Establishing canola on marginal moisture

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Key findings

- Marginal rainfall events result in false germination and patchy establishment.
- In marginal moisture conditions, it is better to sow shallow rather than deep.
- Hybrid varieties are less sensitive to sowing depth than open pollinated.
- Sowing too deep (> 30 mm) reduced yield.

Why do the trial?

Dry sowing is a common occurrence in Mallee and Wimmera cropping systems however, without a reliable forecast this can be a gamble for good establishment, particularly on a small seeded crop like canola. In 2021, the Mallee and Wimmera saw a lot of dry sowing and with little summer rain and unreliable forecasts, some growers made the decision to drop canola out of the rotation for the season. Where it remained in rotation, establishment quality around the region was varied.

A responsive trial was established at Watchupga to investigate the impacts of different factors on canola establishment under marginal moisture conditions.

The aim of this trial was to investigate the effect of variety selection, sowing rate and sowing depth on canola establishment in marginal soil moisture conditions in the Southern Mallee.

How was it done?

Location	Watchupga	**Fertiliser**	Granulock Z @ 60kg/ha at sowing (below seed), urea @ 100 kg/ha July 9 and urea @ 80 kg/ha August 11
Crop year rainfall (Nov-Oct)	234 mm		
GSR (Apr-Oct)	172 mm		
Soil type	Sandy clay	**Seed treatment**	Jockey® @ 2000 mL/100kg and imidacloprid @ 400 mL/100kg
Paddock history	Vetch hay		
Crop type	Canola		
Sowing date	April 19, 2021		
Harvest date	December 6, 2021		

A replicated field trial was established as a split plot design with sowing depth as the whole plot and variety and sowing rate as subplots. Four replicates were included. Assessments conducted were establishment counts, final establishment counts, seedling depth assessment, flowering biomass, grain yield and quality assessments.

Treatments and plant densities trialed are outlined in Table 1.

From November 2020 through to March 2021 the site received 44 mm of rain. There was very little stored moisture. In April, there was only one rainfall event of 1.2 mm received.

Table 1. Trial treatment outline.

Variety	Sowing depth target	Sowing rate (equivalent kg/ha rate ATR stingray/Hyola 350TT)
ATR Stingray (OP)	Shallow (~10 mm)	50 plants/m^2 (2.4 kg/5.1kg)
Hyola 350TT (hybrid)	Normal (~20 mm)	60 plants/m^2 (2.9 kg/6.1kg)
	Deep (~35 mm)	

Results and discussion

Seeding depth

Prior to sowing, three different seeding depths were set, targeting a shallow, normal and deep sowing for canola. Measurements were taken following emergence and found no statistical difference in the depth of shallow and normal seedlings however, deep sown treatments were significantly deeper (Table 2). While the measurements suggest limited differences between treatments, it is important to remember that measurements were taken on established seedlings and there may have been seeds at different depths (potentially very close to the surface) that did not establish.

Table 2. Average seedling depth (mm) achieved at different depth targets across the trial.

Sowing depth target	Established seedling depth (mm)
Shallow	21[a]
Normal	23[a]
Deep	35[b]
Sig. Diff.	**0.001**
LSD (P≤0.05)	**2.4**
CV%	**18.5**

Rainfall and establishment

Emergence did not begin to occur until a month following sowing, after the receival of a 4.6 mm rainfall event. Three previous rainfall events of 1 - 1.4 mm did not trigger germination. Not all treatments began to emerge at this time, however. The majority of plants emerging following this event were Hyola 350TT at the shallow and normal depth. Emergence rate data found that the hybrid was able to establish higher numbers at a faster rate on less rainfall and is less sensitive to sowing depth than the open pollinated, small seeded ATR Stingray (Figure 1).

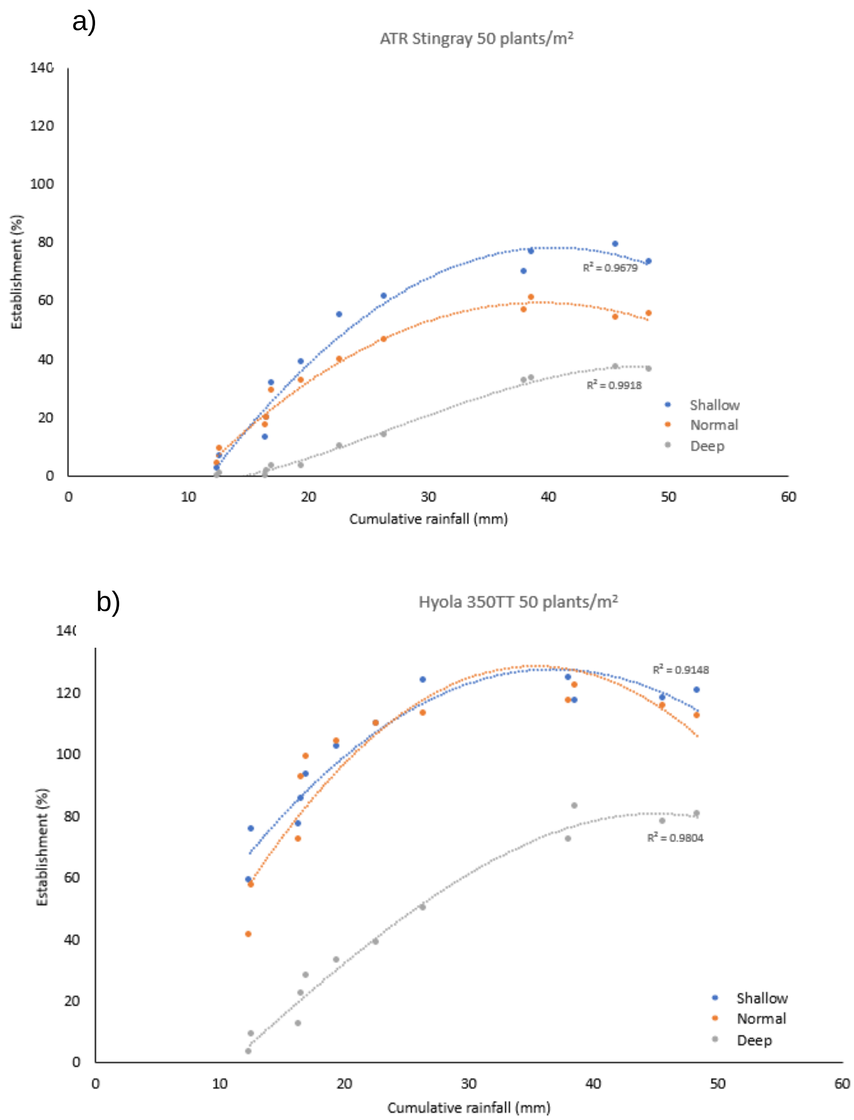


Figure 1. a) ATR Stingray establishment (%) at 50 plants/m^2 sowing rate and b) Hyola350TT establishment (%) at 50 plants/m^2 sowing rate, against cumulative rainfall (mm). Data collected between 29 and 79 days following sowing.

Final establishment was inconsistent and was not affected by sowing rate but was reduced by sowing deep (Figure 2). Hyola 350TT established more plants than ATR stingray however neither reached full targeted establishment (Table 3).

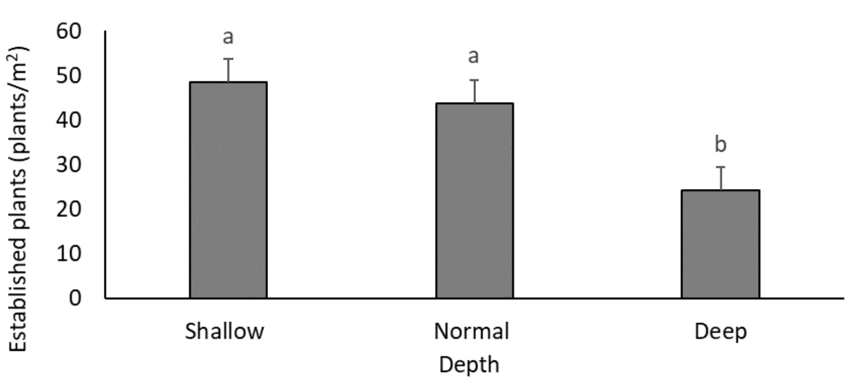


Figure 2. Average establishment (plants/m2) across sowing depths. P=0.001, LSD= 5 plants, CV= 25.2%

Table. 3 Average establishment (plants/m2 and %) of varieties.

Variety	Average established plants (plants/m^2)	Average establishment (%)
Hyola_350TT	46.4^a	85
ATR Stingray	31.5^b	58
CV%	25.02	
LSD (P≤0.05)	**5.8**	

Biomass

Hyola 350TT had higher biomass at flowering when compared to ATR Stingray with an average of 2.2 t/ha and 1.0 t/ha respectively (P=0.001).

In both varieties, biomass at flowering was reduced by placing seed too deep which was reflected in final yield (Figure 3).

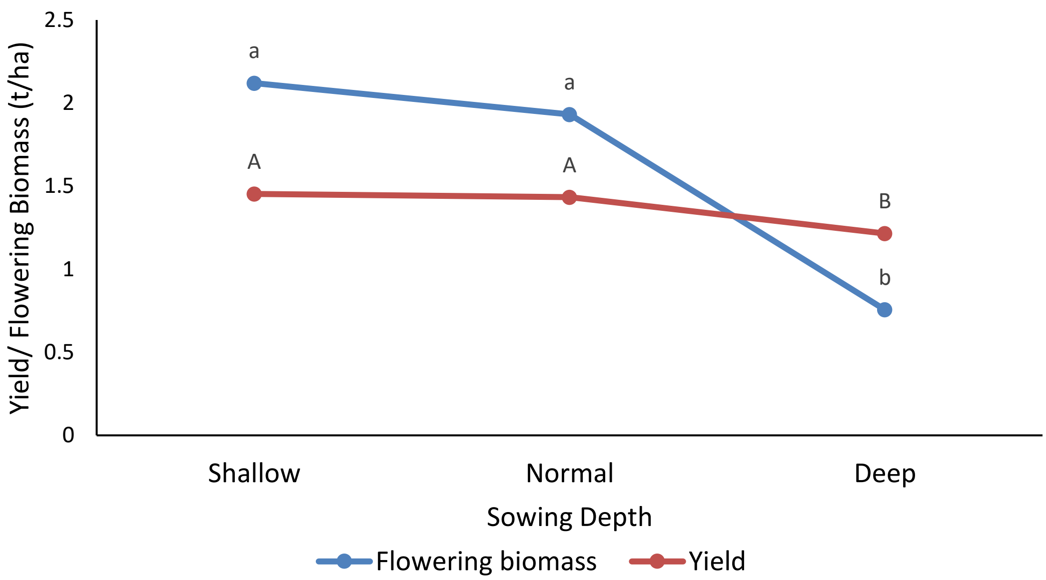


Figure 3. Average flowering biomass (t/ha) and yield (t/ha) for different sowing depths. Biomass: P=0.001, LSD = 0.47 t/ha, CV% 37.8 Yield: P=0.005, LSD = 0.12 t/ha, CV% 7.4.

Yield

Sowing depth and variety both had an impact on yield. There was an interaction between variety and sowing depth. Hyola 350TT yielded higher than ATR Stingray however at depth yields were lower for both varieties (Table 4).

Table 4. Average yield (t/ha) of varieties at different sowing depths.

Sowing depth	Variety yield (t/ha)	
	Hyola 350TT	**ATR Stingray**
Shallow	1.46^{ab}	1.45^{ab}
Normal	1.49^a	1.38^{bc}
Deep	1.32^c	1.11^d
LSD (P≤0.05)	**0.13**	
CV%	**7.3**	

A trend showing lower yield with deeper sowing was observed, however, when comparing the two varieties, Hyola 350TT yield was less sensitive to depth (Figure 4). The effect of sowing depth reflects the influence of depth on established plant numbers (Figure 5).

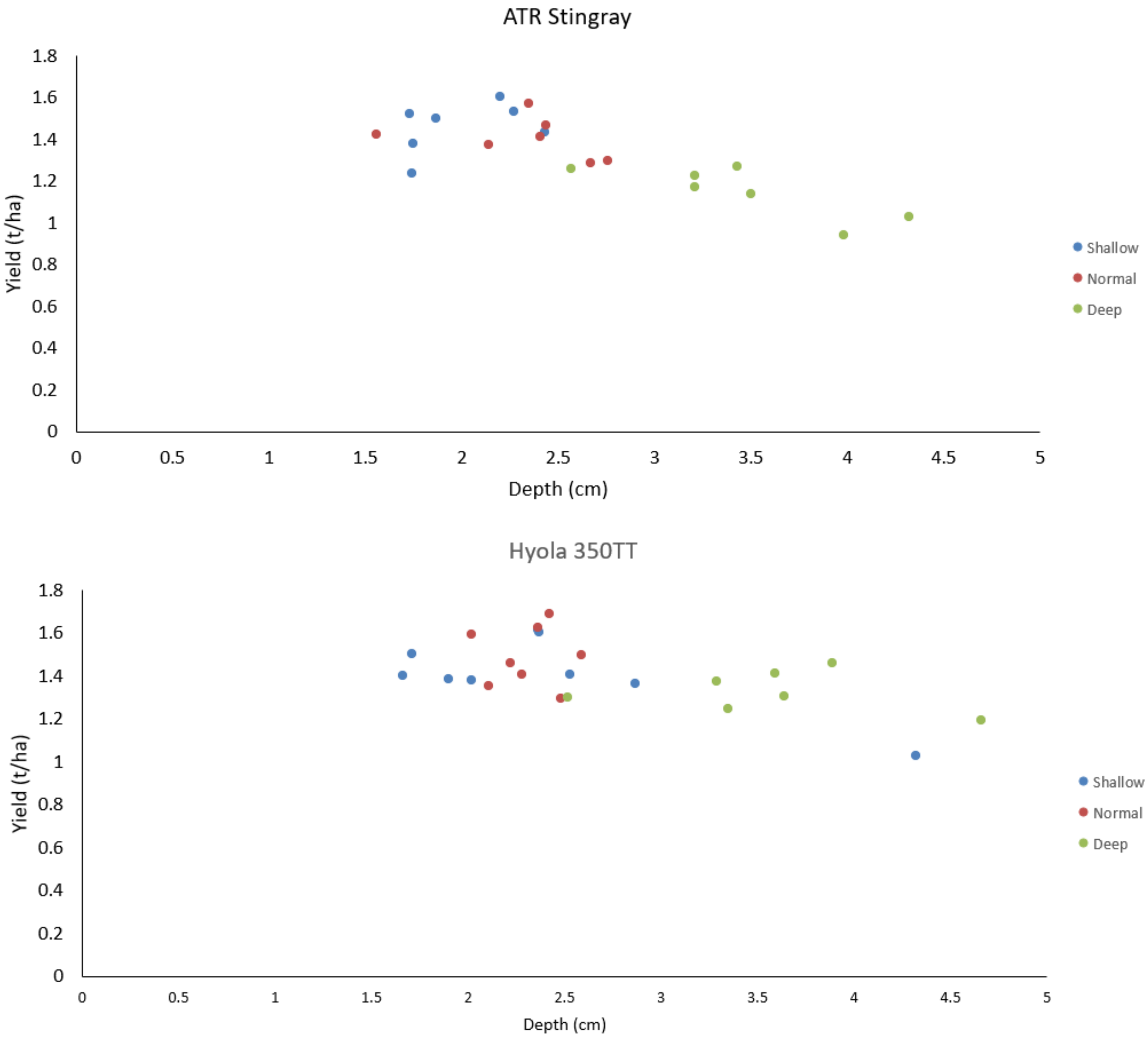
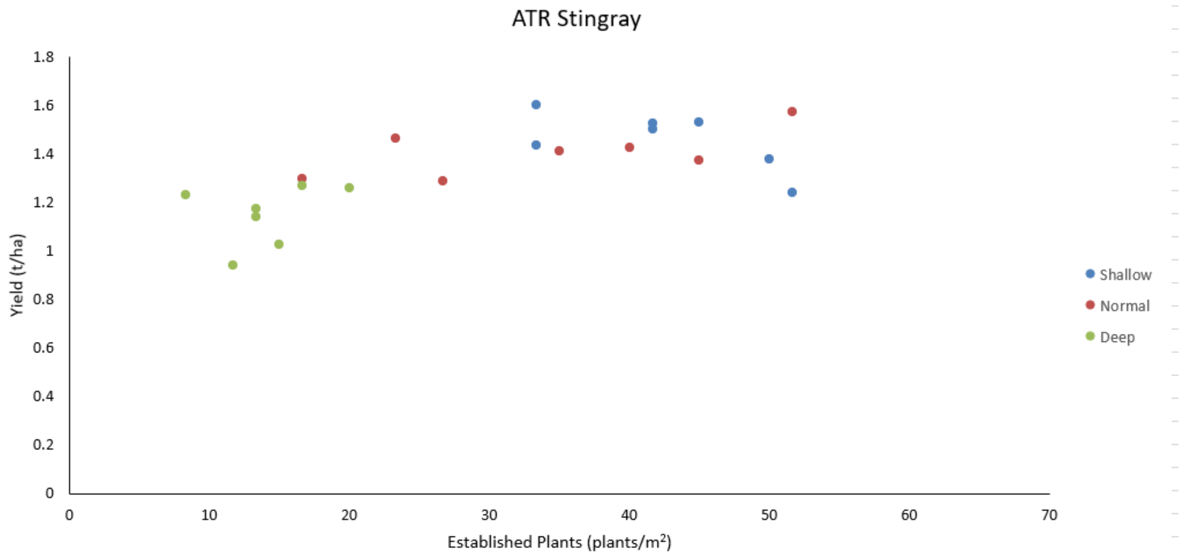


Figure 4. Yield (t/ha) for different seedling depths (cm) for ATR Stingray (top) and Hyola 350TT (bottom).

Table 5. Average yield (t/ha) of different sowing rates (plants/m²).

Sowing rate (plants/m² target)	Yield (t/ha)
50	1.3a
60	1.4b
LSD (P≤0.05)	**0.06**
CV%	**7.4**



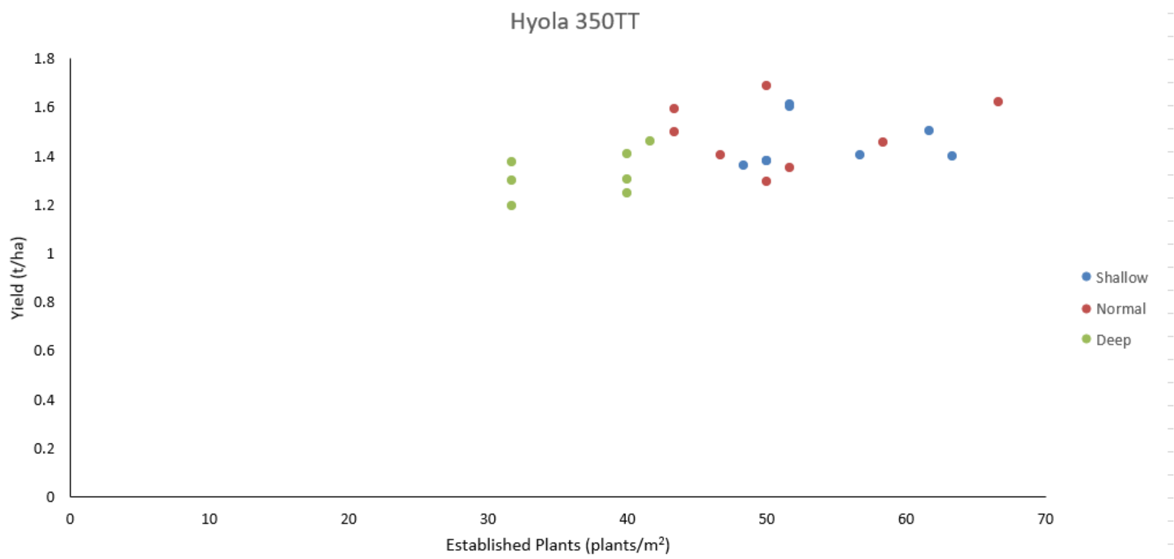


Figure 5. Yield (t/ha) for number of established plants (plants/m2) at different sowing depths for ATR Stingray (top) and Hyola 350TT (bottom).

Commercial practice and on-farm profitability

Canola can be successfully sown into dry soil and establish well. However, a few key factors need to come into play for this to occur. The soil must be dry enough to avoid premature germination and sufficient germinating rains; ~10 mm of cumulative rainfall within a week depending on soil type and variety must fall for even establishment to occur.

Research undertaken as part of the broader plant establishment project investigated how soil moisture can affect canola germination over time.

Seed germination and emergence is sensitive to the availability of soil moisture. At low soil moisture, germination rates decline and the time to establishment is delayed. An example is given in Figure 6 for a sandy loam soil. Seed of hybrid canola was sown at 15 mm depth in soil at different moisture contents. Emergence after three weeks fell from 100% in soil near field capacity (10 – 12% moisture content) to 20% in soil at 7% moisture content. There was no establishment in soil at 5% moisture content.

The effect of moisture content on final emergence in canola and wheat after three weeks is shown in Figure 7 and shows how quickly emergence can decline in dry soil.

In canola, emergence declined from approximately 100% to 70% by a 2% decline in the soil moisture and a further decline of 1 – 2% in soil moisture reduced emergence to approximately 30%.

Wheat showed a greater tolerance and its emergence did not start to decline until about 7%. Similar trends will be seen in other soils although the actual soil moisture values will be different depending on soil texture.

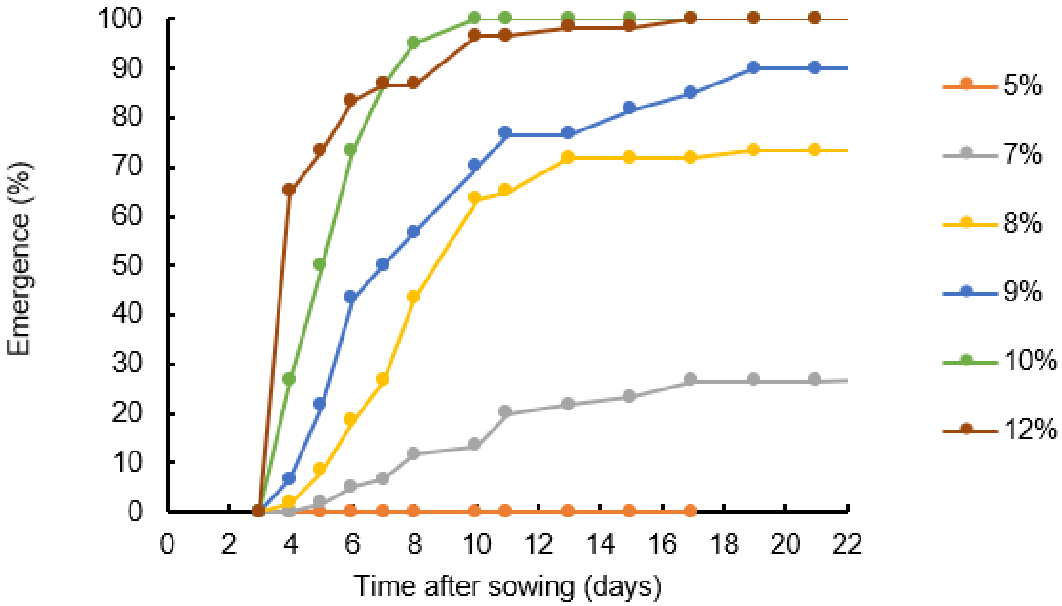


Figure 6. Changes in emergence time of canola sown into soil at moisture contents between 5% and 12%.

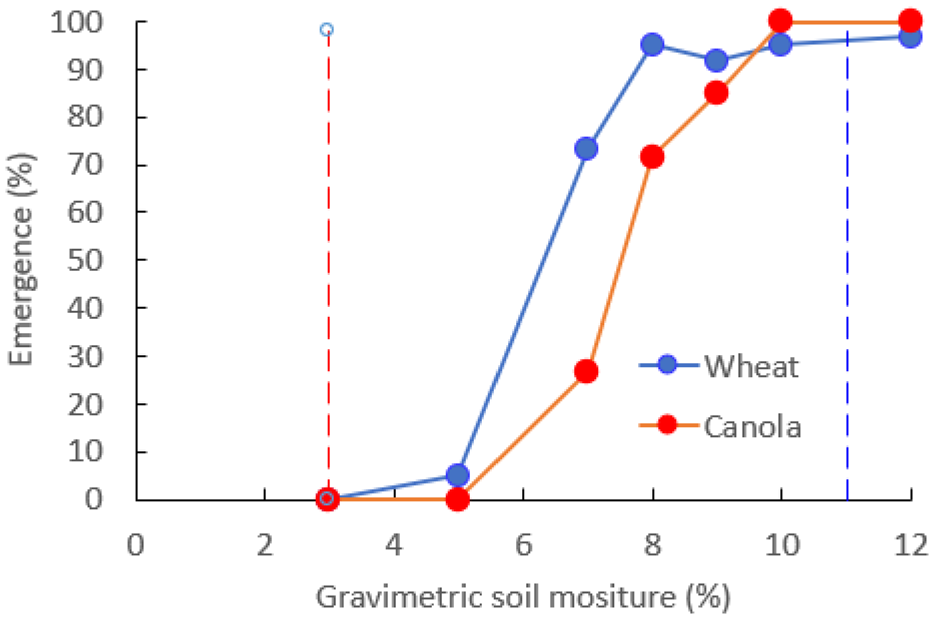


Figure 7. The effect of different soil moisture contents on the emergence of hybrid canola (●) and wheat (●). The vertical dotted lines represent the soil water content at field capacity (blue) and permanent wilting (red).

Patchy establishment was found across this trial with small rainfall events following sowing, resulting in established plant numbers significantly below targets, particularly deep sown ATR Stingray.

Variety selection, with factors such as large seed size and hybrid vigour contributed to faster and better plant establishment on small rainfall events. Selecting a hybrid variety over an open pollinated will provide a stronger choice for establishment due to the significantly greater early vigour of these varieties.

Canola has the ability to branch, compensating for low plant numbers to some degree. If a crop has achieved patchy establishment, it is important to assess established plant numbers and consider the potential of lower plant numbers compared to a better established but later sown crop. Research by BCG in the last few years as part of this project has shown that yield can be optimised in canola with plant numbers as low as 23 plants/m^2 (Clarke and McDonald 2020).

Traditionally, the recommended sowing depth for canola is between 1.5 cm and 3 cm however in some seasons seed can be placed deeper (5 cm) and successfully establish with access to moisture further down the soil profile (GRDC 2018).

Results from this research, and others consistently suggest that the risk of low emergence when sowing at a depth greater than 30 mm is high and targeting a depth < 30 mm is recommended (GRDC 2019). Unless you are sowing into moist soil, targeting a deep sowing depth with canola will result in no advantage. Targeting a shallower depth will take advantage of smaller rain events for germination and will be more successful across most seasons in the Mallee environment. Sowing deeper, particularly on heavier soils when dry, can bring up clods and reduced seed to soil contact required for good establishment. Soil type should be considered when selecting sowing depth.

Acknowledgements

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