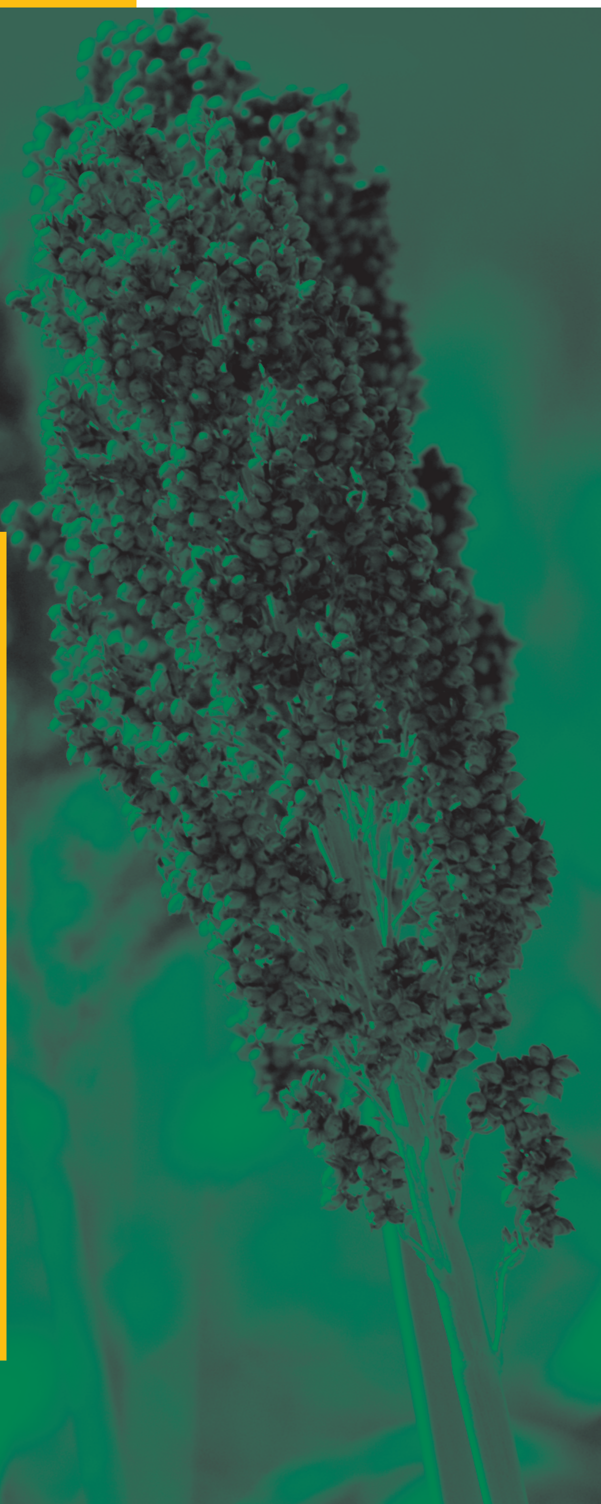
NORTHERN
FEBRUARY 2017

GRDC™ GROWNOTES™

GRDC™ GRAINS RESEARCH & DEVELOPMENT CORPORATION



SORGHUM

SECTION 3

PLANTING

SEED TREATMENTS | TIME OF SOWING | TARGETED PLANT POPULATION | CALCULATING SEED | SOWING DEPTH | SOWING EQUIPMENT

Planting

3.1 Seed treatments

Herbicides containing the active ingredient metolachlor (Dual®, Dual Gold®, Primextra® and Primextra Gold®) can seriously damage sorghum plants. When there is a need to use these herbicides for weed control, it is necessary to 'safen' the sorghum seed by pre-plant seed treatment with the seed-safener, Concep® II. Check labels on all seed treatment products for recommended treatment sequences and procedures. [1] Pacific Seeds Elite seed and Pioneer Hi-Bred Betta Strike Plus seed are both pre-applied with Concep® II.

Factors increasing the chance of sorghum injury

- rainfall or irrigation between planting and emergence wetting down to the seed zone, especially where waterlogging occurs.
- light/sandy/gravel soils
- germinating seedling under stress (e.g. waterlogging, cold shock, insect damage)
- maximum application rates
- marginal soil temperature at planting
- defined planting furrows that with rainfall, act to concentrate herbicide over the crop row
- shallow planting depth

Factors reducing the chance of sorghum injury

- high quality seed, treated with Concep® II seed safener
- Concep® II seed safener applied within the past 18 months
- closing up of the planting slot to avoid herbicide coming into contact with the sorghum seed
- excellent crop agronomy [2]

3.2 Time of sowing

Early plant sorghum currently offers a more attractive proposition to growers in the western zone (west of the Newell Highway) than late plant sorghum, mostly for logistical and rotational reasons. [3] The preferred planting time for the Moree and Narrabri districts is late September through to early October, and for Gunnedah, Inverell and Tamworth districts, mid-October to late November (Table 1). Planting at the beginning of these windows is often more successful in minimising moisture stress during flowering; however, the earlier planted crops are more likely to suffer from cold conditions as seedlings. Early plantings have the advantage of early maturity and harvest enabling the opportunity of double-cropping (often to chickpeas) after favourable midsummer rains (Figure 1).

November can be a difficult month for planting sorghum in northern NSW and southern Queensland. It often means heat stress conditions during flowering and

MORE INFORMATION

http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/sorghum/planting-information

http://www.grdc.com.au/uploads/documents/2010ASGCPowerPointPresentationsPDF/Keller_FusariumInSorghum_slides.pdf

www.apvma.gov.au

VIDEOS

Mark Congreve ICAN discusses the factors that influence crop injury.
Video: Managing sorghum injury when using metolachlor herbicides

MORE INFORMATION

GRDC Tips and Tactics: Managing frost risk - Northern Southern and Western Regions

1 QDAF (2011) Sorghum—planting information. Department of Primary Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/sorghum/planting-information

2 GRDC (2016) Keeping sorghum safe, GRDC Tips and Tactics, www.grdc.com.au/TT-KeepingSorghumSafe

3 L Serafin, G McMullen (2015) Sorghum agronomy to manage risk and improve yield in the western zone, GRDC Update Papers 31 July 2015, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/07/Sorghum-agronomy-to-manage-risk-and-improve-yield-in-the-western-zone

PODCAST

Loretta Serafin NSW DPI discusses sorghum trials in northern NSW aimed at optimising profitability. GRDC Podcast: 094 Optimising sorghum production

early grainfill, although summer weather is notoriously erratic. Yields can be variable because of erratic summer weather, but are generally average or better.

Planting before early January so that the crops finish flowering by mid-March may reduce the risk of sorghum ergot infection. January-planted, midge-resistant hybrids with good soil moisture and nutrition can still have good yield potential despite being slower to dry-down and more prone to midge damage.

Planting after mid-December on the Liverpool Plains increases the risk of ‘incomplete pollination’ caused by night temperatures falling to <13°C during flowering, thereby reducing yield in some of the more susceptible hybrids. Sowing after 10 January is not recommended because of the risk of the sorghum not reaching physiological maturity before an early first frost event.

Table 1: *Suggested sowing times for sorghum in NSW.*

Region	Early plant												Late plant														
	Aug.				Sept.				Oct.				Nov.				Dec.				Jan.				Feb.		
Week:	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
NW plains						>	●	●	●	●	●	●	<				>	>	●	●	●	●	<				
NW slopes, Liverpool Plains									>	●	●	●	●	●	<		>	●	●	●	●	<					
Central west											>	●	●	●	●	●	<										
Southern irrigation areas											>	●	●	●	●	●	<										
Western Downs					>	●	●	●	●	●	●	●	●	●	●	<			>	●	●	●	●	<			
Central Downs							>	●	●	●	●	●	●	●	●	<			>	●	●	●	●	<			
Northern Downs							>	●	●	●	●	●	●	●	●	<			>	●	●	●	●	<			
Southern Downs									>	●	●	●	●	●	●	●	●	●	●	●	<						
Callide Dawson			>	●	●	●	●	●	●	●	<								>	●	●	●	●	●	●	<	
Southern Highlands			>	●	●	●	●	●	●	●	<								>	●	●	●	●	●	●	<	
Northern Highlands	>	●	●	●	●	●	●	●	●	●	<								>	●	●	●	●	●	●	●	<

> Earlier than ideal, but acceptable; ● optimum sowing time; < later than ideal, but acceptable

Figure 1: *Consider soil temperatures prior to sorghum planting.*

Sorghum should be planted when the soil temperature at 09:00 (9 am) EST at the intended seed depth (~5 cm) is at least 16°C (preferably 18°C) for 3–4 days consecutively and the risk of frosts has passed. Soil temperatures usually reach 16°C in early October at Moree and mid-October at Gunnedah. These same planting rules apply in the central west of NSW.

Planting into cold soils slows emergence, reduces germination and establishment, and increases susceptibility to seedling blight. Low soil and air temperatures slow plant growth and reduce nutrient uptake (especially phosphorus), inducing purpling in some hybrids. Very early planted paddocks frequently have to be replanted. Note that some hybrids do have better cold tolerance than others. [4]

In Queensland, sorghum planting time varies from September to January, depending on planting rains and soil temperature early in the season.

Crop failures are likely in central and southern regions from very early plantings in August–September, due to cold conditions at emergence, and very late plantings in February–March, due to cold conditions during crop ripening. Planting at the early end of the range is preferred to avoid midge problems and to allow the option to double-crop a winter crop if sufficient rainfall is received.

Best yields usually follow October plantings. These crops usually miss insect damage by midge. With late crops, midge will need to be managed by selecting midge-

4 N Moore, L Serafin, L Jenkins (2014) Grain sorghum. Summer crop production guide 2014, pp. 5–16, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/303485/Summer-crop-production-guide-2014.pdf

MORE INFORMATION

http://www.australianoilseeds.com/__data/assets/pdf_file/0006/7791/1989_Survey_of_Sorghum_and_Sunflower_Establishment_in_Central_Highlands.pdf

MORE INFORMATION

G Hammer, S Chapman, V Singh, C Nguyen, E van Oosterom, G McLean, B Zheng, D Jordan (2015) Grain sorghum varietal reactions to heat stress and environment, GRDC Update Papers 24 July 2015, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/07/Grain-sorghum-varietal-reactions-to-heat-stress-and-environment

resistant sorghum hybrids and/or with the use of insecticide sprays. Generally, mid-season hybrids are the best overall performers.

Sorghum ergot disease risk can also be minimised by planting from mid-October to mid-January in southern Queensland, so that flowering occurs between mid-December and mid-March, when the probability of ergot developing in sorghum florets is lowest. For more detail on this disease and its management, see GrowNotes Sorghum 9. Diseases.

In central Queensland, use quick-maturing hybrids for rain-grown spring plantings. For the main summer planting (late December to mid-February), plant slow-maturing hybrids early and the quicker maturing hybrids later to improve yield reliability.

At soil temperatures of 15°C, sorghum takes 11–14 days to emerge. At 17°C, it takes only 7–10 days. [5]

3.2.1 The effect of temperature on yield

Collaborative research funded by the Grains Research and Development Corporation (GRDC) and led by the University of Queensland has examined the sowing-date effects on yield and high temperature risk in sorghum.

The superiority of early or late sowing varies from year to year depending on how the season develops. Researchers argue that the best growers can do is to estimate the risks of what might happen for different scenarios given historical climate data.

The APSIM model provides the best technology for doing this, and the sorghum model has been updated to incorporate the latest scientific knowledge on the physiology of crop growth and development (Hammer *et al.* 2010). Researchers can now simulate risks associated with changes in genetics (G) and management (M) across environments (E)—the G × M × E landscape—with increased confidence by using the model with historical climate records (or with climate-change scenarios).

Researchers have looked at the effects of sowing date on yield chances and considered how this is affected by moisture conditions and occurrences of high temperature. Results are given for Goondiwindi, but could be reproduced for other sites (Figure 2). [6]

5 QDAF (2011) Sorghum—planting information. Department of Primary Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/sorghum/planting-information

6 G Hammer *et al.* (2011) Sowing date effects on yield and high temperature risk in sorghum. GRDC Update Papers 6 September 2011

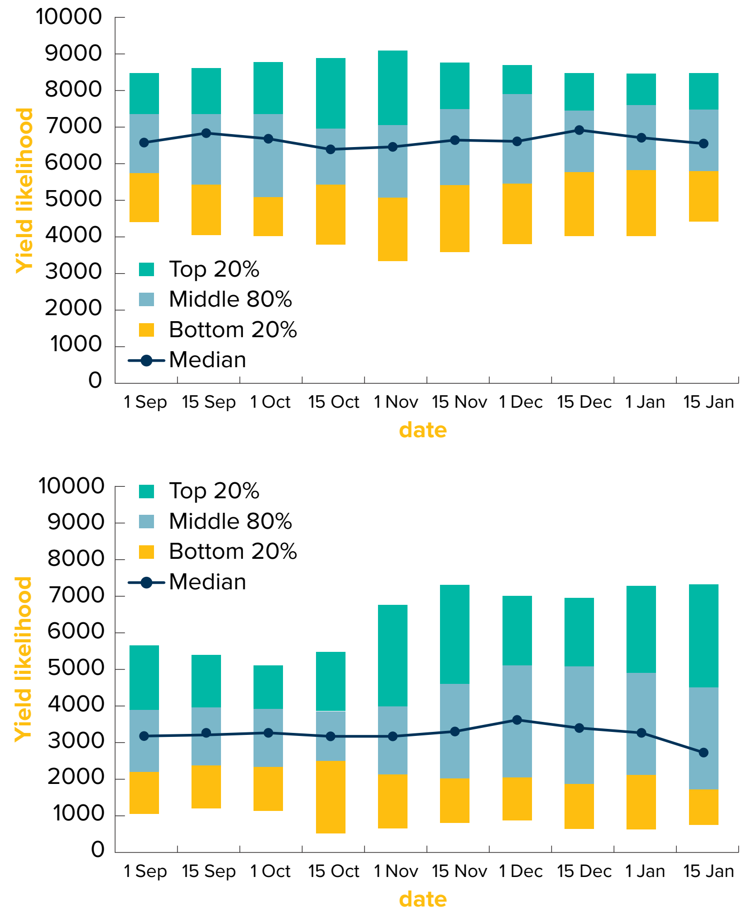


Figure 2: *Yield likelihood v. sowing date at Goondiwindi assuming either a full profile (top panel) or 100 mm available water at sowing (bottom panel). The blue line joins the median (50/50) yield and the bars indicate the range of yield in 80% of years. The best and worst 10% are not included. The 80% of years are broken into the best 20% (top, green), middle 40% (yellow), and worst 20% (bottom, red) of those years.*

MORE INFORMATION

http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/managing-for-dry-times

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/146355/grain-sorghum.pdf

http://www.grdc.com.au/uploads/documents/GRDC_Sorghum_HY.pdf

MORE INFORMATION

GRDC Update Paper: Better profits from good soil water decisions (Goondiwindi)

3.2.2 Maximising yield potential

Early planting of sorghum can help to avoid hot weather. It also raises a compromise between soil temperatures for good sorghum emergence and trying to avoid heat and achieve better Water Use Efficiency (WUE).

Heat affects sorghum in several ways:

- It reduces the time from emergence to flowering.
- High night temperatures result in higher respiration levels and less efficient photosynthesis.
- Temporary wilting occurs during the heat of the day.
- Severe temperatures can affect head development.

The combination of these factors reduces WUE, resulting in the crop using more water in hot weather to grow the same yield.

The effect of heat has implications for planting time. The effect of delay in planting time for wheat is well documented, with a halving of WUE from ~12 kg/ha.mm at the optimum planting date in May, to 6 kg/ha.mm for wheat planted in late July (WUE calculated without subtracting evaporation).

Sorghum is not as greatly affected by heat as wheat, but there are similar effects. The estimated WUE of sorghum from an early planting at Dalby is 16 kg/ha.mm, which drops by 33% to 10.8 kg/ha.mm in December (Figure 3).

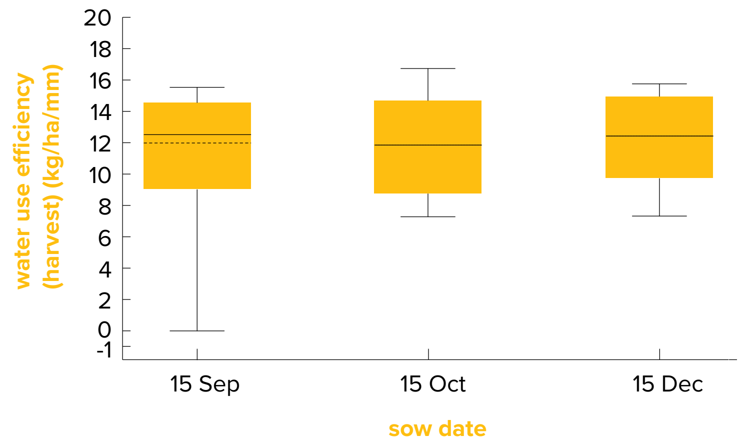


Figure 3: *Simulated Water Use Efficiency (WUE, kg/ha) for three planting dates at Dalby. Soil water 290 mm, medium-maturity planted at 6 plants/m. Note mean WUE slightly higher on the September plant but with more variability.*

Source: Whopper Cropper

By selecting cold-tolerant varieties and using good insecticide treatment and accurate shallow planting of seed with disc planters, sorghum can be established at much lower temperatures than the 17–18°C generally recommended. Sorghum will still emerge at much lower temperatures; it will just take longer and is more prone to disease and insect attack.

Another reason that soil temperatures may not be very useful guide is that they only reflect the weather over the past few days, whereas what is important is the temperature over the week or two after planting.

The alternative to using soil temperatures is to plant according to the expected end of the frost season in a particular locality and paddock on the farm. This means sorghum planting might start around the second week in September in western areas (e.g. Moree and Roma), allowing 10 days for emergence before the end of the frost period.

Around Dalby, the earliest start of a planting period with reasonable risk is around the third week in September, and at Warwick, a week or two later.

Attempting to plant as early as possible means replanting may be needed on occasions, but this will usually be when there is rain soon after planting under cold conditions. The benefit is likely to be better crops in 9 years out of 10.

Key points

- Optimum WUE for sorghum planted in September at Dalby is 16 kg/ha.mm. This is estimated to fall by 33%, to 10.8 kg/mm, for a mid-December planting.
- There is a conflict between ideal soil temperatures and getting the crop in early to avoid heat.
- Cold soil planting is less of a problem with modern planters and insecticides.

- Sorghum will establish at much lower temperatures than the 17–18°C that is generally recommended. [7]

3.2.3 Matching sorghum hybrids and management to site and seasonal conditions

Yield in sorghum is not just agronomy or hybrid choice, what really matters is to understand how to match hybrids and management to sites and expected seasonal conditions.

Substantial opportunities exist to increase productivity by providing growers access to hybrids with a wider range of trait characteristics. [8]

Queensland researchers conducted on farm trials at 19 locations across Queensland investigating the performance of twelve commercial and experimental hybrids representing the major types available, with variations in density and row spacing. More than 2000 plots were planted between 2014 and 2016. Hybrid types were defined by the maturity and tillering characteristics of the hybrids. Maturity in the hybrids varied from 55 to 62 days to flowering; and from 106 to 113 days to maturity. High and low tillering hybrids produced 3.5 and 2.5 tillers per plant (at flowering); though both types produced around 2.1 heads per plant at maturity. [9]

Results from the first season of agronomy trials showed almost a two-fold increase in yield that could be achieved by better matching agronomy to hybrid type across the tested sites. These findings question the idea that agronomy outweighs genetics in sorghum yield; and emphasises that what really matters is to understand how to match hybrids and management to sites and expected seasonal conditions.

- For the high yielding environments, the highest yields were obtained with higher tillering and later maturity hybrids planted in solid configurations at medium to high plant populations.
- In the medium yielding environments, highest yields were obtained with medium tillering and medium maturity hybrids planted in solid configurations at medium to high plant populations.
- In the low yielding environments, highest yields were obtained with low tillering and earlier maturity hybrids planted in solid configurations at low plant populations.

Download the GRDC Update paper from: https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/06/Optimising-sorghum-genetics-and-management-for-targeted-situations

3.3 Targeted plant population

3.3.1 Row spacing

Solid plant rows (75 or 100 cm) typically outyield skip-rows or wide rows under good growing conditions; therefore, solid planting is more appropriate with high-yielding, irrigated crops and/or high rainfall environments. Skip-row configurations are more advantageous in low-moisture, lower yielding dryland situations.

Advantages of solid rows decrease rapidly as soil moisture reserves decline, especially in more marginal areas. Table 2 is a useful guide to determine which row spacing is more appropriate for a particular target yield in a dryland situation.

MORE INFORMATION

Loretta Serafin NSW DPI discusses sorghum trials in northern NSW aimed at optimising profitability. GRDC Podcast: 094 Optimising sorghum production

S Simpfendorfer & L Serafin (eds) (2016) Northern grains research results 2016. Research & Development – Independent Research for Industry, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/679102/Northern-grains-research-results-2016.pdf

7 P Wylie (2008) Managing sorghum for high yields—a blueprint for doubling sorghum production. GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Sorghum_HY.pdf

8 D Jordan, D Rodriguez (2016) Optimising sorghum genetics and management for targeted situations GRDC Update Papers 21 June 2016, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/06/Optimising-sorghum-genetics-and-management-for-targeted-situations

9 D Jordan, D Rodriguez (2016) Optimising sorghum genetics and management for targeted situations GRDC Update Papers 21 June 2016, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/06/Optimising-sorghum-genetics-and-management-for-targeted-situations

Skip-rows are a useful method of conserving water during the vegetative stage of a crop for use at flowering and grainfill. This term 'skip-row' indicates that the row configuration is changed by 'skipping' or not planting rows. This management strategy has been used with peanuts, cotton and maize, as well as sorghum. When discussing row spacing for sorghum (and some other crops, such as cotton), it is useful to refer to Table 3.

Skip-row or wide-row configurations are most effective when starting soil water levels are good, with the wide areas between rows acting as a buffer for poor or variable in-crop rainfall. In more marginal, western dryland areas, growers could regard wide rows or skip-rows as mandatory and consider either single-skip or double-skip rows. These wider rows improve risk management by increasing yield stability and greatly reducing the risk of crop failure. However, in high-yielding environments or seasons, resulting in 1.0 m, solid-plant yields of ≥5 t/ha, yield loss of 10–40% (compared with solid plant) would be expected if wide-row or skip-row configurations are used. The optimum row spacing based on yield expectations is shown in Table 2.

Agronomic management is very important if sorghum is planted on wide or skip-row configurations. Plant population should be the same as solid planting on an area basis (same number of plants/ha).

Uniform (as opposed to patchy) plant establishment within rows will maximise the water use between the wide rows, and good stubble management (groundcover) is necessary to reduce water and soil loss in the skip areas. Effective weed control before and during the season is critical, otherwise the advantages of the wider rows will be lost. Wide rows (>150 cm) allow inter-row cultivation or shielded spraying for weed control.

The yields from skip-row spacing in wet seasons may be less than from solid planting; however, research indicates that in some instances where chickpeas are double-cropped following skip-row sorghum, the gross margin was higher than where the chickpeas were double-cropped out of solid-plant sorghum. These results will obviously depend on both summer and winter seasonal conditions and the relative crop commodity prices. [10]

MORE INFORMATION

http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2003/09/Population-density-studies-in-sorghum-and-wheat

Table 2: *Match row spacing to expected yield.*

Expected yield	Optimum row spacing
>4 t/ha	≤0.75 m, solid plant
3–4 t/ha	≤1.0 m
<3 t/ha	≥1.0 m or skip-rows

Table 3: *Row configurations used to plant sorghum.*

Row configuration	Rows planted
0.75 or 1.0 m, solid plant	All rows planted on row spacing 0.75 or 1.0 m
1.5 m, solid plant	All rows planted on row spacing 1.5 m
Single skip	Two rows planted, one row unplanted (1.0 m)
Double skip	Two rows planted, two rows unplanted (1.0 m)

10 N Moore, L Serafin, L Jenkins (2014) Grain sorghum. Summer crop production guide 2014, pp. 5–16, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/303485/Summer-crop-production-guide-2014.pdf

MORE INFORMATION

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/431279/Sorghum-yields-in-the-western-zone.pdf

VIDEOS

To view Paul Castor (MCA Goondiwindi Pty Ltd) highlighting the benefits and potential issues for growing summer crops on narrow rows for greater crop competition with weeds, visit: http://www.grdc.com.au/Media-Centre/GRDC-Gallery/Video/loACpykKja0.

3.3.2 Plant population

Even though target plant populations vary with conditions, the uniformity of the established plant population is always extremely important. The plant population targeted depends on the depth of soil moisture at planting and the likely growing conditions (Table 4). Under dryland situations, lower tillering hybrids should be planted at slightly higher populations.

Consider re-planting when populations are <12,000–15,000 plants/ha, especially with quick-maturity or low-tillering hybrids.

In skip-row situations, aim for plant populations similar to those for good dryland moisture conditions. [11]

Table 4: *Recommended sorghum plant populations.*

Growing conditions	Target population/m²
Dryland	
Good conditions	4–6
Average conditions	3.5–5.5
Marginal conditions	3–4
Irrigation	
Supplementary	5–10
Full	10–15

Research conducted 2010–15 at sites west of the Newell Highway suggests plant populations should be targeted in the range of 30–50,000 plants/ha where the expected yield is 2.0 t/ha or greater. Where expected yields are less than 2.0 t/ha, plant populations as low as 15,000 plants/ha can provide slight improvements in yield compared to 30,000 and 50,000 plants/ha. [12]

3.3.3 Skip-row sorghum

In the drier sorghum-growing areas, skip-row planting configurations have been used to improve sorghum's reliability.

Outstanding results sometimes occur in dry seasons, where skip-row sorghum can produce a yield of ~2 t/ha while there has been no harvest of sorghum on 1-m rows.

Growing sorghum using skip-row configurations involves the suppression of early plant growth; this is likely to make more water available at flowering. Sorghum roots take time to extract moisture from the inter-row space of wide rows, which further delays the onset of moisture stress.

However, the reduction in plant biomass as a result of skip-row configurations will reduce grain yield as the potential yield increases to >2.5 t/ha.

Four trials conducted as part of the GRDC Western Farming Systems project present a typical range of outcomes. In two of the trials, at Billa Billa and Bungunya, there was no difference between 1-m row spacing of sorghum and single-skip and double-skip row spacings, where there is a gap of 2 m and 3 m, respectively, on each side of two sorghum rows. The mean yields of these two trials were 2.8 and 2.7 t/ha, respectively.

At Croppa Creek, with higher yields, the 1-m sorghum and single-skip sorghum yielded 5.5 t/ha, but the double skip yielded less, at 4.5 t/ha.

The fourth trial, harvested at Billa Billa in 2002, had the reverse trend, whereby double-skip sorghum showed a slightly better yield (of 2.8 t/ha) than sorghum in 1-m rows, which yielded 2.6 t/ha.

11 N Moore, L Serafin, L Jenkins (2014) Grain sorghum. Summer crop production guide 2014, pp. 5–16, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/303485/Summer-crop-production-guide-2014.pdf

12 L Serafin, G McMullen (2015) Sorghum agronomy to manage risk and improve yield in the western zone, GRDC Update Papers 31 July 2015, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/07/Sorghum-agronomy-to-manage-risk-and-improve-yield-in-the-western-zone

In central Queensland, 11 trials conducted between 2001 and 2004 showed yield benefits from wide rows when sorghum yields were <3 t/ha. Of 11 trials, five showed a gain, three trials showed a penalty from using wide rows and three trials showed no difference (Collins *et al.* 2006).

Long-term modelling for central Queensland showed that 1-m rows would produce greater yields in more years than wide rows (Collins *et al.* 2005). However, since 1990, when yield potential has been lower than the long-term average, this analysis showed a benefit in yield slightly in favour of wide rows.

Modelling of sorghum at Dulacca (Hammer 2001) suggested a lower yield threshold of 2 t/ha as a penalty for double-skip rows. In this analysis, the ratio of sorghum yield for double-skip rows to that of solid planting was 88% at 3 t/ha and 75% at 4 t/ha.

An important aspect of wide-row sorghum is that when planted closer together in the row, sorghum does not tiller as much and will produce less vegetative growth. This can be an advantage in dry years and help to ration the water. However, plant stand is often less in wide rows, and if it is too low, the yield penalty in better years can be considerably more than at higher population levels.

Several trials have demonstrated that the optimum plant population is higher in wide rows than narrow rows (Thomas *et al.* 1981). In a trial at Condamine, Bidstrup (2001) demonstrated a fall in yield potential as the plant population increased for 75-cm rows, whereas there was an increase in yield as plant population increased for 150-cm rows.

It is important to consider row spacing in conjunction with determining plant population.

Because farmers across most of the northern grainbelt are targeting average yields of >3 t/ha, they should generally use a row spacing of 1 m with a low plant population of 35,000–40,000 plants/ha in western areas, and increase plant populations with increasing yield potential.

When moisture reserves are low or yield potential is in doubt, wide-row sorghum may provide a more reliable outcome.

In higher yielding situations, row spacings >1 m with plant populations of 60,000–80,000 are a good compromise, although on the Liverpool Plains, 55,000 plants/ha is recommended for dryland production. This is to avoid yield loss in drier years. The effect of temperature on tillering drives target populations across the northern region; populations generally increase when moving north, because increasing temperatures lower tillering.

Although row spacings <1 m may improve yield in some situations, this is mostly due to increased tillering, which can be compensated for by higher population. However, moisture remains the limiting factor in most years, and too many plants or too many tillers (with narrow rows) can have negative effects in years that turn out to be below average. [13]

MORE INFORMATION

http://www.grdc.com.au/uploads/documents/NL40%20V3.pdf

http://www.regional.org.au/au/asa/2012/crop-production/8317_verrellag.htm

http://www.queenslandcountrylife.com.au/story/3608450/the-secrets-to-sorghum-success/

3.4 Calculating seed requirements

When calculating planting rates, allow for an extra 20–25% for establishment losses when planting into a very good seedbed on heavy black soil using press-wheels, and 40–50% when seedbed conditions are fair or when press-wheels are not used (Table 5). Obtain the number of seeds per kg and the germination percentage from the bag.

To determine the planting rate (kg seed/ha):

(Required number of plants/m^2 × 10,000) ÷ (seeds/kg × germination % × establishment %)

13 P Wylie (2008) Managing sorghum for high yields—a blueprint for doubling sorghum production. GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Sorghum_HY.pdf

Example calculation:

(40 (target plant population/m²) × 10,000) ÷ (30,000 (seeds/kg) × 0.90 (germination %) × 0.75 (establishment %)) = 1.98 kg seed/ha [14]

Approximate number seeds/kg = 26,000–30,000 (refer to bag label for an exact count).

Germination percentage

Average germination is 90%. Minimum prescribed percentage is 80%. Refer to bag label for the exact figure.

Table 5: *A guide to field establishment percentage.*

Planter type	Establishment range
Precision planter	60–75%
Airseeder/combine with press wheels	50–60%
Airseeder/combine without press wheels	35–55%

3.5 Sowing depth

MORE INFORMATION

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/146355/grain-sorghum.pdf

It is necessary to plant seed only deep enough to give it moisture to germinate and allow its roots to grow down through moist soil into subsoil moisture, ahead of the drying front. [15]

Correct seed placement is essential, however, to ensure that the seed is planted deep enough into moisture to germinate and allow its roots to grow down through moist soil into subsoil moisture. Research agronomists recommend planting depth is 50–75 mm into moisture. [16] However, in practice, some agronomists on the Liverpool Plains recommend no more than 30 mm planting depth where moisture has been identified, as deeper planting is only advantageous under high temperatures and drying conditions.

3.6 Sowing equipment

Establishment of grain sorghum has improved in recent years, with better planters and improved insecticide treatments that have residual effects on insects that eat the emerging seedling as well as the seed.

Conventional planters in combination with untreated seed in the past have typically resulted in only 40–50% of seeds becoming established as plants, but with the use of disc planters, press-wheels and modern insecticides, 70–80% establishment is commonly achieved.

Airseeders and a toolbar fitted with single-disc openers have provided an economical option and performed well in planting sorghum. Extra benefits of precision spacing may occur; these include higher yields, better evenness and improved competition with weeds. Sorghum's ability to tiller does allow it to compensate for variation in plant population and plant spacing. Although this ability is better than that of maize or sunflowers, uniform spacing should always remain the goal.

Under favorable conditions, seeding depths >7.5 cm reduce emergence; depths >10 cm may result in a complete failure.

Depth of sorghum planting should be varied in response to moisture and temperature. Planting should be as shallow as possible (~5 cm) under cool soil

14 N Moore, L Serafin, L Jenkins (2014) Grain sorghum. Summer crop production guide 2014, pp. 5–16, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/303485/Summer-crop-production-guide-2014.pdf

15 QDAF (2011) Sorghum—planting information. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/sorghum/planting-information

16 NSW DPI (2005) Grain sorghum. Agfact P3.3.5. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/146355/grain-sorghum.pdf

temperatures, with depth increasing under hot, dry conditions. Sorghum has been observed to have better emergence at 8–10 cm depth under high temperatures, which rapidly dry out the soil surface.

In the 1980s, various treatments, including seed soaking and water injection, were trialled by farmers in attempts to improve sorghum establishment.

Radford and Nielsen (1985) trialled the effects of press-wheels, seed soaking and water injection at nine sites in southern and central Queensland. Although press-wheel compaction hastened and improved the emergence of sorghum in all situations, seed soaking and water injection had little effect on hastened emergence and no effect on the final emergence.

The authors concluded that press-wheel compaction at 4 Newtons per mm width of press-wheel is generally recommended for sorghum sowing. [17]

Sorghum is the most widely grown, no-tillage summer crop on the Liverpool Plains and on the floodplains near Dalby. It tolerates compacted subsoil and can stand high press-wheel pressure at planting. Good grass control in the crop is essential to achieve high yields, but this can be expensive with herbicides. Some farmers are now using shielded sprayers and knockdown herbicides prior to planting. The longer the paddock is under no-tillage, the easier it is to establish the following crops. [18]

3.6.1 Moisture-seeking planting

Sorghum has been successfully sown into deep soil moisture several weeks after rain, in early spring. There is a conflict between sowing shallow because temperatures are cold and having to dig deep to find moisture. There is also a problem in getting disc planters to plant deeply.

One way to assist disc planters to plant deeper for moisture seeking is to remove soil in front of the disc units, using a tine or trash-wippers. Often it will only need a small amount of dry soil to be removed to allow the disc opener to penetrate to moisture.

The disc opener generally does not need to plant as deeply as a tine because it does not mix wet and dry soil.

Leaving a significant trench over the seed can be a disadvantage if rain falls while the sorghum is emerging. It can be particularly significant if residual herbicides have been used at planting. The rain will concentrate the herbicide in the seed trench and may reduce the establishment of the sorghum under cool conditions.

Provided the seed is not too deep, raking a little loose soil over the seed trench can help reduce this problem. It can also help to stop the seed trench drying out and cracking when conditions are tough. Some farmers fit chains or mounted harrows behind the planter to bring some loose soil back over the row. [19]

3.6.2 Strip tillage

Strip tillage is a new technique being trialled that some agronomists believe should have merit in the following situations:

- on sodic soils where crop establishment is difficult
- where the stubble burden from the previous cereal crop is heavy, causing hair pinning and poor seed/soil contact

17 P Wylie (2008) Managing sorghum for high yields—a blueprint for doubling sorghum production. GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Sorghum_HY.pdf

18 QDAF (2011) Sorghum—planting information. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/sorghum/planting-information

19 P Wylie (2008) Managing sorghum for high yields—a blueprint for doubling sorghum production. GRDC, http://www.grdc.com.au/uploads/documents/GRDC_Sorghum_HY.pdf