Canola establishment: seed depth, seed size and hybrid vs OP

Martin Harries and Mark Seymour, DAFWA

Key messages

- Even when sowing in April, into drying soil, establishment of canola was better at 1 cm compared to 3 or 7 cm
- Sowing small OP seed deeper, at 3 and 7 cm, resulted in the poorest establishment and yield
- In difficult conditions hybrid seed was better able to establish than OP canola

Aims

1) To refine canola establishment methods for early sowing.
2) To see if it is possible to chase moisture at depth with canola.

Background

With the rapid adoption of hybrid technology it is critical to ensure seed costs are minimised by obtaining good establishment rates. In 2015 in many parts of the Northern Region there was a mid-April season break followed by a month without significant follow-up rain. Temperatures at sowing were above 30°C and the surface soil dried quickly. Many farmers experienced better establishment with canola if they sowed slightly deeper than their normal seed depth. With this in mind it was timely to test the impact of deeper seeding on establishment rates in mid -April conditions. We also tested how the seed type (OP or hybrid) and seed size influenced establishment rates when sowing in mid-April conditions.

Method

Two trials were conducted in the Northern Agricultural Region; one at the Mingenew-Irwin Group light land site at Strawberry (15km west of Mingenew) and the other at the Valentine Road DAFWA Research Annex at Eradu. The soil type of both sites were deep yellow sands (Orthic Tenosol). The trials were sown with a small plot seeder and plots were 20m long x 1.54m wide. Three treatments were used (1) Seed depths of 1, 3 and 7cm, (2) Variety: ATR Bonito (OP) and Hyola 559TT (Hybrid) and (3) Seed size. The different seed sizes were obtained by sieving seed from commercially available seed lots (Table 1). Different sieve sizes were required for each variety to split the original seed lot into size lots with small being ~20% of the original, medium ~60% and large ~20%. For the ATR Bonito sieves were 1.7mm, 1.7-2.0 mm and >2.0mm. For the Hyola 559TT sieves were <2.0mm, 2.0mm to 2.36mm and >2.36mm.

The Strawberry trial was sown on April 15 and the Eradu trial on April 13. The target plant density was 40 plants per square metre calculated with an assumed field establishment rate of 65%, leading to a seed rate range of 1.75 to 5.29 kg/ha (Table 1). This density is higher than recommended for the area, however it was anticipated that the actual field establishment achieved at the 7cm sowing depth would be much lower than 65%.

Table 1. Seed size, weight of seed sown and seed sown per plot.

Variety	Seed Size	Sieve size	% of original lot	1000 seed weight (g)	Seeds/kg	Seed rate (kg/ha)
ATR Bonito	**Small**	<1.7	18	2.70	370370	1.75
ATR Bonito	**Medium**	1.7-2.0	69	3.60	277778	2.33
ATR Bonito	**Large**	>2.0	13	4.31	232019	2.79
Hyola 559TT	**Small**	<2.0	18	4.26	234742	2.75
Hyola 559TT	**Medium**	2.0-2.36	62	6.40	156250	4.15
Hyola 559TT	**Large**	>2.36	20	8.17	122399	5.29

Measurements included gravimetric moisture content at sowing, establishment counts, several measurements of NDVI across whole plots using a handheld green seeker, machine harvested yield and seed weight and oil concentration.

Results

Seasonal conditions

Long term average rainfall for Strawberry Bureau of Meteorology station (8295) is 406mm and for Eradu (8200) 371mm. In 2016, rainfall at Strawberry exceeded the long term average, while at Eradu it was slightly below (Table 2). The summer period was dry with little rain in February or March; however rain in the second week of April meant both trials were sown into moist soil. The Strawberry site received 46.6mm from April 8 to April 12 and the Eradu site 30.4mm over the same period. The days between these rains and seeding were very warm, i.e. 36°C at Mingenew on April 13 and ambient air temperature was above 30°C at both sites when sown. There was approximately 25mm of rain on April 26 at both sites and then an extended period without significant rain through early and mid-May. These conditions caused the soil surface to dry during the seeding operation, however measurements of soil moisture at the three seeding depths of 1, 3 and 7cm along with deeper measurements indicated that soil moisture at the top 1cm was similar or greater than at depth in the two weeks following sowing despite the hot conditions (Figures 1a & 1b)

Table 2. 2016 monthly rainfall (mm) from BOM Strawberry weather station (8295) and Eradu weather station (8200)

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year to date
MIG	14.6	1.6	14	76	61.8	86.2	88.6	75.2	25.0	7.4	-	-	450.4
Eradu	42.6	0.6	0.8	49.0	33.2	70.4	77.4	13.2	57.2	8.8	-	-	353.2

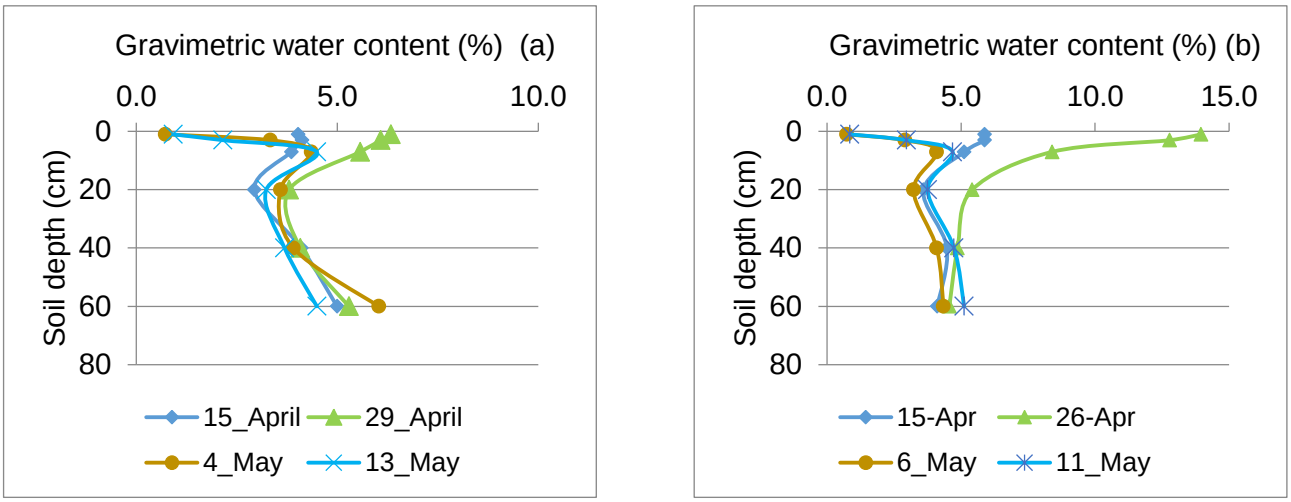

Figure 1. Gravimetric water content (%) (a) Strawberry and (b) Eradu measured at several soil depths including seeding depth.

Establishment and plant growth

Establishment was much lower than the target of 40 plants/m² at both sites, with a mean of 6 plants/m² at Mingenew and 8 plants/m² at Eradu. The field establishment rate achieved was 30% for the treatments with the highest plant density dropping to 1% of viable seed establishing for the ATR Bonito small seed at 7cm seeding depth. This occurred because conditions at seeding were, as previously discussed, not ideal with temperatures above 30°C.

As the depth of sowing increased plant establishment decreased at both sites. In most instances large seeded OP seed produced more plants than medium or small OP seed. The exception to this was when canola was sown deep (7cm) at Eradu, where large and medium sized OP seed produced a similar number of plants/m². Medium sized hybrid seed produced highest or equal highest plants at both sites and all depths (Table 3).

Normalised Difference Vegetation Index (NDVI) taken on May 23 and June 8 was higher ($P < 0.001$) when canola was sown shallow, for the hybrid compared to the OP and for large seed compared to small seed indicating a greater rate of ground cover from these treatments (data not presented).

Table 3. Plant density plants/m² at Strawberry as of 23rd April and Eradu as of 17th of May.

		Strawberry		Eradu	
		ATR Bonito	Hyola 559TT	ATR Bonito	Hyola 559TT
Sowing depth (cm)	**Seed size**	Plants/m^2	Plants/m^2	Plants/m^2	Plants/m^2
1	**Large**	14.0	16.0	17.2	18.2
	Medium	11.5	17.8	13.7	19.5
	Small	7.2	10.6	8.6	12
3	**Large**	6.2	5.5	7.2	7.9
	Medium	2.5	7.4	5.2	9.4

	Small	1.7	4.9	3.4	6.3
7	**Large**	1.1	1.9	2.7	4.3
	Medium	0.8	3.0	3.8	5.3
	Small	0.1	0.9	0.9	2.5
Lsd depth		<.001		<.001	
F Prob depth		1.721		1.42	
Lsd seed size		<.001		<.001	
F prob seed size		1.721		1.42	
Lsd Variety		<.001		<.001	
F prob Variety		1.405		1.16	

Seed yield and quality

Seeding depth had greater influence on yield than plant type or seed size. At Strawberry the 1cm seeding depth averaged 2.2 t/ha, 3cm 1.7t/ha and 7cm 0.8t/ha. At Eradu the 1 cm seeding depth averaged 1.7t/ha, 3cm 1.3t/ha and 7cm 1.0t/ha.

Seed type also had an effect on yield, with the hybrid variety Hyola 559TT yielding 1.8t/ha compared to the OP variety ATR Bonito yielding 1.3t/ha at Strawberry. At Eradu the Hyola 559TT yielded 1.4t/ha compared to ATR Bonito 1.2t/ha.

Seed size used at sowing also had an effect on yield at Strawberry. Canola grown from small seed yielded 1.3t/ha, compared to 1.6 and 1.7t/ha for large and medium sized seed respectively. The effect of seed size was less at Eradu, particularly for Hybrid. Overall medium size seed yielded 1.4t/ha, and small 1.2t/ha mainly due to a drop in yield of the OP at the small seed size (Figures 3 & 4). It should be noted that the Hyola 559TT seed from the commercial seed lot used was large, 180,000 seed/kg. Even the smallest 20% was 235,000 seed/kg, which may explain the lower response to seed size of the hybrid compared to the OP.

Size of harvested seed was greater from shallow sowing and the Hybrid variety at Eradu ($P < 0.001$), while oil % was greater from shallow sowing, larger seed ($P< 0.05$) and the OP Variety ($P < 0.001$). At Strawberry the only significant effect on seed size or oil was a greater seed size of the hybrid compared to the OP ($P < 0.001$).

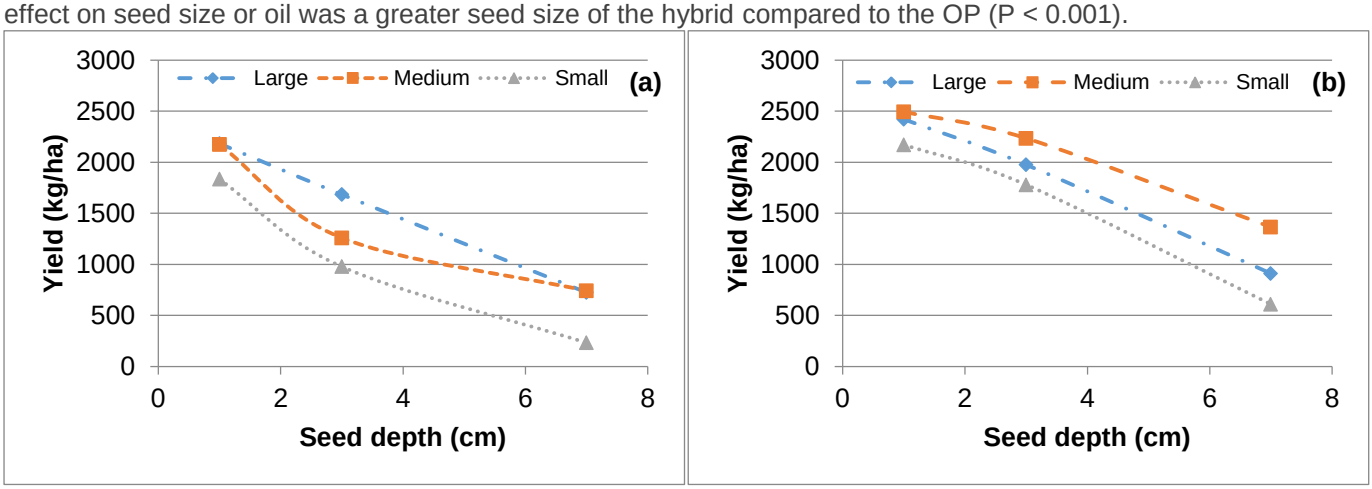

Figure 3. Strawberry site yield by seed size and seed depth **(a)** ATR Bonito **(b)** Hyola 559TT

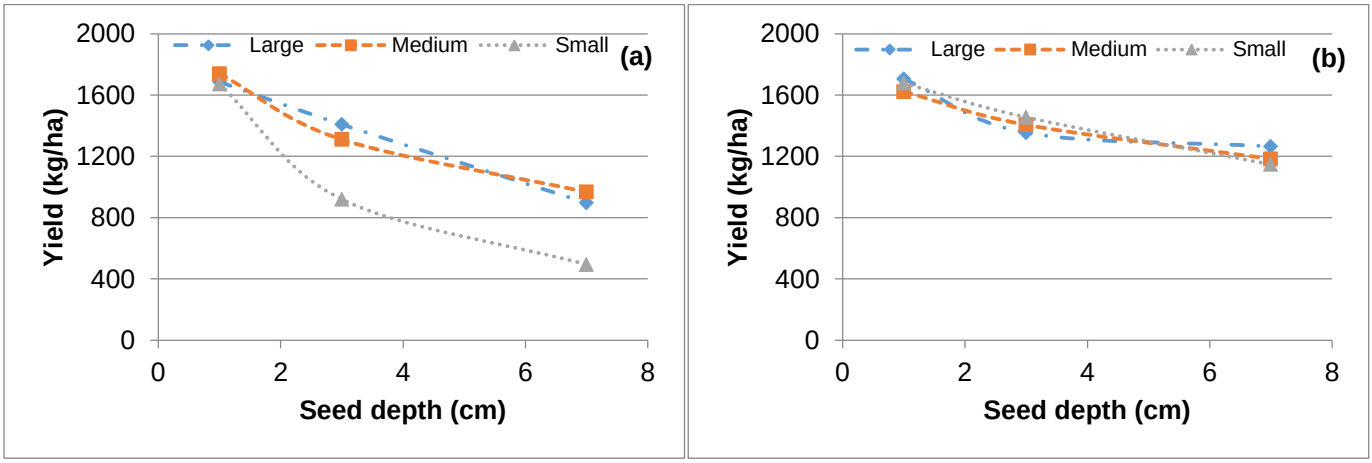

Figure 4. Eradu site yield by seed size and seed depth **(a)** ATR Bonito **(b)** Hyola 559TT

Gross Margins

Total seed costs were calculated using cost per kilo for each seeding rate. Seed costs ranged from $127/ha for the large size hybrid seed sown at 5.29kg/ha to $23/ha for the small size open-pollinated seed sown at 1.79kg/ha. Grain prices used were 5 year averages of non-GM canola worth $543/tonne and GM canola $523/tonne. There was a large range in gross margins with greater variability at Strawberry where margins ranged from -$260/ha to $990/ha compared to Eradu where margins ranged from -$138 to $468/ha.

When sown at a depth of 1cm ATR Bonito had higher gross margins than Hyola 559TT, due to similar yields but lower seed costs. It should be noted that seed costs were high for the Hyola 559TT because of the large seed size in the original seed lot. As seeding conditions were made more difficult by sowing deeper with small seed, the gross margins of Hyola 559TT were greater than ATR Bonito demonstrating the benefit of the hybrid in more difficult seeding conditions (Figures 5 & 6). Medium sized hybrid seed produced highest (Strawberry) or equal highest (Eradu) gross margins than small or large of hybrid seeds at all sowing depths.

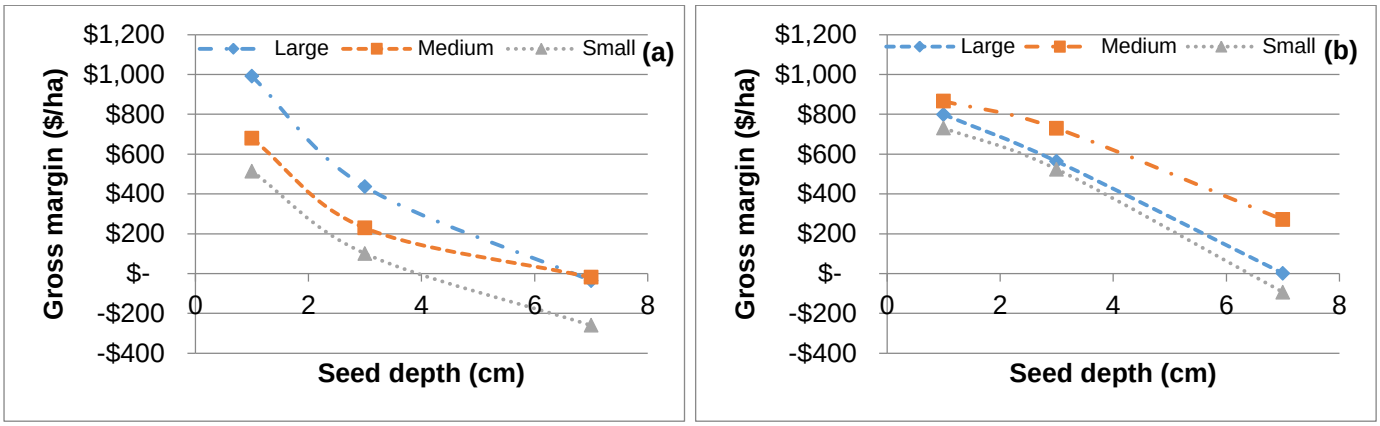

Figure 5. Strawberry site gross margin ($/ha) by seed size and seed depth **(a)** ATR Bonito **(b)** Hyola 599TT

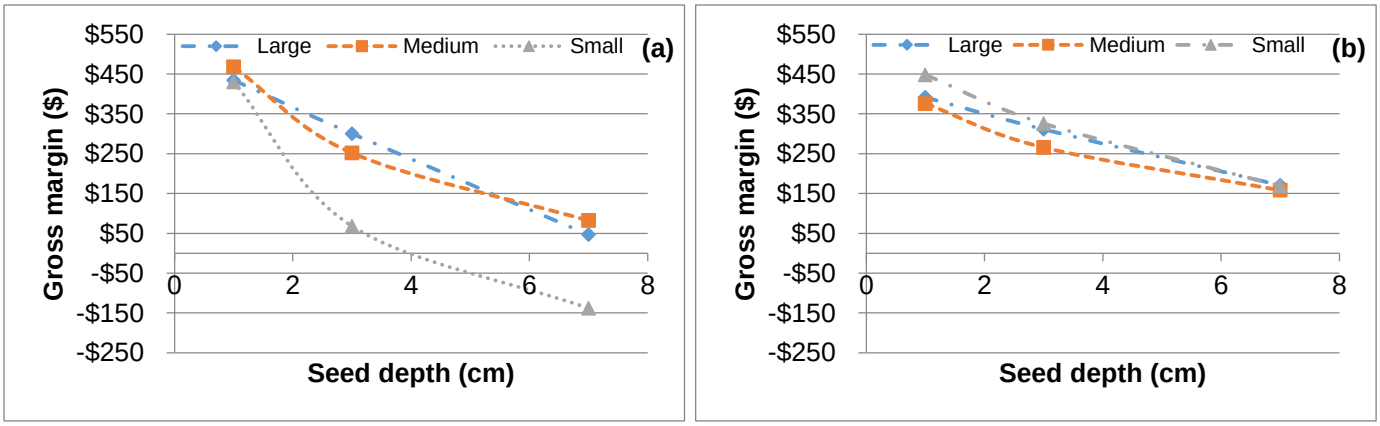

Figure 6. Eradu site gross margin by seed size and seed depth **(a)** ATR Bonito **(b)** Hyola 599TT

Conclusions

Trying to chase deep soil moisture did not work. Even though conditions at seeding in mid-April were hot and drying the 1cm treatments established and yielded better than deeper sowing depths. When canola was sown at 1cm the OP variety ATR Bonito established a reasonable amount of plants and gross margins were higher than hybrid canola due to lower seed costs. However there was an advantage using hybrid canola when sowing deeper than 1cm.

Again the plasticity of the canola plant in the northern region environment was demonstrated with impressive yields achieved from very low plant populations when sown in April. It highlights that early sowing of canola is critical and to maximise the sowing opportunities more work is required to improve establishment methods in harsh conditions. We intend to continue testing in more controlled laboratory conditions to determine rules of thumb for field establishment rates under different soil temperature and moisture conditions.

Reference: Brill R., Jenkins M. L., Gardner M. J., Lilley J. M., Orchard B. A. (2016) Optimising canola establishment and yield in south-eastern Australia with hybrids and large seed. Crop and Pasture Science 67, 409-418.

Key words: Canola, establishment, density

Acknowledgments: Thanks to Stephanie Boyce and Geraldton RSU for trial management and measurements and to the MIG group, Blake family and Bruce Ley for providing the trial sites.

GRDC Project Number: DAW00227**. Paper reviewed by:** Andrew Blake.