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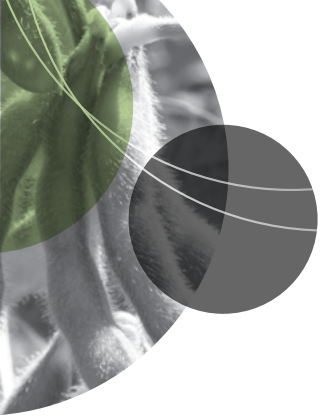

Summer crops

The changing face of sorghum planting windows – Breeza dryland 2018/19

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NSW DPI Tamworth

Key findings

- The planting time for sorghum can be moved earlier than the traditional 16–18 °C soil temperature without negatively affecting crop establishment and grain yield.
- Defining the minimum soil temperature required is still tenuous as temperatures are variable in late winter–early spring and there is still the risk of mild and severe frosts.
- Planting sorghum earlier (September as opposed to late October) at Breeza moved the flowering window forward and resulted in improved grain yields in 2018/19.
- Varying plant population did not affect final grain yield at this site in this season. This was primarily due to there being more primary heads as the plant population increased, but this was offset by fewer fertile tillers being produced.

Introduction

Dryland grain sorghum producers are focused on the need to produce high yields to achieve positive gross margins. One of the major limiting factors to increasing yields is the hot temperatures that commonly occur during flowering and grain fill.

On the Liverpool Plains, the sorghum planting window is considered to open in mid–late October, with a strong preference for a November planting. This traditional planting window is based on avoiding soil temperatures below the recommended 16–18 °C level and frosts in the early growth stages. The combination of high temperatures and flowering has increased in frequency for crops planted in the traditional October–November planting window across the Liverpool Plains in the past 10 years. This has meant the need to consider alternative planting dates to avoid this impact on crop yield potential.

Earlier than traditional planting dates (PD) are being evaluated through this research, where soil temperatures as low as 12 °C are being tested. Lower soil temperatures at planting would be tolerated if uniform, rapid plant establishment could still be achieved, frosts damage avoided and, importantly, the flowering and grain fill period was moved forward. The effects from planting rotational sorghum earlier than normal also need consideration as this can result in an earlier harvest and thus a longer period to refill the soil profile or consider a double crop.

In 2018/19, three experiments were established in this project, a dryland and an irrigated experiment at Breeza and a dryland experiment north of Moree. This report provides the results from the dryland Breeza experiment only.

Site details

Location	Liverpool Plains Field Station, Breeza. 31°10'S, 150°25'E
Co-operator	NSW DPI

Soil type and nutrition	The site was soil cored to establish starting nutrition levels (Table 1); 141 kg/ha of nitrogen to 120 cm deep.
Starting soil water & rainfall	The site was soil cored before each PD to measure the amount of plant available water. PD1 had 127 mm; PD2 200 mm and PD3 152 mm PAW to 120 cm deep. A total of 368 mm rainfall was recorded at the site during between September 2018 and March 2019 (Table 2). In-crop rainfall varied across the three planting times. PD1 and PD2 received 222.9 mm of in crop rainfall and PD3 received 170 mm (Table 2).
Experiment design	Split, split plot with PD as the main plot and then plant population as a sub plot. Hybrids were randomly allocated to plots. Three replications.
Fertiliser	Granulock Supreme Z (43 kg/ha) was applied with the seed at planting.
Harvest dates	PD1: 24 January 2019 PD2: 5 February 2019 PD3: 28 February 2019

Table 1 Site soil chemical characteristics for 0–120 cm depth at Breeza in 2018.

Characteristic	Depth (cm)				
	0–10	10–30	30–60	60–90	90–120
pH_{Ca}	7.7	7.9	8.0	8.1	8.2
Nitrate nitrogen (mg/kg)	29	11	6	8	5
Sulfur (mg/kg)	10.1	8.2	14.7	15.5	29.4
Phosphorus (Colwell) (mg/kg)	37	13	19	28	35
Organic carbon (OC) (%)	1.00	0.53	0.45	0.35	0.32

Table 2 In-crop rainfall at Breeza in 2018/19.

Month	September	October	November	December	January	February	March
Rainfall (mm)	22.0	56.6	62.0	29.0	27.0	39.0	132.4

Treatments

Planting dates (3)

Three PDs to target different soil temperatures, recorded as the seven-day average at 8 am AEST.

- PD1: 6 September 2018; soil temperature 11.2 °C.
- PD2: 17 September 2018; soil temperature 10.3 °C.
- PD3: 23 October 2018; soil temperature 18.8 °C.

Planting rate (4)

Four target plant populations on 100 cm solid plant rows on raised beds (Figure 1).

- 3.0 plants/m^2 (30 000 plants/ha)
- 6.0 plants/m^2 (60 000 plants/ha)
- 9.0 plants/m^2 (90 000 plants/ha)
- 12.0 plants/m^2 (120 000 plants/ha)

Hybrids (6)

MR Buster, MR Apollo, G33, Cracka, HGS114 and Agitator.

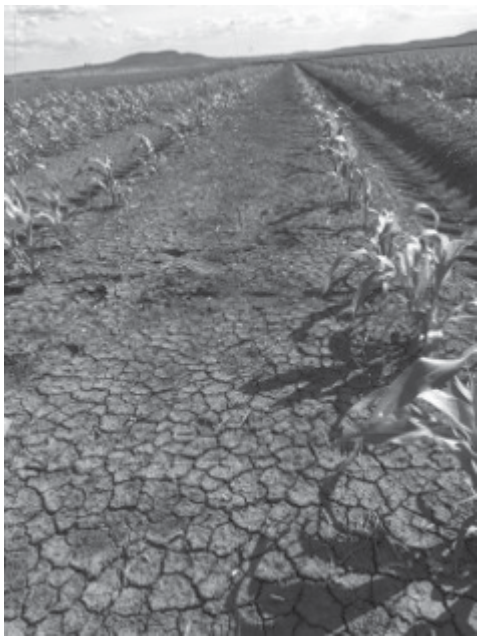

Figure 1 Breeza dryland experiment planted on one metre raised beds.

Results

Establishment

At Breeza the soil temperatures rose nearly to 12 °C during early September, which prompted PD1 and then continued to rise, which led to PD2. However, immediately after PD2, soil temperatures cooled to a seven-day average of 10.3 °C. At these cooler soil temperatures, PD significantly affected plant establishment. PD1 and PD2 had significantly reduced plant establishment compared with the standard (PD3) planting date, representing one of the risks of planting early.

Most hybrids did not achieve the four target plant populations of 3 plants/m^2, 6 plants/m^2, 9 plants/m^2 and 12 plants/m^2 for PD1 or PD2. PD3, which established in soil temperatures closer to 19 °C, was better (data not shown).

There were a couple of small differences between hybrids for plant establishment. Agitator had a significantly lower establishment than all other hybrids and G33 established fewer plants than MR Buster (Figure 2).

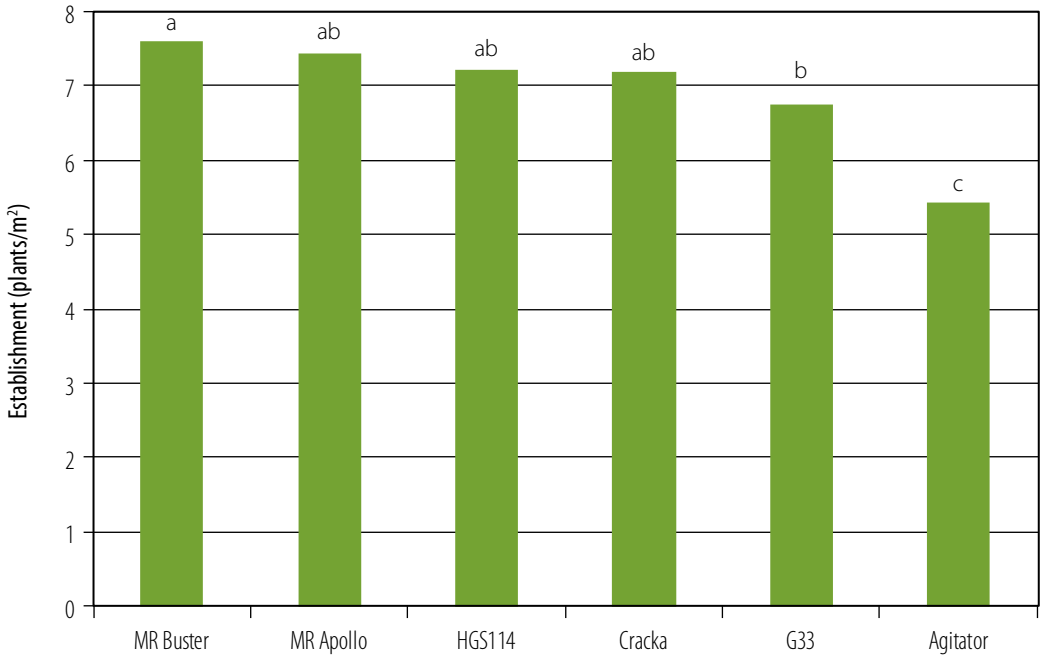

Figure 2 Hybrid establishment (plants/m²) averaged across planting dates and plant populations.

Planting date and plant population effects on crop development

There was a significant interaction between PD and plant population. The number of fertile tillers declined as the plant population increased for all PDs. PD3 had much lower levels of tillering than PD1 or PD2 (Figure 3).

Planting date did not affect the number of primary heads at Breeza. There were more primary heads produced with higher plant populations. Agitator and MR Apollo produced the lowest number of heads (data not shown).

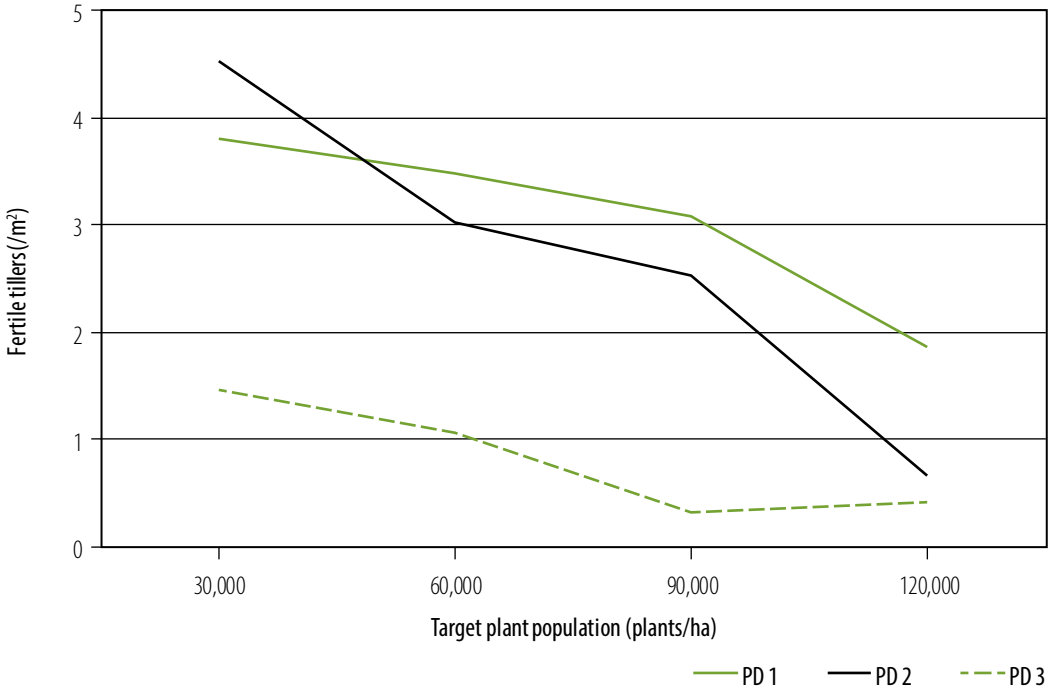

Figure 3 Interaction between planting date and target plant population effect on fertile tiller number (tillers/m²).

Did planting earlier affect the flowering date?

The number of days taken to reach 50% flowering reduced as PD was delayed. For PD1 it was 95 days, PD2 was 10 days faster at 85 days and it was 69 days for the standard planting date of PD3. Between PD1 and PD2, delaying planting by 15 days resulted in a 10-day difference in flowering. PD3 developed in much warmer conditions, so though there was a 30-day difference in planting between PD2 and PD3, there was only a 16 day difference to flowering.

There was a much smaller difference between the hybrids for time to flowering at Breeza compared with Moree in 2018/19. However, Agitator was the quickest hybrid to start flowering for all PDs, although by PD3, MR-Buster flowered in a comparative number of days. MR-Apollo remained the slowest of the hybrids evaluated (Figure 4).

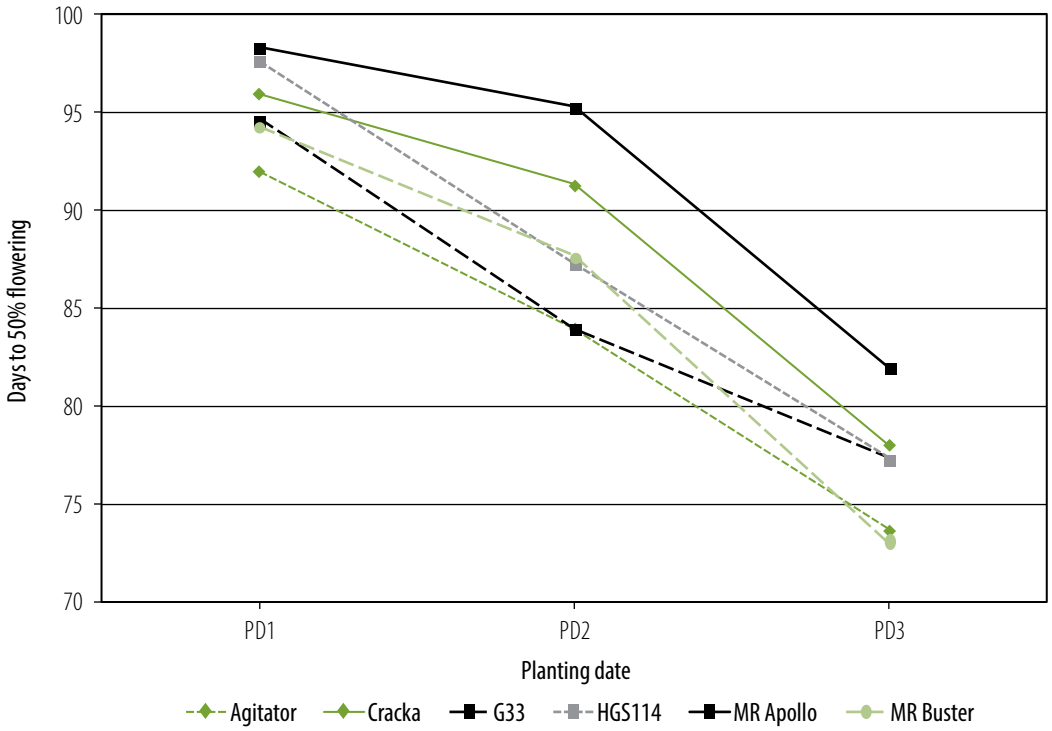

Figure 4 Days to 50% flowering at Breeza – dryland at six plants/m^2 target plant population.

How did varying planting date affect grain yield and quality?

The site mean yield was 1.73 t/ha at Breeza in 2018/19. There was a significant impact of PD and hybrid on final grain yield (Table 3). PD1 (2.23 t/ha) and PD2 (2.12 t/ha) had significantly higher grain yield than PD3 (0.85 t/ha), averaged across hybrids and plant populations. There was no significant impact of plant population on grain yield.

The quicker maturing hybrids tended to have better yields in this season for PD1 and PD2 as opposed to PD3. That is Mr Buster, G33 and Agitator were significantly better than HGS114, Cracka and MR Apollo. MR Apollo performed poorly for all three PDs.

Table 3 How planting date and hybrid affected grain yield (t/ha) at 13.5% moisture.

Hybrid	PD1	PD2	PD3
MR Buster	2.61[a]	2.41[ab]	1.26[def]
G33	2.59[a]	2.43[ab]	0.83[eg]
Agitator	2.57[a]	2.31[ab]	0.88[eg]
HGS114	2.22[bc]	2.32[ab]	0.87[eg]
Cracka	2.16[bc]	1.91[acd]	1.00[efg]
MR Apollo	1.25[defg]	1.32[e]	0.26[h]
l.s.d. (P<0.05)	0.75		

Test weights were significantly lower for PD3 (54.8 kg/hl) compared with PD1 (62.7 kg/hl) and PD2 (62.8 kg/hl), although neither made sorghum grade 1. Similarly, no hybrid produced the required test weight to achieve grade 1 sorghum (>71 kg/hl).

Planting date, plant population and hybrid affected screenings at Breeza with all levels being relatively high. PD1 and PD2 had significantly lower screenings at 12.6% and 13.2 % than PD3 at 27.4%. The hybrid interaction was also significant with Agitator and Cracka producing the lowest screenings at 15.3% and 15.7% respectively. G33 had the highest screenings at 21.5%. Higher screenings also occurred as plant population increased (data not shown).

Conclusions

Planting into slightly cooler temperatures (10–11 °C) at Breeza significantly affected sorghum establishment, resulting in lower plant establishment. However, planting earlier in this season moved the flowering window forward. This helped to ensure flowering occurred before the peak of heat and moisture stress. The earlier planting date resulted in improved yields, even though average yields at Breeza were not high due to the dry conditions.

Varying the target plant population, from three plants/m^2 to 12 plants/m^2 did not affect final grain yield. The plants modified their tiller and head production in response to the surrounding competition and seasonal conditions. For example, as plant population increased the number of primary heads increased and the number of fertile tillers decreased.

While the benefits of planting sorghum earlier than traditionally recommended appear to be improved grain yield and grain quality, the risks have not yet been fully evaluated. Plant establishment losses were higher, meaning additional seed costs for no resulting plants. The effect of frost in particular also needs to be further assessed including determining the actual temperature and duration that cause plant death.

Acknowledgements

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