant available water capacity (North Star). GRDC Update Papers 3 March 2016, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/03/Methods-and-tools-to-characterise-soils-for-plant-available-water-capacity-North-Star

6 K Verburg, J Whish (2016) Drivers of fallow efficiency: Effect of soil properties and rainfall patterns on evaporation and the effectiveness of stubble cover. GRDC Update Papers 23 February 2016, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/02/Drivers-of-fallow-efficiency

3.2.1 Northern NSW

In the western zone, commence sowing mid-maturing varieties in late April. Sow early-maturing varieties about 2 weeks later than mid-maturing varieties to minimise the risk of frost damage. In the eastern zone, commence from the first week of May and finish by the end of May.

3.2.2 Central and southern NSW

Have paddocks ready to sow by mid–late April. An early break, allowing sowing to occur mid–late April maximises yield potential and oil content. Sowing before mid-April may lead to crops becoming too vegetative, increasing their susceptibility to lodging, disease and moisture stress during podfill. They can also be at greater risk of frost damage. For these reasons, longer season varieties should be chosen for early sowings so that flowering and pod filling occur in a period of lower frost risk and lower risk of spring moisture and heat stress.

Where there is a low risk of frost damage at early podfill, early-maturing varieties can be planted from the second week of April in the western zone. In the eastern zone of central and southern NSW, sow mid–late-maturing varieties at the start of the sowing window and early-maturing varieties towards the end of the sowing window. Aim to finish sowing by mid-May in the better rainfall areas. Yields can fall by 10% per week after this period.

3.2.3 Southern NSW irrigation areas

Sowing time is often determined by the close to the irrigation season. The risk of winter waterlogging, spring water availability and high spring temperatures are other considerations. These factors need to be taken into account when choosing a variety with suitable maturity. For most situations, mid-maturing to early–mid-maturing varieties are preferred. [7]

To maximise grain yield potential, canola needs to be planted early. This requires careful attention to detail in relation to crop establishment. Because the soil surface dries out more rapidly in early–mid April than mid-May, seed may need to be planted slightly deeper than optimal (up to 5–6 cm deep). In this early-planting situation, pay strict attention to seed quality.

Research in the southern region has almost universally shown a negative correlation between canola later sowing date and grain yield. The challenge is that earlier sowing of canola is generally (but not always) more risky for successful crop establishment.

Recent GRDC-funded NSW Department of Primary Industries (DPI) research aimed not to improve canola establishment *per se*, but rather to increase the likelihood of achieving an adequate plant stand from sowing canola on time or early. The results have greatest relevance for an early planting opportunity and a lesser relevance for canola that is dry-sown or planted into moisture in May. [8]

MORE INFORMATION

Canola establishment; does size matter?

Canola time of sowing Cowra

7 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

8 R Brill, L Jenkins, M Gardner (2014) Canola establishment; does size matter? GRDC Update Papers, 5 February 2014, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/Canola-establishment-does-size-matter

IN FOCUS

3.3 NSW DPI research. Improving canola profit in central NSW: effect of time of sowing and variety choice

- In western NSW, the practice of moisture seeking (sowing seed deeper than 3 cm) of canola in early–mid April into marginal moisture conditions may result in lower plant establishment rates than sowing just prior to or just after a rainfall event.
- Waiting until there was adequate moisture for sowing (early May), or dry sowing (late April) with a reliable forecast of follow-up rain, achieved higher yields than sowing in mid-April in 2012. However, the yield loss from early sowing in 2012 was assumed to be due to factors in addition to lower establishment rates.
- A high number of frost events contributed to the reduced yield potential of early-planted (mid-April) canola in 2012 in this trial in western NSW. [9]

3.3.1 Background

Canola is an important winter crop-rotation option in western NSW. The advent of new varieties in all four herbicide groups has enabled widespread adoption over recent years. As in all areas where canola is produced, timely and uniform establishment is critical to the success of the crop. Sowing date is known to be an important management strategy to optimise yield of canola in all canola-growing regions.

Time of sowing is a balance between ideal sowing conditions and the appropriate maturity cultivar. Early sowing maximises vegetative growth (biomass) and the length of the flowering period but can predispose the crop to yield-damaging frosts at flowering and early grainfill. Later sowing may reduce frost risk but can result in poor vigour due to cold and/or wet soils at planting time, and an inability to complete seed maturity before the onset of high temperatures and moisture stress, reducing both yield and oil content.

NSW DPI recommends sowing canola from early-mid April to early May in the central-west zone (Condobolin–Nyngan), regardless of soil type (Figure 3). For western NSW regions, warm soil conditions in April, which can enable more vigorous establishment of current varieties, are often offset by lack of soil moisture in the seedbed at planting time. A trial was conducted in 2012 to investigate the effect of three times of sowing on yield and oil content of seven canola varieties (hybrid and open-pollinated) and evaluate the impact on length of flowering. For two varieties, a seeding-rate component was also included to determine interactions between sowing time and plant population, especially to investigate whether early-sown, low-density crops (<15 plants/m) show yield comparable to early-sown, higher density crops (>20 plants/m). [10]

9 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

10 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

Figure 3: *NSW DPI recommends sowing canola from early-mid April to early May in the central-west zone.*

Photo: Penny Heuston

3.3.2 2012 trial details

The 2012 canola time-of-sowing trial was conducted at Trangie Agricultural Research Centre on a Grey Vertosol (cracking clay) soil (Colwell phosphorus (P), 22 µg/g, 0–10 cm). The trial was sown with 80 kg/ha of Granulock Supreme Z (11% nitrogen (N), 22% P, 4% sulfur (S) and 1% zinc (Zn)), by using a Morris Contour drill planter with the fertiliser placed directly with the seed. The trial was topdressed with 100 kg/ha of GranAm (21% N, 24% S) on 1 June, ahead of 9 mm rain on 2 June.

Table 2 indicates the dates and respective conditions at each time of sowing. Dates and conditions were chosen to reflect typical risk scenarios experienced by growers across the region. Table 3 shows the variety treatments. The seven varieties were chosen to compare a range of canola types, including early and midseason maturity, hybrid and open-pollinated, and herbicide tolerance type: conventional, TT and imidazolinone-tolerant (CLF). All seed was sourced from seed suppliers for this trial.

Table 2: *Sowing dates, sowing depth and conditions for canola time-of-sowing trial, Trangie, 2012.*

Time of sowing	Sowing depth and conditions	Prior and/or follow-up rainfall
1. 13 April	Moisture seeking into marginal moisture, sown 5 cm deep	119 mm, March 2012 (pre-sow)
2. 26 April	Dry-sown, sown 2 cm deep	14 mm, 2 May (post-sow)
3. 14 May	Moderately moist soil, sown 3–4 cm deep	14 mm, 2 May (pre-sow); plus 21 mm, 24 May (post-sow)

Table 3: *Variety characteristics, target plant population, number of seeds planted, seed size and actual sowing rate for canola time-of-sowing trial, Trangie, 2012.*

Variety	Characteristics	Target plant population (plants/m)	No. of seeds planted per m	Seed weight (g/1000 seeds)	Actual sowing rate (kg/ha)
43C80 (CL)	Open-pollinated, Clearfield®, early maturity	40	80	3.68	2.94
43Y85 (CL)	Hybrid, Clearfield®, early maturity	40	80	5.03	4.02
44Y84 (CL)	Hybrid, Clearfield®, early to early–mid maturity	40	80	5.38	4.30
AV-Garnet	Open-pollinated, conventional, mid to mid–early maturity	40	80	3.47	2.78
Hyola 555TT	Hybrid, triazine-tolerant, mid–early maturity	40	80	4.26	3.41
Jackpot TT	Open-pollinated, triazine-tolerant, mid–early maturity	40	80	3.76	3.01
ATR-Stingray	Open-pollinated, triazine-tolerant, early maturity	40	80	3.44	2.75
44Y84 (CL)_Low	As per 44Y84 (CL), low seed rate	15	30	5.38	1.61
AV-Garnet_Low	As per AV-Garnet, low seed rate	15	30	3.47	1.04

Total establishment was assumed to be 48% (rounded up to 50%) based on germination of 80% and field establishment of 60% (industry standard figures). Hence, where 40 plants/m was the target density, sowing rate was 80 seeds/m, and for 15 plants/m, sowing rate was 30 seeds/m.

The canola varieties used in this trial were chosen as representative of particular herbicide, plant-type and maturity groups; seed companies may market other varieties with potential similar to or better than the varieties used in this trial. [11]

11 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

3.3.3 2012 trial results

Effect of time of sowing on establishment

Date and days to emergence (as an average for all varieties) were recorded for the three times of sowing (TOS): 1 (24 April), 11 days; 2 (4 May), 8 days; 3 (28 May), 14 days. Plant counts (Figure 4) were conducted progressively for each time of sowing once there was no recorded change in emergence scores (conducted three times per week).

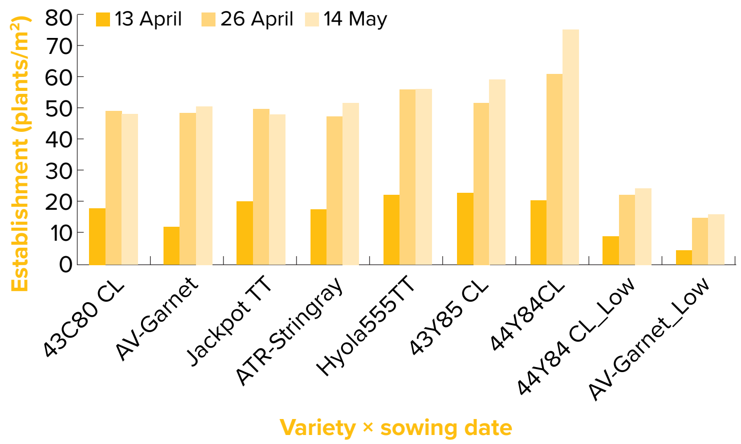

Figure 4: *Establishment of seven canola varieties with two target plant populations (40 or 15 plants/m) at three sowing dates (13 April, 26 April, 14 May), Trangie, 2012.*

All varieties had reduced establishment from TOS 1, regardless of type (open-pollinated or hybrid) or seed size. For TOS 1, moisture seeking was used to a depth of 5 cm into marginal moisture because there was no rainfall event in early April to plant on. Depth of sowing at TOS 1 may have had a greater effect on establishment than lack of moisture at sowing. For the standard target plant population (40 plants/m), the average of all varieties was 16 plants/m, with only two hybrids (Hyola 555TT and 43Y85 (CL)) achieving >25% establishment (i.e. plant count >20 plants/m from 80 seeds/m planted). For the low seeding rate (target 15 plants/m), the average was <7 plants/m (i.e. <25% target establishment from 30 seeds/m planted). AV-Garnet had the lowest plant count at both seeding rates.

Establishment for all varieties at TOS 2 and TOS 3 exceeded the target plant population, because plant establishment was greater than the assumed 50% on which seed rates were calculated. This could be due to either the shallower sowing depth and/or the follow-up rainfall received post-sowing. TOS 2, with dry sowing at 2 cm depth, showed quicker emergence than either TOS 1 or TOS 3, once follow-up rain was received. The average plant counts for the standard sowing rate (target 40 plants/m) was 48 plants/m (60%) for both TOS 2 and TOS 3, whereas for the low sowing rate (target 15 plants/m), TOS 2 achieved 18 plants/m (60%) and TOS 3 achieved 20 plants/m (67%).

In terms of variety effect, the three hybrids, with seed size >4 g/1000 seeds (Hyola 555TT, 43Y85 (CL) and 44Y84 (CL)), averaged 74% establishment, compared with the four open-pollinated varieties, with seed size <4 g/1000 seeds, which averaged 61% establishment. [12]

12 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

Effect of time of sowing on length of flowering

Previous time-of-sowing trials with canola have suggested that late sowing shortens both the vegetative and reproductive phases through temperature and photoperiodic effects, as well as increased water stress during the grain-filling period. Weekly observations of flowering were conducted to assess the impact of time of sowing on length of flowering. The summary in Figure 5 highlights 10% start flower, 100% full flower and 10% end flower, defined as follows:

- 10% start flower: the date when 10% of plants in the crop (plot) have commenced flowering.
- 100% full flower: the date when 100% of plants in the crop (plot) are in full (maximum) flower. The crop is bright yellow with all branches flowering. Some early pods may be visible in the lower section of branches.
- 10% end flower: the date when 10% of plants in the crop (plot) have flowers remaining at the top of the branch. The lower 90% of the branch will have pods formed or forming.

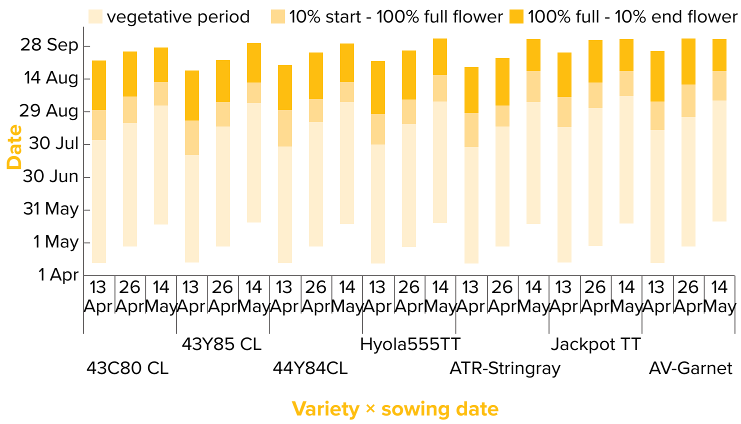

Figure 5: *Length of flowering of seven canola varieties with three sowing dates, Trangie, 2012.*

The observations presented below are based on calendar days, which do not take into account the difference in thermal time (accumulated day-degrees) between each TOS treatment. Temperature effects are a major driver of plant growth and development in canola. As an example, TOS 1 would have accumulated more day-degrees in May than TOS 3. In addition, these data have not been statistically analysed.

For each canola variety, the length (calendar days) of the vegetative period was reasonably consistent regardless of time of sowing, within a range of ~10 days of variation between TOS treatments. There were differences between varieties for average length of vegetative period. Longer season varieties Jackpot TT and AV-Garnet averaged >100 days. Short-season varieties 43Y85 CL and ATR-Stingray averaged 90 and 92 days, respectively. The lower seeding rate lengthened the vegetative period of 44Y84 (CL) for TOS 1 only (by 4 days). The lower seeding rate shortened the vegetative period of AV-Garnet by 4 days for TOS 1 and lengthened it by 5 days for TOS 2.

There were differences in the total length (calendar days) of flowering period as a time-of-sowing effect. For each canola variety (including those planted at lower seeding rates), total length of the flowering period was shortened as sowing was delayed. Lengths of flowering period averaged for all varieties were 62 days (TOS 1), 55 days (TOS 2) and 47 days (TOS 3). Some varieties showed a greater difference between TOS 1 and TOS 2 (e.g. 43Y85 (CL), 13 days; 44Y84 (CL), 11 days), whereas other varieties were more affected by the delay from TOS 2 to TOS 3 (e.g. AV-Garnet, 12 days; Jackpot TT, 10 days). The Pioneer Clearfield® varieties appeared more affected than the TT varieties (shorter flowering period by up to 20 days). The lower seeding rate had opposite effects on the two varieties tested. In 44Y84 (CL)_Low, flowering period was 1.5 days shorter for TOS 1 but 2–3 days longer for TOS 2 and TOS 3 than in 44Y84 (CL). In AV-Garnet_Low, flowering period was 4 days longer for TOS 1 but up to 5 days shorter for TOS 2 and TOS 3 than in AV-Garnet. [13]

Effect of time of sowing on yield

There were significant differences in yield (Figure 6) with regard to both variety and time of sowing. However, there was no significant variety × sowing time interaction, meaning that varieties performed relatively consistently regardless of when they were planted.

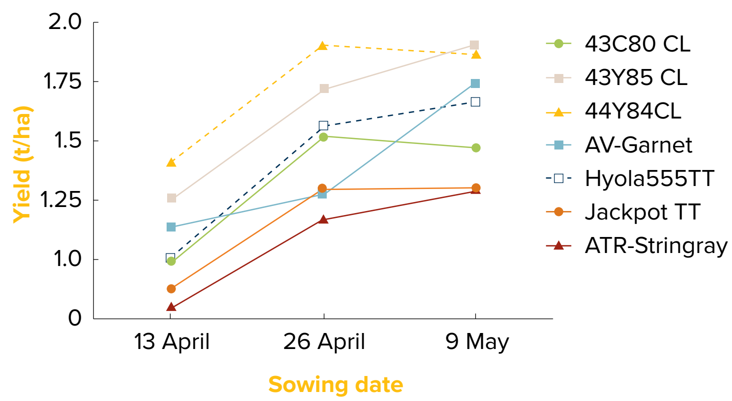

Figure 6: *Grain yield (t/ha) of seven canola varieties sown with three sowing dates, Trangie, 2012. For statistical comparisons, l.s.d. (P = 0.05) is 0.16 t/ha for varieties and 0.1 t/ha for sowing dates.*

Analysis of the effect of time of sowing, averaged for all varieties, showed that yield for TOS 3 was significantly higher than for TOS 2 (by 0.11 t/ha) and, in turn, yield for TOS 2 was significantly higher than for TOS 1 (by 0.43 t/ha). The lower yield of TOS 1 was likely due to a combination of factors including reduced plant establishment, frost damage from early flowering, and potentially higher rates of vegetative water use.

The hybrids 44Y84 (CL) and 43Y85 (CL) were the highest yielding varieties in the trial, with an average yield across all sowing times of 1.72 and 1.62 t/ha, respectively. Jackpot TT and ATR-Stingray were the lowest yielding varieties, with an average yield across all sowing times of 1.15 and 1.07 t/ha, respectively.

Seeding-rate treatment had a significant effect on yield (*P* = 0.002). Averaged over the two varieties (44Y84 (CL) and AV-Garnet), the high seeding rate targeting 40 plants/m yielded 0.24 t/ha more than the low seeding rate targeting 15 plants/m (l.s.d. (*P* = 0.05), 0.14 t/ha). There was no

13 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

seeding rate × sowing time interaction, meaning that the advantage of the higher seeding rate was observed for all sowing times. [14]

Effect of time of sowing on oil content

There were significant differences in oil content between varieties (Figure 7), but no significant difference due to time of sowing. Jackpot TT had the highest average oil content (43.2%), followed by 44Y84 (CL) (42.1%). All other varieties averaged less than the minimum base oil content of 42%, meaning that discounts would apply at delivery. The lowest of these were 43Y85 (CL) (40.8%) and Hyola 555TT (40.6%)

There was no significant effect of seeding-rate treatment on oil content. [15]

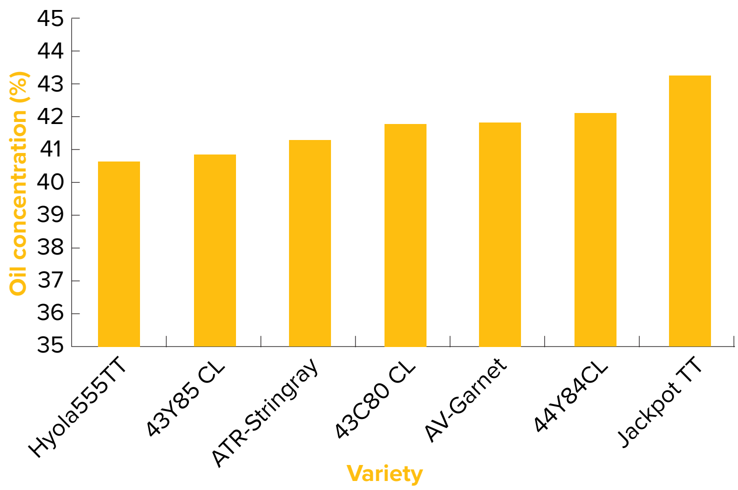

Figure 7: *Oil concentration at 6% moisture of seven canola varieties averaged across three sowing dates, Trangie, 2012. For statistical comparison between varieties, l.s.d. (P = 0.05) is 0.6%.*

3.3.4 Discussion

Previously published time-of-sowing trial data suggest that, generally, early sowing (early–mid April) predisposes the crop to greater frost risk during flowering, whereas delayed sowing (late May–late June in southern grain zones) can result in reduced yield potential. This reduced potential is due to a combination of factors, including a shortened vegetative period (reduced crop biomass), reduced length of flowering period, and moisture and high temperature stress at grainfill.

The present trial was focused on the early sowing period for western NSW, from mid-April to early May. TOS 1 (13 April) involved moisture seeking into marginal moisture at 5 cm depth, resulting in an average of <25% establishment of target plant densities. TOS 2 (26 April) showed that dry sowing can be a viable option for canola if there is a reliable forecast of follow-up rain (15–20 mm). TOS 2 received 14 mm rain on 2 May and the crop had begun emerging by 4 May. TOS 3 (14 May) was sown into good moisture and received 21 mm follow-up rainfall. Both TOS 2 and TOS 3 achieved plant densities higher than the target because the field establishment percentage was greater than the assumed 50%.

14 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

15 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

The 2012 Trangie trial confirmed previous studies that the length of the flowering period is reduced as time of sowing is delayed, regardless of variety maturity. However, the shorter flowering period for TOS 2 and TOS 3 compared with TOS 1 did not translate into reduced yield or oil content. Both TOS 2 and TOS 3 resulted in significantly higher yields (as an average for all varieties) than TOS 1, and there was no significant difference in oil content.

The most likely contributing factor to the reduced yields for TOS 1 was greater frost damage. Frost-impact data (number of aborted pods) were collected at the end of flowering but the data are not yet analysed. Meteorological data from Trangie Agricultural Research Centre weather station support grower observations that 2012 had an unusually high number of frosts during late winter–early spring. There were 59 frosts (defined as <2°C recorded in Stevenson screen) from 1 May to 30 September in 2012. Several periods of consecutive frosts occurred from late July to early September. Some of these frost events were severe, e.g. 3 days below –3.0°C recorded 31 July–2 August. Because TOS 1 commenced flowering earlier (average for all varieties 17 July) and flowered for a longer period than TOS 2 or TOS 3, which commenced flowering on average 2 August and 16 August, respectively, it is assumed that TOS 1 was more affected by frosts during flowering.

Further research is required to investigate the effect of early sowing on vegetative water use. The early sowing date resulted in plants growing in May, in relatively warm temperatures; therefore, water use may also have been higher, leaving less water available for grainfill. [16]

3.3.5 Conclusion

Conditions at sowing can affect crop establishment rates. Moisture seeking early (mid-April) into marginal moisture conditions may reduce establishment. Delaying sowing until moisture conditions are better after an autumn break (early May), and even dry sowing (at a shallow depth) prior to the autumn break, can be acceptable for canola, provided adequate rainfall (15–20 mm) is received soon after sowing. In this 2012 trial, if May had remained dry, the early deep-sown treatment may still have had a better outcome than not planting canola at all. Seeding rates that target a lower plant population may reduce yield potential. However, the greatest risk associated with early sowing is the impact of frost, which may significantly reduce the yield potential of early-planted (mid-April) canola in western NSW. [17]

MORE INFORMATION

Canola agronomy research in central west NSW

FAQ

3.4 Targeted plant population

Plant population, which is determined by sowing rate, germination percentage and establishment percentage, is an important determinant of biomass at flowering and therefore yield.

Crops with low plant densities tend to yield poorly. Low-density crops can compensate with increased pod and seed production per plant; however, they are more vulnerable to disease, pests, weed competition and environmental stress.

Aim for 40–60 plants/m (20–40 plants/m in northern and western NSW) which can normally be achieved with 2–4 kg/ha of seed. Plant densities as low as 15 plants/m, if

16 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

17 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

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consistent across a paddock, can still result in profitable crops when sown early and plants have time to compensate. Seed size varies between and within varieties and hybrids. Check seed size to calculate the correct number of seeds per square metre to be sown (see NSW DPI Winter crop variety sowing guide 2016). [18]

Increasing the sowing rate increases competition between plants, creating thinner main stems and fewer, less productive branches.

Reducing the sowing rate creates plants with thicker main stems and more branches, delays leaf-area development, reduces biomass at flowering, and ultimately reduces yield.

3.4.1 Calculating seed requirements

Correct seed rates are critical in ensuring that target plant density is reached. Calculation of seeding rates for canola is different from that for wheat.

Suppliers usually supply canola seed by number of seeds per kg, e.g. 200,000 seeds/kg. To determine the seeding rate based on this, the formula below assumes that plant density and germination are known.

Sowing rate (kg/ha) = (target plant density × 1,000,000)/(seeds/kg × expected germination)

Example

44Y84 has a seed count of 211,400 seeds/kg. We want to achieve a target plant density of 40 plants/m and assume that 85% of the seeds will germinate.

Thus, the seeding rate = (40 × 1,000,000)/(211,400 × 85)
= 40,000,000/17,969,000
= 2.23 kg/ha [19]

Seeding rate calculators

Pacific Seeds: canola seed planting rate calculators

Pioneer canola seed rate calculator

3.4.2 Row spacing

Canola has traditionally been sown at 15 cm row spacing, but the adoption of stubble retention and no-till farming systems has resulted in a trend to wider row spacing and the possibility of inter-row sowing using GPS guidance systems.

Experiments in southern NSW have shown that widening row spacing in canola does appear to reduce yield when the row space is increased to 35 cm. [20] Aim for 40–60 plants/m (20–40 plants/m in northern and western NSW), which can normally be achieved with 2–4 kg/ha of seed. Plant densities as low as 15 plants/m, if consistent across a paddock, can still result in profitable crops when sown early and plants have time to compensate. Seed size varies between and within varieties and hybrids. Check seed size to calculate the correct number of seeds to be sown per m.

Establishment can be significantly reduced by sowing too deep, sowing late into cold, wet soils, and no-till sowing into dense stubble. Use the higher seed rate, consider sowing the seed at a shallower depth, or select a variety or hybrid with high vigour in these situations. Hybrids are generally more vigorous than open-pollinated varieties, primarily because of larger seed size. Where seed is retained on-farm, grade the seed and keep the largest seed for sowing.

High plant densities, combined with suitable environmental conditions, can increase the risk of Sclerotinia stem rot during flowering. High plant densities can also

18 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

19 BCG (2015) Calculating canola seeding rates. News article. Birchip Cropping Group, http://www.bcg.org.au/calculating-canola-seeding-rates/

20 J Edwards, K Hertel (2011) Canola growth and development. PROCROP Series. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/516181/Procrop-canola-growth-and-development.pdf

increase the risk of moisture deficit during grainfill in dry spring conditions, potentially reducing yields. [21]

3.5 Sowing depth

Where conditions allow, aim to drill seed through the main seed box to 1.5–3 cm deep and up to 5 cm in self-mulching clays. Where there is moisture below 1.5–3 cm, a reduced but viable establishment may still be achieved by sowing deeper, provided large seed is sown. This strategy can be used to sow some of the crop on time in seasons of good summer rainfall followed by drying surface seedbeds in autumn. Success with this strategy depends on soil type, soil structure and the amount and timing of follow-up rainfall. [22]

Sowing depth has a major influence on seedling vigour, which subsequently affects seedling establishment and crop performance. A sowing depth of 1.2–2.5 cm is ideal.

Deep seed placement increases the risk of failed emergence. Deeper sowing reduces light availability, and the hypocotyl (the shoot that emerges from the seed) responds to this by elongating, reducing the chance of seedling emergence. Seeds planted >2 cm deep or into >5 t/ha of stubble develop elongated hypocotyls. This elongation depletes the seed reserves more quickly than in seeds with shorter hypocotyls. The longer hypocotyls are also thinner, with decreased tissue density, and are more susceptible to mechanical damage and collapse.

Plants with longer hypocotyls have smaller root systems, less leaf area from an early stage, and less leaf and root biomass. Leaves are slower to expand, which reduces dry matter. As a result, plants that allocate more resources to the hypocotyls at the expense of leaves and roots have lower relative growth rates. [23]

This effect can contribute to slower growth of plants in surface-mulch treatments, and the slower growth can be compounded by low temperatures.

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IN FOCUS

3.5.1 Canola establishment research

Sowing depth trials were conducted at Coonamble, Nyngan and Trangie in 2012 and at Nyngan and Trangie in 2013. Each trial had six common varieties with a range in seed size (Table 4). Target seeding depths were 2.5, 5 and 7.5 cm.

Table 4: *Seed size and number of seeds sown in three canola variety–sowing depth trials in 2012.*

Variety	Seed weight (g/1000 seeds)		No. of seeds sown per m
	2012	2013	
AV-Garnet	3.78	3.27	60
ATR-Stingray	3.06	2.97	60
Pioneer 43C80 (CL)	3.68	4.11	60
Pioneer 43Y85 (CL)	5.03	4.77	60

21 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

22 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

23 L Jenkins, R Brill (2013) Improving canola profit in central NSW: effect of time of sowing and variety choice. GRDC Update Papers 25 February 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Improving-canola-profit-in-central-NSW-effect-of-time-of-sowing-and-variety-choice

Variety	Seed weight (g/1000 seeds)		No. of seeds sown per m
	2012	2013	
Pioneer 44Y84 (CL)	5.34	5.20	60
Hyola 555TT	4.26	4.00	60

In 2012, averaged across all trials and varieties, establishment (as a percentage of seeds sown) at the target depth of 2.5 cm was ~66%, with no difference between varieties. All varieties had reduced establishment at 5 cm sowing depth relative to 2.5 cm sowing depth, with the exception of Pioneer 44Y84 (CL), which had the largest seed (Figure 8). At 7.5 cm sowing depth, the differences between varieties, and seed size, became more marked, with the largest seeded variety achieving 50% establishment compared with 20% for the smallest seeded variety.

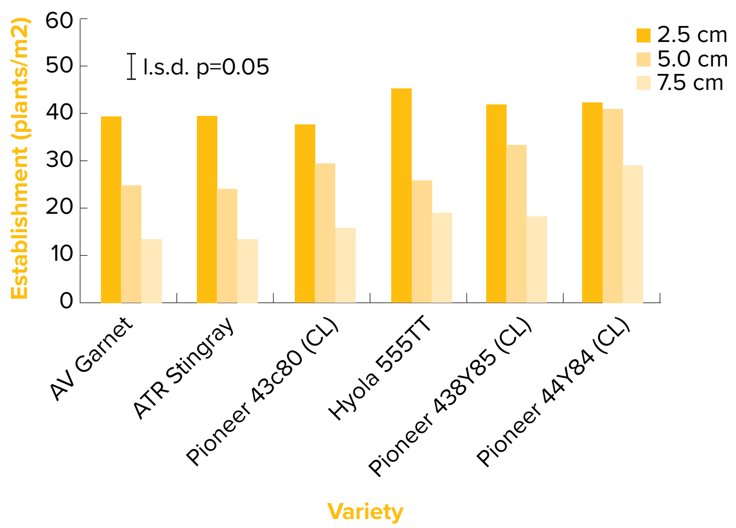

Figure 8: *Establishment of six canola varieties at three sowing depths, averaged across three trials at Coonamble, Nyngan and Trangie in 2012.*

The effect of sowing depth on grain yield in 2012 was less marked than the effect on establishment. At Nyngan and Coonamble, the target depth of 7.5 cm yielded ~250 kg/ha less grain than the target depths of 2.5 and 5 cm. At Nyngan, Pioneer 44Y84 (CL) showed no grain-yield reduction at 7.5 cm sowing depth compared with the shallower sowing depths; however, all other varieties showed a significant grain-yield reduction as a result of deep sowing. There was no effect of sowing depth on grain yield at Trangie.

In 2013, the overall establishment achieved was less than in 2012. At 2.5 cm sowing depth, establishment was approximately 50%, with no significant difference between varieties (Figure 9). All varieties showed reduced establishment at 5 cm sowing depth compared with 2.5 cm; however, the reduction was less severe for the hybrids than for the open-pollinated varieties. Establishment was further reduced at 7.5 cm sowing depth, with a hybrid advantage similar to that at 5 cm sowing depth.

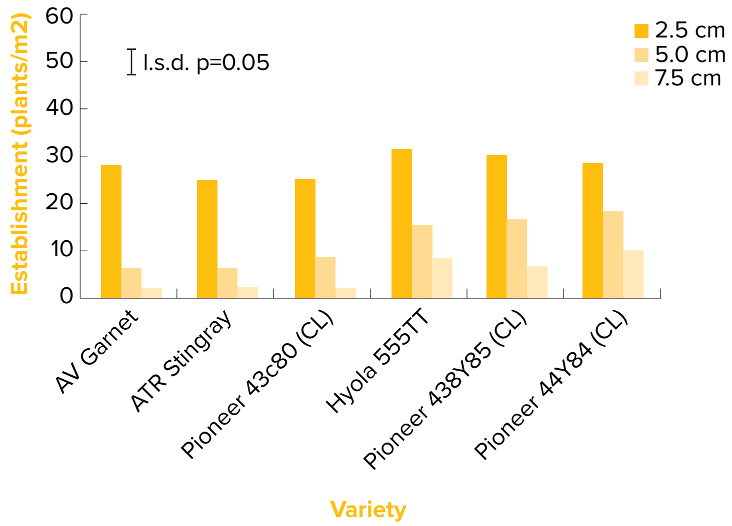

Figure 9: *Establishment of six canola varieties at three sowing depths, averaged across two trials at Nyngan and Trangie in 2013.*

The effect of sowing depth on grain yield was greater in 2013 than in 2012 but was still of a lesser magnitude than the effect of sowing depth on establishment. At Nyngan, the grain yields of Pioneer 44Y84 (CL), AV-Garnet and Hyola 555TT were similar for 2.5 cm sowing depth. However, AV-Garnet and Hyola 555TT both had a significant grain-yield reduction at 5 and 7.5 cm sowing depths, whereas Pioneer 44Y84 (CL) did not suffer a yield penalty from deeper sowing. At Trangie, all varieties suffered a grain-yield penalty with increasing sowing depth, but this reduction in grain yield was less severe for the larger seeded varieties.

At each trial site in 2012, a P rate trial was also sown. The P product used was triple superphosphate, which does not supply any N with the P. The P rates applied were 0, 5, 10 and 20 kg/ha, the fertiliser being placed directly with the seed.

There was no effect of P rate on canola establishment on the cracking clay (Grey Vertosol) soil at Trangie. By contrast, increasing P rate significantly reduced the establishment of all varieties on the lighter textured soils at Nyngan (Red Chromosol) and Coonamble (Brown Chromosol) (Figure 10). All varieties experienced a similar reduction in establishment, regardless of seed size or plant type.

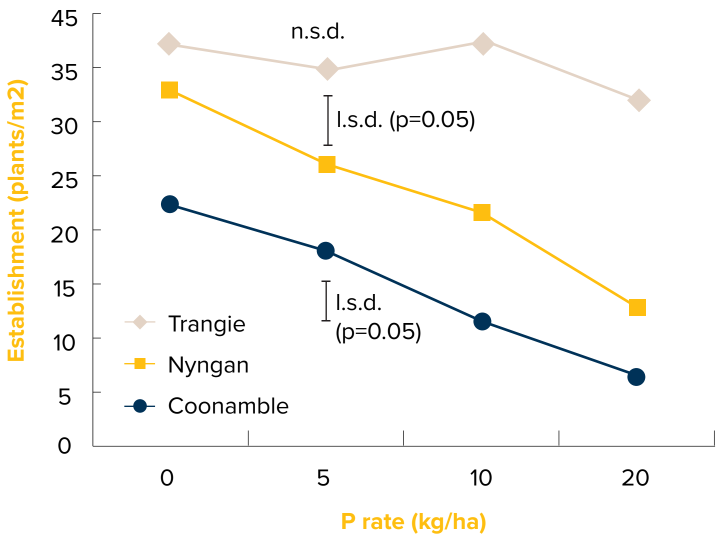

Figure 10: *Average establishment of four canola varieties sown with four rates of phosphorus at Trangie, Nyngan and Coonamble in 2012.*

Grain yield responded positively to P application at Trangie and Nyngan, which highlighted that the complete exclusion of P in order to improve crop establishment is not reasonable.

Two further P trials were conducted in 2013, with the Trangie trial planted on a lighter textured soil (Red Chromosol) rather than the heavy (Grey Vertosol) soil used in 2012. There was a significant establishment reduction at both sites as P rate (applied as triple superphosphate) increased (Figure 11). Further product comparisons at a common P rate showed that all major phosphate fertilisers (mono- and di-ammonium phosphate, single and triple superphosphate, Supreme Z) affected establishment to a similar degree. Despite the effect on establishment, grain yield still responded positively to P at Nyngan, with the 5 kg P/ha rate yielding 0.25 t/ha more than the nil P treatment but with no further yield increase beyond this rate.

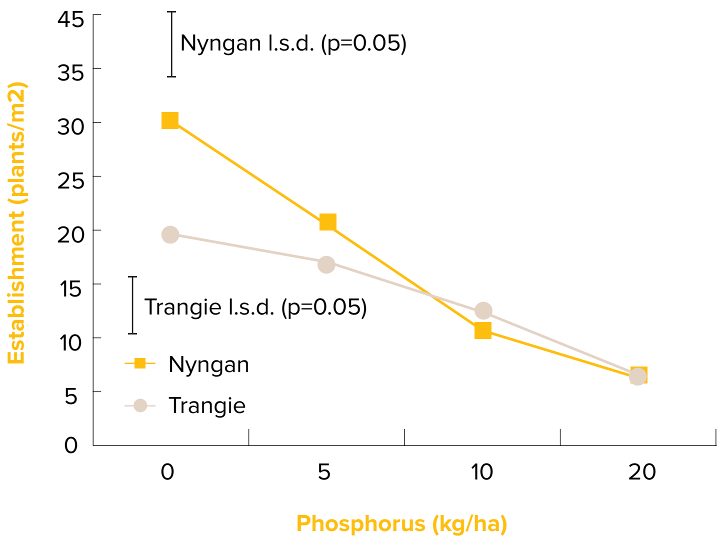

Figure 11: *Average establishment of two canola varieties sown with four rates of phosphorus at Trangie and Nyngan in 2013.*

For growers using a tine seeder, it is generally possible (and recommended) to separate seed and fertiliser to avoid the negative effects of starter fertiliser. For growers with a disc seeder (or considering a disc seeder), several management options are available, such as:

- Plant on relatively narrow crop rows to reduce fertiliser concentration in the furrow.
- Plant canola early to allow greater root exploration, with potentially less P application required.
- Pay strict attention to closing devices; the firmer or heavier the closing device, the greater the negative effects of P fertiliser. [24]

Conclusion

To maximise grain-yield potential, canola needs to be planted early. This requires careful attention to the details of crop establishment. Because the soil surface dries out more rapidly in early-mid April than mid-May, seed may need to be planted slightly deeper than optimal (up to 5–6 cm deep). In this early planting situation, pay attention to seed quality. Sowing large seeds (> 5 g/1000 seeds) increases the likelihood of achieving an adequate establishment. For growers who wish to purchase seed, hybrid seed is generally larger than open-pollinated seed. For growers who retain open-pollinated seed on farm for their own use, aim to clean seed with a 2-mm screen.

Phosphorus is essential for canola growth, but starter fertiliser may have an effect on crop establishment. Avoid high rates of P in direct contact with canola seed at sowing. Further research is required on P nutrition of canola, especially on the interactions between P application and sowing time and the effect that liquid P products may have on canola establishment. [25]

MORE INFORMATION

Canola establishment; does size matter?

3.6 Sowing equipment

Canola can be sown by using no-till techniques or sown into a well-prepared, cultivated seedbed. When sowing into cereal stubble, ensure that straw and header trash is pushed away from the sowing row. Stubble covering the row can reduce canola emergence and early plant growth to reduce yield significantly. Use rollers, cultipackers or press-wheels to improve seed–soil contact where appropriate, ensuring that the pressure applied by these devices is low. [26]

Sow seed through the main seed box or small seed box of standard wheat-sowing equipment. The air-seeder or combine should be in good condition and the level adjusted (from side to side, front to back, and tine to tine) to ensure sowing at a uniform depth. Regulate ground speed to avoid tine bounce, which will cause an uneven sowing depth. Diffusers are fitted to the sowing tines of air-seeders to stop seed from being blown from the seed row. A maximum sowing speed of 8–10 km/h is suggested for most soils.

Several options are available to level the seedbed and help compact moist soil around the seed. These include the use of press-wheels or a rubber-tyred roller, coil packers (flexi-coil roller), or trailing light harrows or mesh behind the planter.

24 R Brill, L Jenkins, M Gardner (2014) Canola establishment; does size matter? GRDC Update Papers, 5 February 2014, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/Canola-establishment-does-size-matter

25 R Brill, L Jenkins, M Gardner (2014) Canola establishment; does size matter? GRDC Update Papers, 5 February 2014, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/02/Canola-establishment-does-size-matter

26 J Edwards, K Hertel (2011) Canola growth and development. PROCROP Series. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/516181/Procrop-canola-growth-and-development.pdf

Knifepoints with press-wheels are the preferred option. Avoid heavy harrows with long tines because they can disturb seed placement.

The seed box on most modern air-seeders and combines can be calibrated for low seeding rates. Check calibrations from year to year, because seed size can change and affect actual sowing rate.

Checklist for sowing equipment:

- Ensure accurate calibration for sowing rate.
- Ensure even wear of points for accurate seed placement.
- Use narrow points to reduce ridging.
- Keep front and rear rows of tines level.
- Sow slower rather than faster, to avoid overly shallow depth, seed bounce, or increased soil throw by tines, which effectively result in front-tine seed being sown too deep.
- Ensure level ridges behind the seeder. If using harrows, heavy harrows may be too severe and finger harrows too light.
- Avoid seed–superphosphate mixes that contain excess rates of N (see above). [27]

3.6.1 Alternate sowing techniques

The use of wider row spacing to conserve moisture in low-rainfall areas has seen an expansion of the areas in which canola is grown. Other techniques, such as dry sowing, aerial sowing and the use of raised beds, have been further refined, which can reduce sowing delays caused by unseasonably dry or wet conditions. [28]

27 L Jenkins (2009) Crop establishment. Ch. 5 In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

28 L Jenkins (2009) Crop establishment. Ch. 5 In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf