Grain & Graze National Feedbase Project

Using sorghum as a dual purpose crop by grazing ratooned stubble in the Border Rivers region

JPM Whish

18 May 2007

Enquiries should be addressed to:

Dr «GreetingLine»

CSIRO Sustainable Ecosystems
GPO Box 102
Toowoomba 4350
jeremy.whish@csiro.au

The decision to ratoon grain sorghum after harvest has implications for following crops. Water is the underlying driver of northern farming systems and the decision to use water for the production of additional biomass may have implications on yields of the next crop. This analysis attempted to answer the question: will the water used by a ratooned unsprayed sorghum crop significantly reduce the starting water for a following crop, resulting in reduced grain yield? What extra sorghum biomass could be grown from rationed sorghum potentially for livestock production? A simulation analysis using the APSIM-grain sorghum module and a modified forage sorghum-module were used to assess the implications of ratooned sorghum biomass on the plant available water for following sorghum crops.

Allowing October-sown sorghum crops to ratoon after harvest reduced the starting water for a following October crop by an average of 14 mm at the wetter location of Warialda and 23 mm at the drier location of Nindigully. On average the production of forage by ratooning sorghum after grain harvest cost the following sorghum crop 108 kg/ha of grain at Warialda and 332kg/ha of grain at Nindigully. An estimate of the average additional biomass produced by ratooning the crop was ~ 7121 kg/ha at Warialda and ~6469 kg/ha at Nindigully. This result shows if water is the sole decision criteria, then in the majority of seasons allowing sorghum to ratoon would significantly impact on the PAW for following sorghum crops.

Introduction

Divided opinions exist as to the suitability of using sorghum as a dual-purpose crop and grazing ratooned regrowth after grain harvest. It is argued that allowing sorghum to re-grow depletes stored soil water reserves potentially limiting the yield of following crops. The counter argument suggests the lost yield to be insignificant compared to the benefit of supplementing the feedbase. Quantifying the impact of regrowth on stored PAW will inform and assist in understanding the tradeoffs associated with grazing sorghum stubble.

Methods

The APSIM simulation model was used to identify how much water was depleted from the soil by ratooning sorghum. However, the current grain sorghum module in APSIM does not allow grain sorghum to ratoon. A simplified grain sorghum module based on forage sorghum was developed and parameterised to produce similar biomass and water use results to grain sorghum. This model was used in combination with the grain sorghum module to assess the impact of allowing crops to ratoon.

All simulations were performed on a grey vertosol soil with a PAWC for sorghum of 220 mm. Simulations were run using the Warialda, NSW (650mm mean annual rainfall, located in the east of the northern cropping region) and Nindigully, Queensland (520 mm mean annual rainfall, located in the west of the cropping region) daily meteorological records for the years 1957 to 2006. Sorghum was sown at a crop density of 70,000 plants per ha on a 1m row spacing. Both grain and forage sorghum were fertilised equally by the addition of 150 kg/ha of urea at sowing, no additional nitrogen was applied to the ratooning crop.

Results

The forage sorghum module was adjusted to reproduce similar biomass and water use values to the grain sorghum module (Figs 1-3). However, at this stage the water use by the forage sorghum module is higher than that of the grain sorghum (Fig. 2).

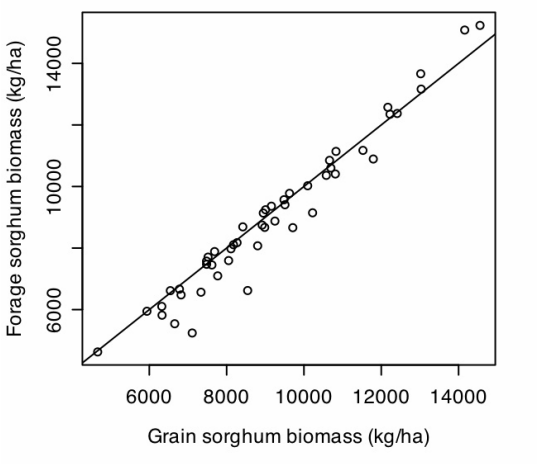

Figure 1: Modelled biomass predictions of the existing APSIM-Sorghum module v the modified APSIM-Forage sorghum module.

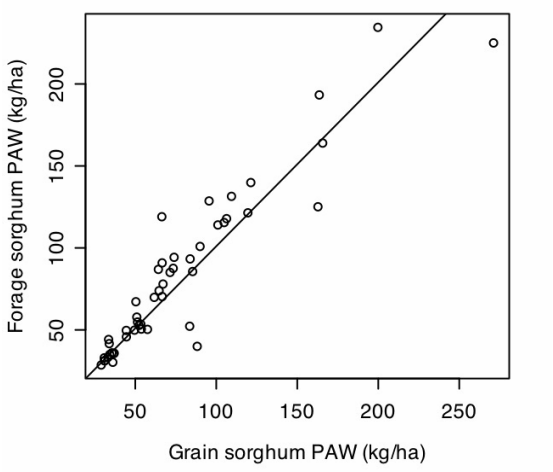

Figure 2: Modelled plant available water (PAW) predictions of the existing APSIM-Sorghum module v the modified APSIM-Forage sorghum module.

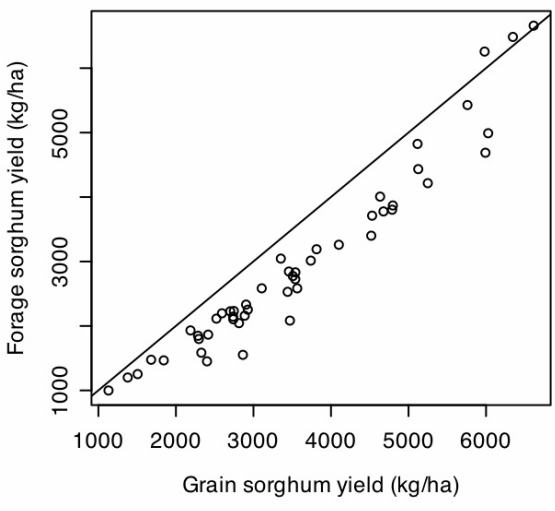

Figure 3: Modelled grain yield predictions of the existing APSIM-Sorghum module v the modified APSIM-Forage sorghum module.

Grain yield was not reproduced as well, with the new model consistently under-predicting compared to the grain sorghum module (Fig. 3). The new model successfully ratooned after harvest and continued to produce biomass into the cooler months; all ratooned sorghum was killed on 1st May. No validation of the ratooned biomass is available so ratoon biomass simulations are only indicative at this stage.

Allowing a sorghum crop to ratoon and use water between grain harvest and 1st May produced a significant difference ($P < 0.05$) in PAW compared to a non-ratooned control when sampled at winter crop sowing (15th May) at Nindigully (average 34 mm) and Warialda (average 33 mm) (Figs 4,5).

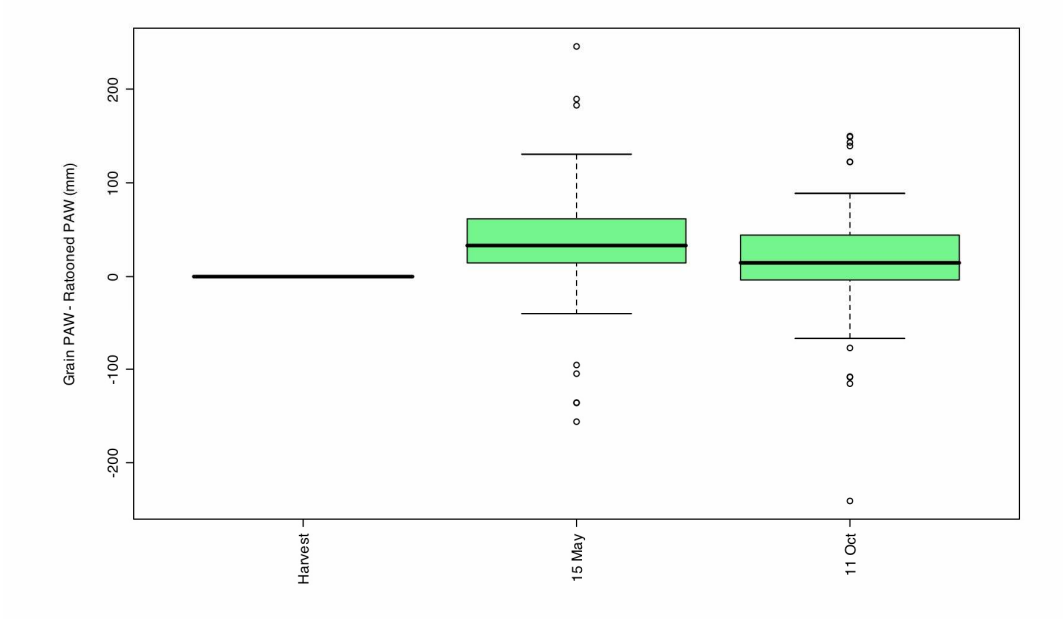

Figure 4: Box and whisker plots showing the difference in plant available water between grain sorghum and ratooned sorghum at sorghum harvest (15-20 Jan), winter crop sowing on 15th May and summer crop sowing on 11th October at Warialda.

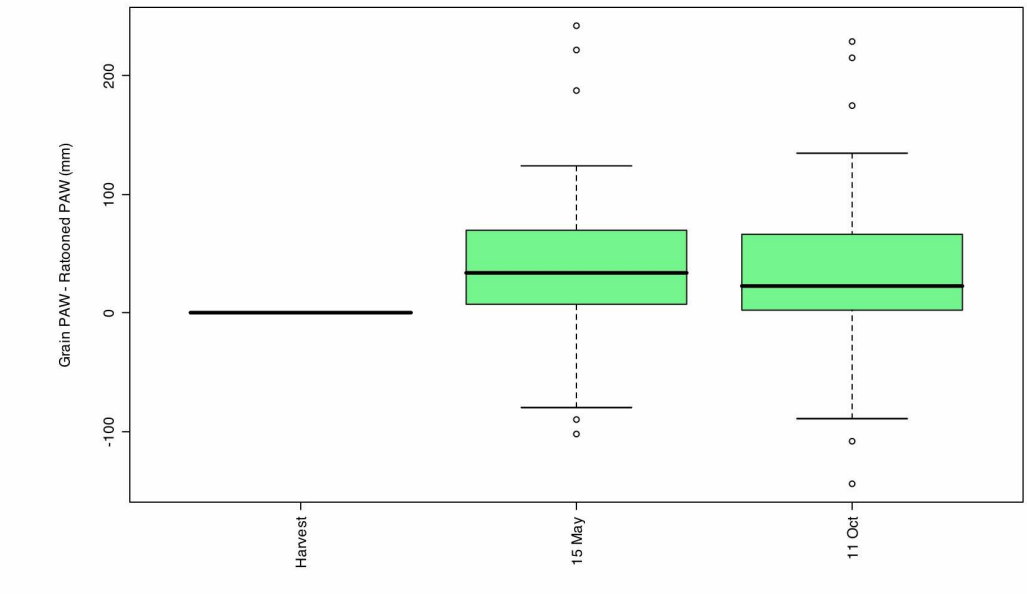

Figure 5: Box and whisker plots showing the difference in plant available water between grain sorghum and ratooned sorghum at sorghum harvest (15-20 Jan), winter crop sowing on 15th May and summer crop sowing on 11th October at Nindigully.

No difference in soil PAW was observed between the ratooned and non-ratooned sorghum crops by the following October sowing date for crops grown in Warialda (average 14 mm), but a significant difference existed in Nindigully (average 24 mm).

The impact on the yield of a following grain sorghum crop sown in the following October was not significant despite back to back grain sorghum crops consistently out yielding grain sorghum following a ratoon at both sites (Figs 6,7). The ratoon crop had a greater impact on grain sorghum yields at the drier location of Nindigully.

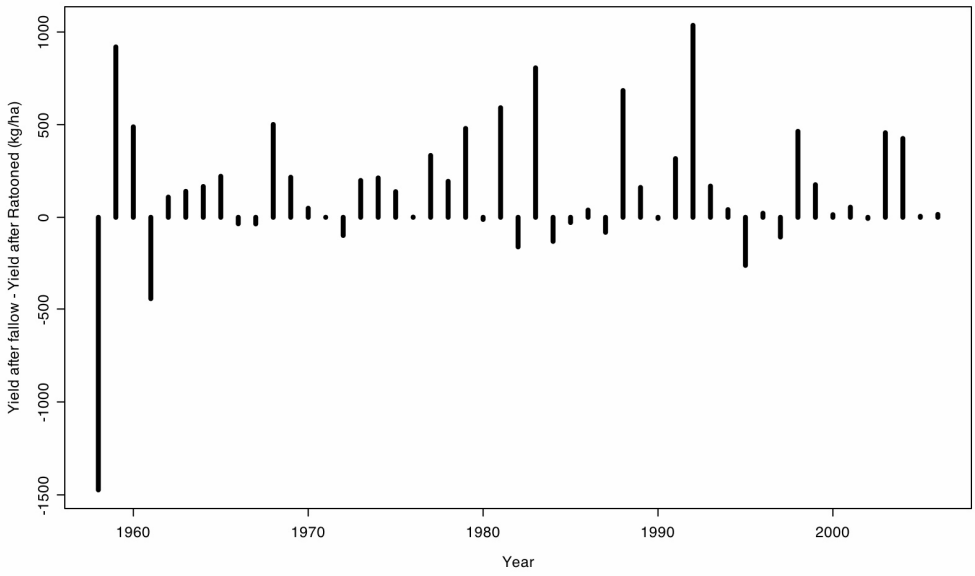

Figure 6: Difference (grain minus ratoon) in yield between grain sorghum grown at Warialda after a short fallow and grain sorghum after a ratooned sorghum crop. Grain sorghum was sown on the 15 October.

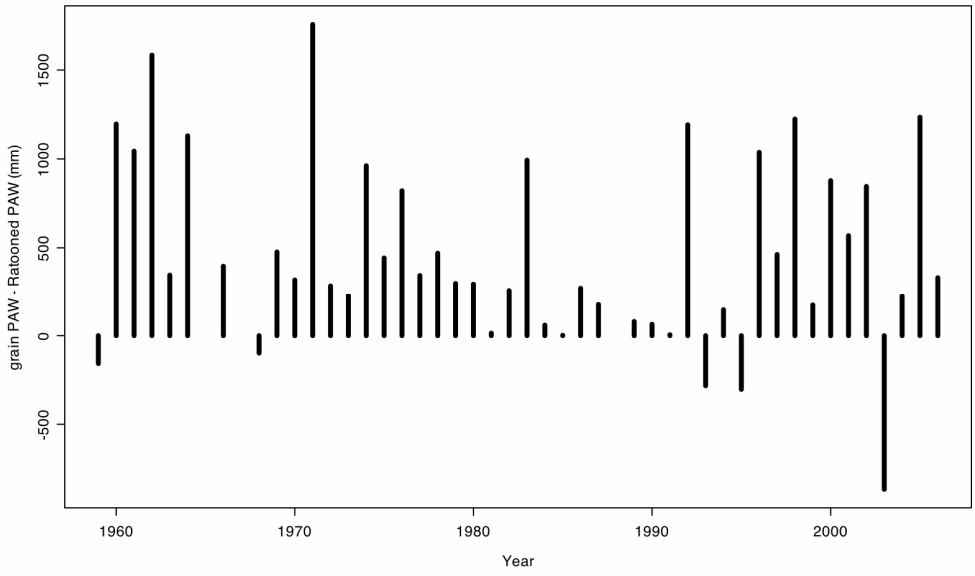

Figure 7: Difference (grain minus ratoon) in yield between grain sorghum grown at Nindigully after a short fallow and grain sorghum after a ratooned sorghum crop. Grain sorghum was sown on the 15 October.

On average the production of forage by ratooning sorghum after grain harvest cost the following sorghum crop 108 kg/ha of grain at Warialda and 332 kg/ha of grain in Nindigully. An estimate of the

additional biomass produced by ratooning the crop produced on average ~ 7121 kg/ha at Warialda and ~6469 kg/ha at Nindigully

Conclusion

The view that allowing a sorghum crop to ratoon will significantly impact on the starting PAW of following crops is generally supported by these results especially in the low rainfall area of Nindigully. In Warialda sufficient rainfall fell over the summer to replace the majority of the water used by the ratoon. However, despite yields of the following crops being reduced it was not statistically significant. If the intention is to double crop winter crops after sorghum then the PAW following a ratooned sorghum will be significantly lower than following a crop sprayed out at harvest

If the decision to ratoon sorghum is singular and only involves the trade-off between water for biomass and livestock feed or water for the following crop. Then the decision to ratoon will impact on the next crop but not significantly. However, as with many farming decisions trade-offs are pluralistic and other considerations will impact on the decision.

Basing a decision simply on available water is valuable, but simplistic. What this analysis does not consider is the management implications of ratooning sorghum. Such implications are mixed and varied, but include: the creation of a green bridge for disease and insects, poor weed control, reduced soil cover, the tie up of nitrogen reserves, and implications on deep drainage and erosion. Future work will look at some of these components and link these with surveyed responses from farmers examining the motivation of farm practitioners to ratoon sorghum stubble.