Grain sorghum agronomy, risk management and key decision points for Central Western New South Wales

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Take home messages

- Set a target yield based on soil moisture availability, seasonal rainfall outlook and local yield expectations
- Sorghum has a wide planting window in most areas. Avoid planting too early (cold) or too late (ergot and frost). Monitor rising soil temperatures to target the optimum time to sow. Aim to avoid flowering during the extreme heat of late December to early January
- Match the plant population and row spacing to the target yield. Plant uniformity is important, use a precision planter where possible
- Select at least 2 high yielding hybrids that have the desired characteristics (e.g., maturity, standability) for your growing conditions to spread production risk
- Use registered, knockdown herbicides to desiccate crops when they reach physiological maturity to hasten crop dry down, improve harvesting and commence the refilling of the soil moisture profile in dryland crops potentially allowing double cropping with a winter crop.

Introduction

Grain sorghum production in central west NSW is not a new phenomenon, in fact, 20 years ago the 2000-2001 ABS Statistics reported that 60 growers were growing close to 8 000 hectares of grain sorghum with an average yield of 2.6 t/ha.

The success of growing sorghum is largely founded on the same principles as other broadacre crops; the better your management practices, paddock preparation and in-crop rainfall, the higher the chance of good yields and gross margins and the lower the risk of poor crop performance or failure.

Grain sorghum is a deep rooted, perennial crop which is the backbone of many northern cropping rotations and for good reasons. It is drought tolerant (to a point!), generally reliable, easy to manage and has several end uses and hence marketing options. Sorghum is also a useful rotation tool to vary herbicide groups to manage weeds, utilise variable summer rainfall and split labour, cash flow and peak logistical requirements in farm operations.

Starting soil water

Starting soil water is important for most crops with the level of starting soil water available to sorghum being a strong indicator of likely crop yields especially when little in-crop rain is received. It has long been recommended to only sow sorghum when you have a full moisture profile. This recommendation is based on minimising the risk of crop failure, as sorghum is subjected to high temperatures, high evaporation rates and more variable rainfall events during its critical growth stages of flowering and grain fill compared with winter crops.

Choosing to plant sorghum without a full soil profile, indicates growers are either:

1. Willing to accept a higher risk of crop failure or poor yields (e.g., <2.5 t/ha)
2. Have expectations of above average, in-crop rainfall
3. Are going to use risk mitigation tools such as skip row configurations.

The interaction between starting soil water, in-crop rainfall and grain yield was compared at a range of trial sites in north west NSW (Figure 1). At 1 site, starting plant available water (PAW) was low (<50 mm) but substantial, well timed in-crop rain occurred (257 mm in crop) resulting in high yields. This site was the beneficiary of luck but not good planning.

In contrast, when around ~100 mm starting PAW was available, but no effective in-crop rainfall was received, a crop failure resulted. This demonstrates that a half full profile at planting can reduce the risk of crop failure but not eliminate it.

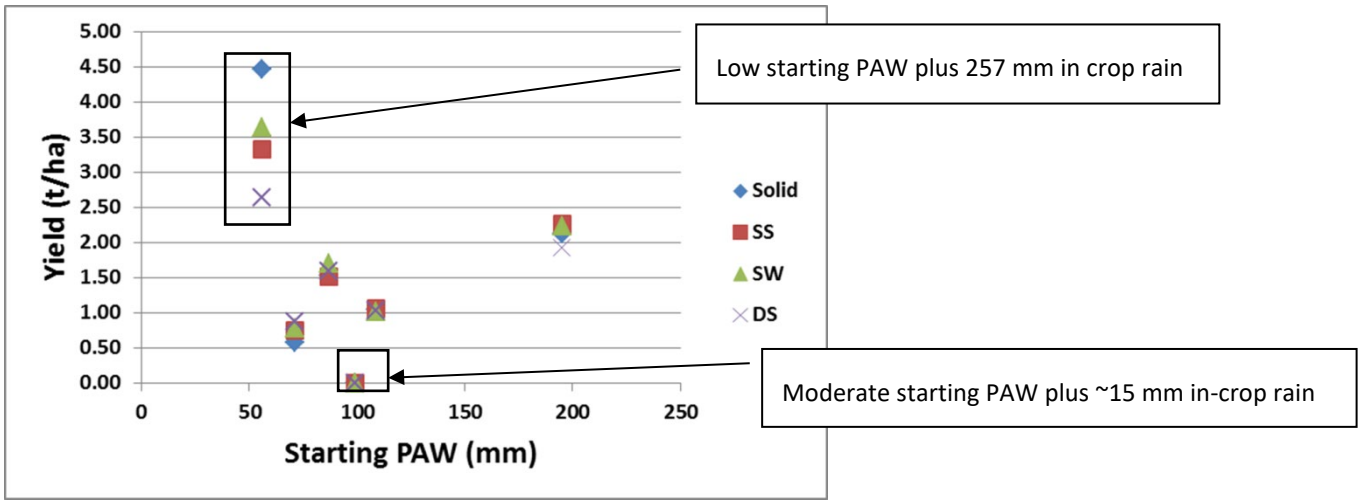

Figure 1. Starting soil water and resulting grain yield from a selection of sites in northwest NSW (Legend: Solid = 100cm spacing, SS = single skip, SW = super wide (150cm planting), DS = double skip)

When is the best time to sow?

Traditionally, sorghum would be planted when the soil temperature was at 16-18°C at 8 am EDST at the intended seed depth (3–5 cm) for 3 to 4 consecutive days and the risk of frosts has passed. This is a very reliable method which ensures quick germination and emergence.

More recently a joint GRDC project with UQ, NSW DPI and QDAF has experimented with moving the planting window forward by planting into cooler soils, where soil temperatures were at 12°C and rising. This practice can be successful if a few guidelines are adhered to:

1. Measure your soil temperature and only plant when above 12°C and rising
2. Use only high-quality seed (both germination and vigour)
3. Ensure sufficient seedbed moisture to allow germination and emergence over ~ 2 weeks
4. Be prepared to increase planting rates or accept lower establishment %
5. Select paddocks with low weed burdens.

Early planting has significantly widened the planting window for growers in the Northern Grains Region. It also has the bigger impact of bringing the flowering window forward to avoid the peak heat and moisture stress periods in late December/January. Earlier harvests also result in additional time for fallow refill, increasing the chances of double cropping back into a winter crop.

However, there is still an inherent risk of frost damage, particularly once the crop has reached 6-8 leaves when it is more susceptible to frost.

In contrast late planting (January), exposes the seeds to very high soil temperatures at germination that can reduce establishment. The later planted crops experience milder grain filling conditions but have other challenges. It is a balance though to plant crops early enough to ensure flowering and seed filling occur prior to the onset of frosts. There is also a higher risk of ergot and midge and this is accompanied by slow grain dry down, late harvest and potentially wet grain which requires drying.

Traditionally the central west would commence planting from around mid-late October until early December. If growers were choosing to plant early, when soil temperatures were cooler then there could be opportunities to plant from early October.

Selecting a row spacing and a plant population

Sorghum can be successfully established on row spacing's as close as 25 cm or as wide as a double skip on 100 cm configurations. The choice of which option to use depends on the environment, starting water and likelihood of in-crop rain. The preferred planting operation where yield expectations are > 3.5 t/ha is 75-100 cm row spacing using a precision planter. Sorghum has a strong compensatory mechanism through its production of tillers and will respond to competition and environmental conditions.

It is recommended to match your row spacing to your expected yield and the available soil water. As a rule of thumb, > 3.5 t/ha use solid plant row spacing's. For yields between 3-4 t/ha use 100 cm row spacing's and for < 3t/ha use 100 cm solid or consider skip or wide row configurations. The advantage of wide or skip row spacing is the ability to conserve water in skip areas for flowering and grain fill as the plant roots don't generally explore this area fully before flowering. Weed control is more critical in these wide row configurations.

Aim to establish 40-60000 plants/ha. This will provide plenty of top end yield potential with most hybrids (exceptionally low tillering hybrids might require higher populations).

The use of precision planters enables less seed to be used, more uniform seed spacing and a more even crop maturity. However, sorghum can still be successfully established using air seeders.

Hybrid selection

There is a good range of sorghum hybrids currently on the market (> 20 hybrids). It is recommended to select at least 2 hybrids which have slightly different maturities to ensure flowering times are staged over a couple of weeks to reduce the risk of heat impacting on pollen viability and seed set. Ensuring the crop is not under undue moisture stress during the flowering and grain fill periods will also help to offset the effects of excessive heat.

Select hybrids based on grain yield, access NVT results via the website for regional information on comparative hybrid performance. www.nvt.grdc.com.au

Plant growth and flowering

Sorghum planted in the main planting window usually takes 5-7 days to emerge at soil temperatures of 16-18°C. Under cooler soil temperatures this phase may take as long as 2-3 weeks.

Slow emergence creates an opportunity for increased damage by soil dwelling insects, competition from late emerging winter weeds, and the potential for reduced plant establishment. Selecting

suitable paddocks with low weed burdens and treating seeds with insecticide are important tools to reduce the risk of weed competition and insect damage.

Early planted sorghum has an extended period of vegetative growth, resulting in the crop taking more days to reach flowering, but still flowering 2-3 weeks earlier than a normal spring planting.

Results from experiments planted at Breeza on the Liverpool Plains in 2019 demonstrate the delay in reaching 50% flowering as the planting date is moved earlier (Table 1). This relationship has been fairly consistent across northern NSW in sites planted from Breeza to Moree and Mungindi.

Table 1. Days to 50% flowering for eight hybrids planted 11 Sept, 8 Oct and 28 Oct 2019 at Breeza

Hybrid/ Sowing date	11 Sept	8 Oct	29 Oct
A66	90	81	70
Agitator	89	78	70
Cracka	107	90	82
HGS114	91	85	73
MR-Bazley	92	83	73
MR-Buster	96	86	76
MR-Taurus	95	85	74
Sentinel IG	103	88	77

Desiccation

Sorghum will be "killed" by frosts at the end of the growing season if left late enough, but it will re-grow the following spring if not desiccated. Desiccation is an invaluable tool for speeding up crop dry down and evenness of grain moisture, starting the fallow weed control process and stopping the use of soil water which could be preserved for the following crop.

Identification of the correct time to desiccate is crucial to ensuring maximum yield is achieved and additional water use is minimised. Check the lowest grains on the heads for the presence of a "black layer" which indicates the crop is at physiological maturity i.e., has stopped filling grain and is simply drying down and so a chemical desiccant can be applied.

The alternative to desiccation is to leave the crop to naturally dry down and then harvest once the grain moisture content is below 13.5%. This option is typically used by growers with livestock to utilise the remaining green feed but will mean the crop is standing in the paddock for longer.

Grain yield and quality

The effect of planting time on grain yield has been measured at the trial sites from Breeza to Emerald in Central Qld, from 2018-2020. Grain yields ranged at the trial sites was from <1 t/ha up to 12 t/ha under both dryland and irrigated conditions.

Across all these environments and seasons, the yield of early planted sorghum was similar or higher than that of later planting dates (Figure 2a). This was due to higher seed set (Figure 2b) resulting from the reduced incidence of heat stress around flowering. As grain number is the largest determinant of yield, any strategies which improve seed set are critical to the final crop success.

Grain quality was also improved with early plantings with improved grain size (reduced screenings). This was due to increased availability of soil water later in the season (data not shown).

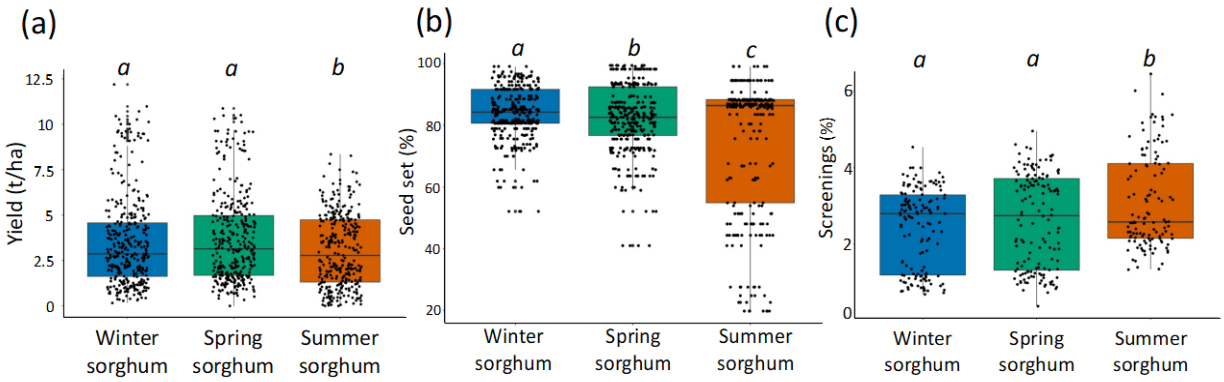

Figure 2. Results from 15 trials sown across the Liverpool Plains, Northern NSW, Darling Downs, Western Downs, and Central Queensland for the 2018/19 and 2019/20 seasons. (a) Mean yields for the 3 tested times of planting (winter, spring, and summer); (b) the estimated seed set from the incidence of extreme air temperature events around flowering; and (c) percent screenings. Different italic letters on top of the boxplots indicate statistically significant differences (p<0.05).

Conclusions

There are opportunities available to include sorghum in central west NSW production systems, especially considering the area lost or unplanted this winter. For new growers the focus should be on minimising risk and trying to establish, manage and successfully harvest their first sorghum crops.

There is a lot of experience, knowledge, and data on grain sorghum to be accessed. While little of this research has been conducted in the central west, a large proportion is readily adoptable regardless of the region.

Crop establishment is critical to the final crop success. Start by assessing paddocks for sorghum suitability, obtain good quality seed and focus on seed placement into good seedbed conditions. Measure your soil temperature and apply good agronomy to achieve your yield potential.

Early planted sorghum has provided benefits which have far outweighed the risks in the northern grains region to date. Additional information on seed quality impacts (germination and vigour), methods to improve plant establishment, prediction of hybrid flowering time and overall crop water use, which are being delivered by the Optimising Sorghum Agronomy project will continue to improve our confidence in early sorghum over time.

Grain sorghum provides substantial system benefits such as stubble cover, disease breaks, splitting labour and cashflow and opportunities for herbicide chemistry rotation. There is a unique opportunity for sorghum production in the central west which is waiting to be explored.

Further information

Early planting grain sorghum in northern NSW 2021

https://soundcloud.com/user-889937785/early-sowing-sorghum-with-loretta-serafin

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