Innovative Management of Grain Sorghum in Central Queensland.

G.B. Spackman[1], K.J. McCosker[2], A.J. Farquharson[3] and M.J. Conway[4]

[1.] Agricultural consultant, Graham Spackman & Associates, Emerald, Queensland.
[2.] Extension agronomist, DPI Farming Systems Institute, Emerald, Queensland..
[3.] Product development manager (CQ), Pioneer Hi-Bred Australia, Emerald, Queensland.
[4.] Technical officer, DPI Farming Systems Institute, Emerald, Queensland..

ABSTRACT

Grain sorghum is the most important crop in Central Queensland, both in terms of the area planted and tonnage produced annually. However, yield is limited by climatic extremes, which mainly influence soil moisture availability for planting, crop growth and yield. New farming practices have now been developed and adopted by leading farmers that improve the reliability of grain sorghum in the farming system by improving the management of rainfall and soil water. These practices include controlled traffic farming and zero-tillage, wide-row and skip-row planting configurations, pre-harvest spraying with glyphosate and the use of high-clearance spraying equipment. Such practices also provide more flexible, efficient and cost-effective management of crop nutrition, weeds, diseases, insects, harvesting and post-harvest stubble regrowth. They also increase opportunities to plant other crops following sorghum in the farming system.

KEY WORDS

Sorghum, innovative, management, practices, reliability, Central Queensland.

INTRODUCTION

Grain sorghum is the most important crop in Central Queensland, both in terms of the area planted and the tonnage of grain produced. Sorghum can be planted over a wide range of planting dates (September to January), which makes it well-suited to the opportunity-based cropping system commonly used in the variable CQ climate. Despite being widely grown however, grain sorghum is one of the least profitable cropping options for many farmers in the region, in view of current low prices and production difficulties.

Production problems include:

- Yield instability as a result of high rainfall variability. Rainfall variability results in crops suffering water stress at critical stages, particularly in shallow soils and marginal planting conditions. This causes variable and often low yields, and lodging losses.
- Poor crop establishment. Despite significant upgrades in planting equipment on most farms in the last decade, crop establishment failures or difficulties still occur in some seasons and circumstances. This leads to yield losses due to sub-optimal and non-uniform plant stands; increased incidence of weeds, insects (sorghum midge) and diseases (sorghum ergot); and harvest management difficulties.
- The perennial growth habit of sorghum after harvest leads to inefficient use of soil water, reduced subsequent cropping opportunities, and increased post-harvest weed control costs.

A new sorghum production system

Scientists and agribusiness have developed a new sorghum production system that manages many current production difficulties, and improves the reliability of sorghum in the farming system. Leading farmers are now concurrently adopting the components of this system, which are as follows:

1. Controlled traffic farming and zero-till fallow management

Controlled traffic farming (CTF) provides permanent wheel tracks and straight runs that improve the efficiency of farming operations. This occurs by eliminating overlaps, which allows considerable savings in fuel and other cropping inputs. The permanent wheel tracks also permit fallow spraying at night, which enables the elimination of foam and other boom spray marking systems, thereby facilitating easier management of fallows using zero-tillage. CTF facilitates the use of row cropping planters and practices, which further improve efficiency and flexibility in crop management.

Zero-tillage has been proven to maximise the retention of rainfall and minimise soil erosion in the Central Queensland environment, and therefore increase cropping opportunities.

2. Pre-harvest spraying of sorghum

Pre-harvest spraying with glyphosate provides an improved and earlier kill of the sorghum plant and surviving in-crop weeds. This improves harvest efficiency, and reduces wastage of soil water that is a benefit to subsequent crops. Data collected in 2000 at Emerald shows that pre-harvest spraying saved 32mm of soil water at harvest compared to unsprayed sorghum (K.J. McCosker, unpublished).

3. Adoption of wide-row planting configurations

Wide-row planting improves yield stability, especially in marginal soils and seasons (see below). Wide rows also provide agronomic flexibility, through banded spraying of insecticides and herbicides, shielded spraying of weeds between the crop rows, and side-dressing of nitrogen in-crop in good seasons. Wide rows also facilitate easier planting operations in high-stubble situations, such as in zero-till and double-cropping opportunities. Lastly, wide rows mean that fewer rows are planted, which lowers planting equipment costs.

4. Use of high-clearance spraying equipment

Recent improvement in the availability of high-clearance ground spraying equipment in the region permits improved efficiency of in-crop chemical application. They provide opportunities for banded insecticide application that reduces costs and the pesticide load in the environment, and they often achieve better results than aerial application in marginal spraying conditions or where high water volumes are required.

WIDE ROWS AND YIELD STABILITY

On-farm trials conducted throughout the Central Highlands in 1999 and 2000 show that wide-row sorghum performs at least as well as conventionally-spaced sorghum at yields levels up to 3.5 t/ha (Figure 1).

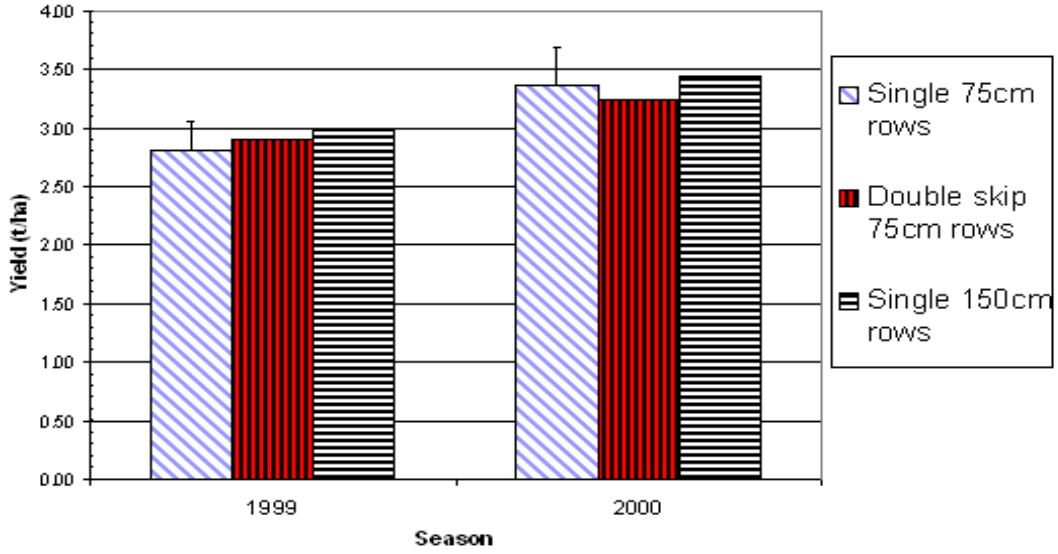

Figure 1. Wide row sorghum on-farm trial results in Central Queensland in 1999 and 2000. Treatments are the means of five sites in each year, and lines above bars indicate 5% LSD within season (Source: Pioneer Hi-Bred Australia).

The research shows that wide-row planting is unlikely to limit top-end yield potential in the majority of years. It did not significantly reduce yield in the favourable season in 2000, and it maintained yields in the "average" season of 1999. Individual site data suggests that wide row planting will increase yield stability and reduce the risk of crop failure in dry and average seasons.

Yields above 3.5t/ha rarely occur in Central Queensland, except on the few farms in the region with exceptionally high quality soils and in occasional highly favourable seasons. In fact, the long-term district average sorghum yield is 1.5-2.0t/ha, depending upon soil type and fertility, and water availability commonly limits sorghum yield in most seasons and on most farms in the region. Wide row planting configurations are therefore an appropriate on-going management strategy for sorghum production on most farms in the region.

The data in Figure 1 suggests that single 1.5 metre rows may be superior to a 75cm double-skip configuration in many circumstances, presumably because of the reduced competition for soil water between adjacent wide single rows. Many farmers have adopted one metre rows in their cropping program in recent years. While there is as yet no data on how these results compare to wide row configurations based on one metre rows, commercial experience in Central and southern Queensland and northern New South Wales suggests that similar trends in yield can be expected.

Soil water use in wide-row sorghum

A water-use study conducted in 2000 by a group of farmers and scientists in the Sustainable Farming Systems Research project in Central Queensland illustrates how sorghum grown in a wide row configuration may survive and yield more than in a conventional configuration in conditions of soil moisture shortage.

Figure 2 shows that grain sorghum will extract water a considerable distance from the row, if given the choice. Sorghum roots need time to proliferate and exploit the soil, and will grow both vertically and laterally into the inter-row space exploiting soil water. Previous research (1,2) has shown that sorghum roots grow at rates of 1.5 to 4cm per day, depending on the growth stage. Moisture stress occurs when the roots run out of wet soil to exploit. If the rate of root growth (and therefore soil water extraction)

averages 2.5cm/day, crops planted in narrow rows on typically shallow soils exploit the available moisture by the time the crop reaches the critical flowering stage, in the absence of in-crop rain. Hence, in dry seasons without in-crop rain, most sorghum crops in Central Queensland suffer moisture stress at critical stages of flowering and grain filling. Wide row configurations are effective because the plant is still able to access soil water at these critical growth stages.

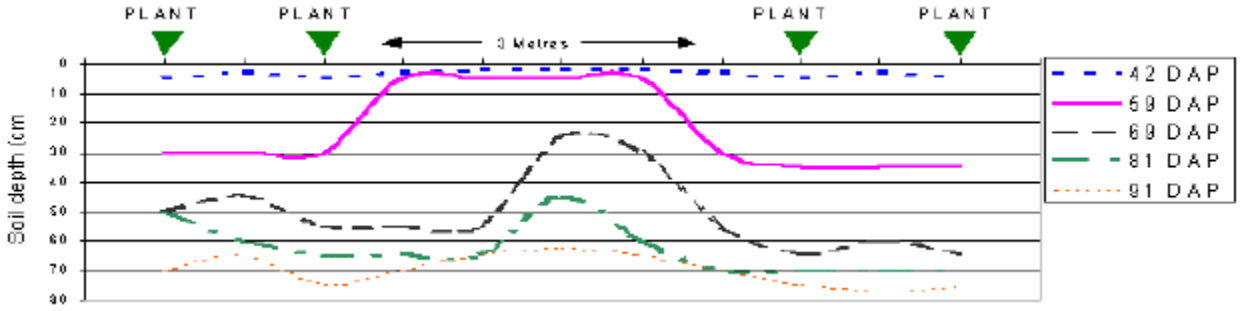

Figure 2. Soil water extraction front under double skip (1m row spacing) grain sorghum as measured with a neutron moisture meter, Emerald 2000.

Excessive loss of soil water from evaporation has been an industry concern (3) with wide row configurations in Central Queensland. Figure 2 shows that losses due to evaporation are comparatively small, and that a significant portion of the soil water between the rows appears to have been extracted by plant roots.

Management considerations with wide-row planting

The wide-row configuration adopted by an individual farmer will ultimately depend on the planting equipment available and other machinery considerations. Configurations based on one-metre spacing generally conform best to industry standards at present. Regardless of the configuration adopted however, certain management factors are critical to fully capitalise on the benefits of wide-row planting.

Crop establishment

The plant population per hectare must be maintained regardless of the row configuration used. When planting in wide rows, gaps between plants in the row must be eliminated, as there may not be a near-by row to compensate for gaps between plants. Precision spacing and placement of seed is therefore critical, and the most appropriate row configuration for a farmer to use will depend largely upon the planting equipment available. A skip-row configuration (such as plant two rows, miss one) will be the most appropriate if using an air seeder, because of this machine's inability to precisely meter individual seeds in the row. Skip-row or single wide row configurations can be chosen if using a precision planter. Management of soil insects is also critical in obtaining satisfactory crop establishment and uniform plant spacing within each row, and is therefore particularly important when adopting wide row configurations.

Weed control.

Weed control is more difficult with wide row configurations due to the increase in sunlight reaching the soil surface between the rows, and reduced early crop competition against weeds. Accordingly, increased herbicide rates and/or shielded sprayers for inter-row weed control may need to be adopted.

CONCLUSION

The sorghum management system described reduces production risk, and increases profit from grain sorghum by reducing costs and providing yield stability in seasons of average and below-average rainfall

in the Central Queensland environment. It eliminates some of the management difficulties with sorghum, especially using zero-tillage, and improves prospects for other crops grown in rotation with sorghum.

Wide-row planting is unlikely to improve yield in seasons and/or soils with a yield expectation above 3.5t/ha. However, it will reduce the incidence of poor crops and failures in all situations, and therefore improve average yields. Given that soil moisture shortage regularly limits yield in most soils in Central Queensland, wide-row planting is therefore expected to significantly improve regional long-term sorghum yields and profitability, as well as facilitate easier management of sorghum in the farming system. In particular, wide-row planting is likely to significantly improve the yield, reliability and profitability of sorghum in marginal conditions and planting dates, including spring planting opportunities.

Further research is needed to refine wide row planting recommendations, particularly the optimum plant population, row configuration and hybrid maturity for specific planting dates and circumstances. Computer simulation studies currently underway will assist in determining the long term effects of wide row sorghum planting on yields in the northern region, particularly in dry seasons. The management benefits offered by wide row planting, including the banded application of pesticides and nutrients during crop growth, also need further quantification.

ACKNOWLEDGMENTS

Mr David Reid, Senior Biometrician, DPI Rockhampton conducted statistical analysis of the yield data. The soil water studies were conducted on a trial on the Sullivan family property, “Springton, Springsure Qld.

REFERENCES

1. Robertson M.J., Fukai S., Ludlow M.M., and Hammer G.L. 1993. Water extraction by grain sorghum in a sub-humid environment. I. Analysis of the water extraction pattern. *Field Crops Research*, **33**, 81-97.

2. Robertson M.J., Fukai S., Ludlow M.M., and Hammer G.L. 1993. Water extraction by grain sorghum in a sub-humid environment. II. Extraction in relation to root growth. *Field Crops Research*, **33**, 99-112.

3. Myers R.J.K., Foale M.A., Thomas G.A., French A.V., Hall B. 1986. How row spacing affects water use and root growth of grain sorghum. In: *Proceedings of the first Australian Sorghum Conference*, Gatton, pp 586-591.