Sorghum in the western zone: row configuration × population × hybrid – "Koiwon", Bellata 2014–15

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Key findings

In a low-yielding season varying row configuration had no effect on sorghum yield.

Yield declined as plant population and hybrid tillering ability increased and staygreen levels decreased.

Introduction

Sorghum is a reliable summer crop in eastern areas of northern NSW. However, there is a need to improve its reliability in western cropping areas and to assess strategies that will allow growers to adapt to increasingly variable seasonal conditions. Introducing hybrids with increasing levels of staygreen (SG), or using a combination of different tillering habits, plant population and row configuration may help improve the reliability of sorghum yield in western regions.

In the eastern zone, there has been a reasonable amount of research evaluating population and row spacing. Modelling studies suggest that sorghum can be a reliable component of western cropping systems, but this work needs applied research to verify the modelling and give growers confidence to incorporate sorghum into their rotations.

In northern NSW, crown rot – a stubble-borne fungal pathogen, continues to be the most prevalent and damaging disease affecting winter cereals. Sorghum is recommended as a break crop, but the success is dictated by the amount of breakdown of the winter cereal stubble. Although altering row configuration and population might improve the reliability, it could also reduce the rate of decomposition of cereal stubble and reduce water accumulation during the fallow period and hence the break crop benefits.

The trial outlined below aimed to answer some of these questions and provide data for use in modelling the trial outcomes over long-term climatic data sets. This was one of three sites planted across northern NSW in the 2014–15 season. The other sites were located at Gurley and north of Ashley.

Site details

Location:	**"Koiwon", Bellata**
Co-operator:	**Bruce Kirkby**
Sowing date:	**7 and 8 January, 2015**
Harvest date:	**11 May, 2015**
Fertiliser:	**42 kg Granulock Z at sowing**

Starting soil water

The site was cored pre-sowing to establish starting soil water. There was 87 mm of plant available water (PAW) for sorghum.

Starting nutrition

The site was cored just prior to sowing to determine starting soil nutrition (Table 1).

Table 1. *Starting soil nutrition at "Koiwon" Bellata*

Depth (cm)	Nitrate (mg/kg)	Colwell P (mg/kg)	Colwell K (mg/kg)	Sulfur (mg/kg)	Organic carbon (%)	Conductivity (dS/m)	pH ($CaCl_2$)
0–10	21	6	189	2202.4	0.18	1.069	6.9
10–30	23	9	246	826.0	0.10	0.845	7.6

Starting crown rot

Wheat stubble was collected and plated pre-sowing. Results indicated a 10% infection level in the crown and 18% infection in the first node of the stubble above ground. As such, it was rated as a low risk for crown rot and no further stubble collection was warranted.

Rainfall 2015

Table 2. In-crop rainfall (mm) at "Koiwon" Bellata

Jan	Feb	Mar	Apr	May	Total
0	0	10.5	19	0	29.5

Treatments

Hybrids MR Apollo (low tillering and high SG)
MR 43 (moderate SG and tillering)
MR Bazley (high tillering and low SG)

Row configuration Solid on 1 m spacings
Single skip
Double Skip
Superwide (1.5 m spacings)

Plant populations Populations were targeted using germination for each hybrid and an estimated establishment of 80%. Three populations were targeted in each of the row configurations:
15,000 plants/ha
30,000 plants/ha
50,000 plants/ha

Results

Throughout tables values followed by the same letter are not significantly different at the 95% confidence level (P=0.05).

Plant establishment

The trial established reasonably well, but achieved plant populations were below the targets (Table 3). Significant differences between the treatments were evident though. There were also differences in establishment between the hybrids with MR Apollo establishing fewer plants than MR 43 and MR Bazley (Table 4). There was no impact of row configuration on plant establishment (data not shown).

Table 3. Target plant population versus established plant population

Target population (plants/ha)	Established population (plants/ha)
15,000	13,220 c
30,000	26,520 b
50,000	37,190 a

Table 4. Impact of sorghum hybrid on established plant population

Hybrid	Established population (plants/ha)
MR Apollo	23,030 b
MR 43	26,420 a
MR Bazley	27,470 a

Tillering

Tiller counts revealed significant differences in all three treatments: configuration, plant population and hybrid. The number of tillers per m^2 declined as the row configuration widened (Table 5). This was not surprising as there is less competition between plants in the solid rows compared with the double skip configuration. The same relationship was also evident for the number of tillers per plant, with fewer tillers as the effective row spacing widened (Table 5).

__Table 5.__ Row configuration effect on tillering

Configuration	Tillers (number/m²)	Tillers (number/plant)
Solid	3.94 a	1.69 a
Superwide	2.68 b	1.31 b
Single skip	2.60 bc	1.35 b
Double skip	2.03 c	1.10 c

The hybrids also performed as expected with MR Apollo producing the lowest number of tillers, followed by MR 43 and then MR Bazley producing the most tillers both per m^2 and per plant (Table 6).

__Table 6.__ Hybrid effect on tillering

Hybrid	Tillers (number/m²)	Tillers (number/plant)
MR Apollo	2.30 c	1.17 b
MR 43	2.72 b	1.29 b
MR Bazley	3.42 a	1.63 a

As the plant population increased the number of tillers per m^2 and per plant declined (Table 7). The effect on the number of tillers per plant was more dramatic than the overall tillers per m^2, with the highest target population producing less than half the number of tillers when compared to the lowest target population.

__Table 7.__ Target plant population effect on tillering

Target population (plants/ha)	Tillers (number/m²)	Tillers (number/plant)
15,000	3.09 a	2.08 a
30,000	3.01 a	1.30 b
50,000	2.34 b	0.70 c

Head production

There was no evidence of significant effect from row configuration or plant population on the measured number of heads produced (data not shown). However, the sorghum hybrid MR Apollo produced fewer heads per m^2 and per plant than MR Bazley, with MR 43 being intermediate between the two hybrids (Table 8).

__Table 8.__ Hybrid effect on head production

Hybrid	Heads (number/m²)	Heads (number/plant)
MR Apollo	3.13 b	1.50 b
MR 43	3.47 ab	1.58 ab
MR Bazley	3.71 a	1.75 a

Varying plant population only impacted on the number of heads produced per plant with a declining number of heads as plant population increased (Table 9).

__Table 9.__ Plant population effect on heads production

Target population (plants/ha)	Heads (number/plant)
15,000	2.33 a
30,000	1.44 b
50,000	1.07 c

Dry matter production

Dry matter production was measured at flowering; neither row configuration nor hybrid selection affected dry matter production (data not shown). Varying plant population did have an effect, with more dry matter produced by the higher target plant populations (Table 10).

Table 10. *Plant population effect on dry matter production*

Target population (plants/ha)	Dry matter (t/ha)
15,000	1.51 c
30,000	2.50 b
50,000	3.86 a

Grain yield

The average grain yield at the site was 1.59 t/ha reflecting the dry finish to the season. Significant differences were still measured between plant population (Table 11) and hybrid selection (Table 12), but not between row configurations (data not shown). The low target plant population of 15,000 plants/ha was the highest yielding, followed by the 30,000 plants/ha and then the 50,000 plants/ha target populations (Table 11). Increasing the target plant population caused declining yields.

Table 11. *Varying plant population effect on final grain yield*

Target population (plants/ha)	Grain yield (t/ha @ 13.5% moisture)
15,000	1.81 a
30,000	1.60 b
50,000	1.35 c

At this site, grain yields declined as the hybrid's tillering ability increased and the staygreen level decreased. Therefore, MR Apollo yielded the highest, followed by MR 43 and then MR Bazley (Table 12).

Table 12. *Varying hybrid effect on final grain yield*

Hybrid	Grain yield (t/ha @ 13.5% moisture)
MR Apollo	1.71 a
MR 43	1.59 b
MR Bazley	1.45 c

Grain quality

Subsamples were collected from each plot at harvest and were used to measure grain quality parameters including grain protein, 1000 grain weight and test weight.

Grain protein averaged 11.08 %, indicating that there was sufficient nitrogen to achieve maximum yields. No treatments affected final grain protein levels (data not shown).

The test weight averaged 77.82 kg/ hectolitre (hL) showing the grain was sound. The highest yielding hybrid, MR Apollo, had the lowest test weight (Table 13), as did the lowest target plant population (Table 14). There was no difference in test weight between configurations except the superwide, which had a higher test weight (Table 15).

In contrast, MR Apollo had the highest 1000 grain weight (Table 13). Thousand grain weight also declined as plant population increased (Table 14).

Screenings were very low for all treatments at the site with no treatment above 5% (data not shown).

Table 13. *Varying hybrid effect on grain quality*

Hybrid	Test weight (kg/hL)	1000 grain weight (grams)
MR Apollo	75.83 c	28.90 a
MR 43	79.18 a	26.43 c
MR Bazley	78.45 b	27.20 b

Table 14. *Varying plant population effect on grain quality*

Target population (plants/ha)	Test weight (kg/hL)	1000 grain weight (grams)
15,000	77.23 c	28.42 a
30,000	78.41 a	27.53 b
50,000	77.82 b	26.57 c

Table 15. *Varying row configuration effect on grain quality*

Configuration	Test weight (kg/hL)	1000 grain weight (grams)
Solid	77.16 b	26.76 c
Single skip	77.14 b	27.43 b
Superwide	79.04 a	27.29 bc
Double skip	77.95 b	28.56 a

Summary

At this site, in a season where starting soil moisture and in-crop rainfall were limited, it is not surprising that final sorghum grain yields were low. Under these low-yielding conditions, grain yield declined as plant population increased. Row configuration did not affect yield. Similarly, grain yield declined as the hybrids' tillering ability increased and the staygreen level decreased, hence MR Apollo was the highest yielding sorghum hybrid at this site.

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