The impact of the timing of sorghum spray-out – The Research View

Guy McMullen and Alan Bowring I&I NSW, Tamworth

Sorghum desiccation, or spray-out, with glyphosate is a common practice for sorghum growers in NSW and QLD. Anecdotal evidence has suggested that NSW growers and advisers are generally more conservative when determining the time of desiccation.

Desiccation can reduce the time to harvest, control late season weeds, increase soil water after harvest and increase the length of the fallow period to maximise future cropping opportunities. Desiccating the crop too early however can result in increased lodging if harvest is delayed, reduced grain yield and grain quality – particularly grain size.

Typically it is recommended that desiccation should occur when the crop has reached physiological maturity, at ~25-35 % grain moisture. An important indicator that the crop has reached this stage is to assess the later maturing grains in the bottom third of the head for the presence of the abscission or black layer.

Sorghum (Buster) at Premer prior to (left) and after desiccation (right) in 2008.

Currently there is little published research available on sorghum desiccation and optimal timings for crop yield and quality under Australian conditions. To address this need

research trials were conducted in the 2007/8 and 2008/9 seasons to answer the following main questions:

1. What is the impact of spray-out timing on sorghum grain yield?
2. How is grain quality affected by earlier spray-out?
3. What are the benefits for soil water conservation with earlier spray-out?

In 2007/8 two small plot replicated trials were established on the Liverpool Plains, NSW in commercial sorghum paddocks. In 2008/9 7 trials were established from Goondiwindi in southern QLD to Premer in northern NSW. Paddocks were targeted where growers indicated they were at least 4 weeks from commercially planned desiccation.

The trials evaluated 5-6 timings of desiccation, applied at weekly intervals commencing approximately 14 days after flowering (DAF) on the main heads. Glyphosate was applied using a hand-boom. Grain samples were taken for quality assessment and grain moisture determined at each spray timing.

Table 1. Location of sites, varieties and dates of desiccation sprays in 2008.

Site Variety	Spring Ridge 86G56	Spring Ridge MR43	Premer Buster	Pine Ridge Buster	Goondiwindi 86G56	Goondiwindi MR43	Millie MR43
14 DAF	23/03/2009	9/03/2009	24/02/2009	23/03/2009	22/12/2008	19/02/2009	10/3/09
21 DAF	30/03/2009	16/03/2009	3/03/2009	30/03/2009	29/12/2008	26/02/2009	17/3/09
28 DAF	8/04/2009	23/03/2009	10/03/2009	8/04/2009	5/01/2009	4/03/2009	24/3/09
35 DAF	26/04/2009	30/03/2009	17/03/2009	17/04/2009	12/01/2009	12/03/2009	1/4/09
42 DAF	26/04/2009	6/04/2009	24/03/2009	27/04/2009	19/01/2009	19/03/2009	7/4/09
49 DAF	-	-	-	-	28/01/2009	25/03/2009	15/4/09

Plots were harvested using a small plot harvester and grain yield, protein, screenings, hectolitre weights and grain size determined. Soil cores were taken from each plot immediately after harvest and soil moisture determined gravimetrically.

Grain yield:

Very early spray-out (~14 DAF) resulted in dramatic yield losses at all sites (figure 1). The minimum yield loss across the eight trials was ~35% while the average was over 50%. The most severe yield penalty at this stage was 78% of the yield of the final spray timing. When spraying at 28 DAF, 3 of 7 sites in 2008 had significant yield reduction after desiccation. Desiccation at 35 DAF resulted in only 1 site that had a significant yield loss compared to the final timing. Desiccation at 35 DAF in 2008 resulted in mean yields across all 7 sites of 98% of the final desiccation timing.

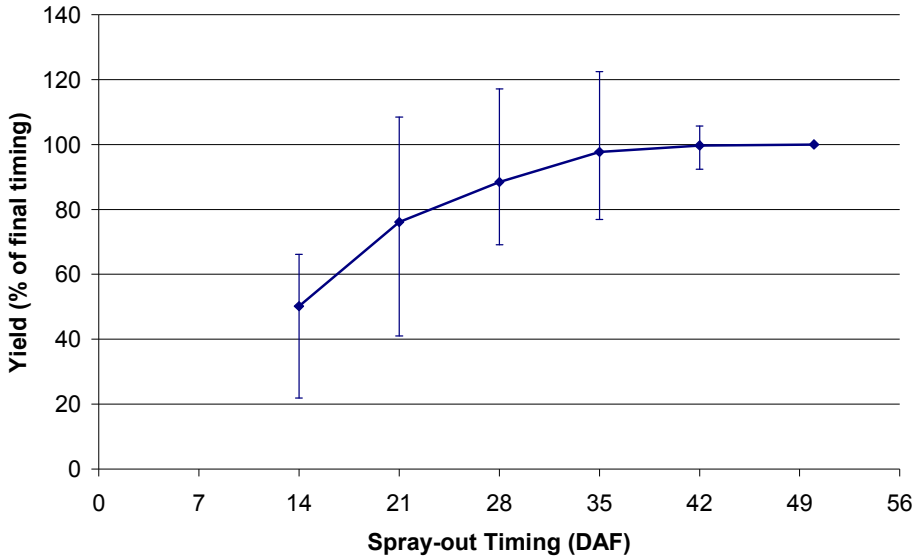

Figure 1. Average grain yield in 2008 from 7 sites as a percentage of the final desiccation timing. (*Top and bottom of the vertical bar represents the maximum and the minimum yields respectively, while the points represent average yield*).

Grain quality:

Screenings increased dramatically at all sites at the earliest spray-out timing. When desiccation occurred at 21 DAF screenings were increased at 5/7 sites. When desiccation was timed after 28 DAF there was no significant increase in grain screenings.

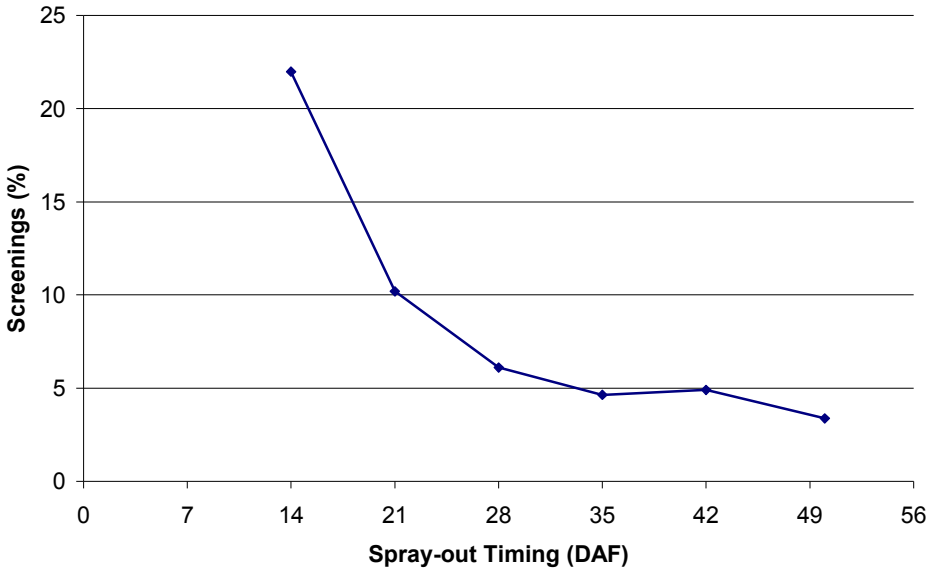

Figure 2. Average grain screenings from 6 sites as a percentage of the final desiccation timing. *(Grain quality analysis not conducted on samples from Millie trial)*

For grain test weight, a measure of grain density, and grain size early desiccation resulted in severe penalties. There was a large decrease in both at the earliest timing while desiccation later then 21 DAF resulted in no significant change in test weight.

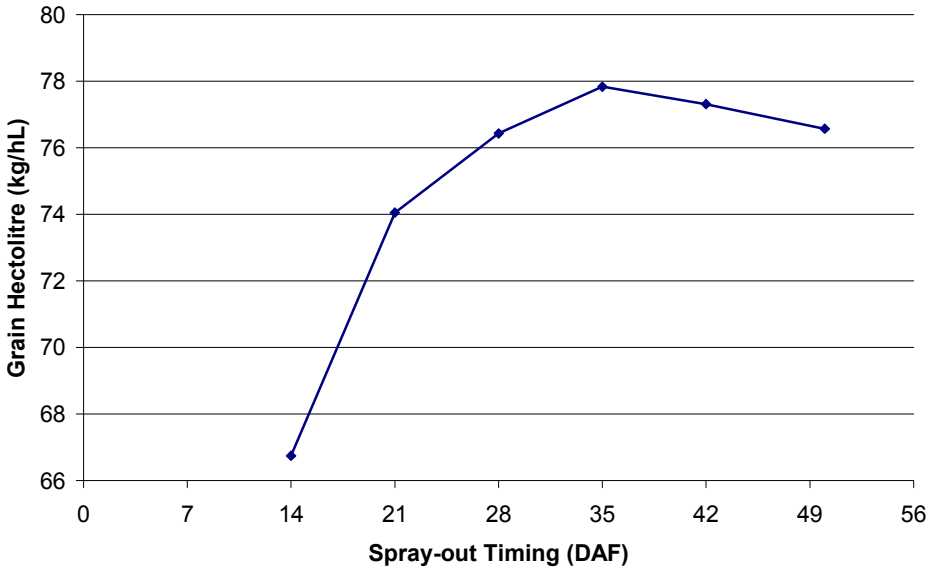

Figure 3. Average hectolitre weight from 6 sites *(Grain quality analysis not conducted on samples from Millie trial)*

Soil water conservation:

One of the other key questions was the impact of earlier desiccation on residual soil water levels. If growers were able to spray-out sorghum earlier would this increase the soil water remaining post-harvest and improve production in the subsequent crop in the rotation.

Soil water conservation ranged from 0-40 mm when grain yield was not reduced by desiccation. Much of the soil water that was conserved was at depth (below 30cm) which can have significant benefits for the next crop in the rotation as it may be used with greater efficiency.

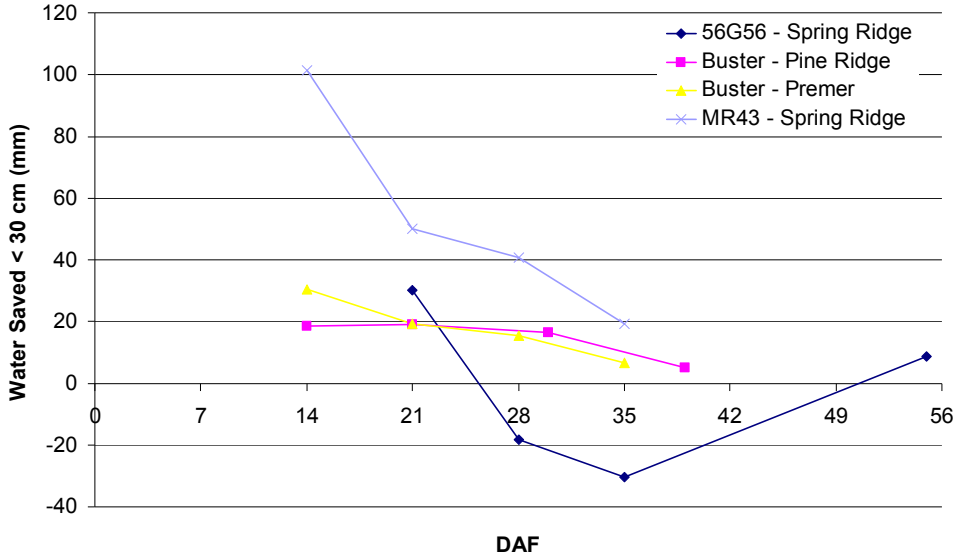

Figure 3. Soil water (mm) saved below 30 cm by earlier desiccation compared to the final desiccation timing.

Summary

Spray-out timing

Overall, 35 DAF provided a good starting point when planning sorghum spray-out timing. However, it is critical to fine tune the actual timing by variety and situation. Identify and assess the maturity of the youngest heads that you are targeting for harvest and time your spray-out accordingly. The penalties of desiccation too early can be extreme in terms of both yield and quality.

Costs and benefits

Getting the spray-out timing right can lead to benefits in the conservation of soil water for the next crop in the rotation while contributing to late season weed control. However, the soil water benefit, from optimal spray-out timings, in these trials was generally less than 10 mm.

Overall

To maximise the benefit from sorghum spray-out, it is important to assess each paddock individually for physiological maturity. It is importantly to identify the maturity of the head that you are targeting for harvest, particularly in skip row configuration where there is often a higher proportion of later developing heads, and judge paddock timing on these. Going too early is obviously fraught with danger but ensure you time spray-out as close as practical to physiological maturity to avoid yield/quality impacts but maximize the chance of retaining soil moisture to benefit the next crop in the rotation.

Pre-harvest Spraying of Sorghum – The Consultant's View

By Greg Giblett, Greg Giblett Consulting Pty Ltd

Pre-harvest sprayout of sorghum has been common practice on the Liverpool Plains for over 10 years.The main reasons for the popularity of pre-harvest spraying are

1) Evening up crops and bringing the harvest date forward
2) Stopping current crop water use and storing more water in the soil profile for the next crop
3) Speed of harvest is increased with more tonnes per/hour possible through the header.

Farming programs are run on the basis that all stubble is retained and most growers are using or moving towards controlled traffic and no-till systems with the aid of tractor guidance. Overall farm profitability is based on maximising cropping frequency without taking undue risk on fallows with less than 70 cm of wet soil. Hence crop sequences are developed on the assumption that we need to have as many re-cropping options as is possible after the sorghum.

For example sorghum harvested in April has the possibility of being-

1) Long fallowed into cereal. (14 month fallow)
2) Double cropped into cereal given adequate soil moisture. (2 month fallow)
3) Double cropped into a legume such as chickpea. (2 month fallow)
4) Short fallowed to a second summer crop such as sorghum or sunflower. (7 month fallow)

Spraying out of sorghum pre-harvest becomes the "corner stone" in this strategy as we can then select any subsequent crop choice to maximise return per hectare whilst making a rotation choice that allows us to manage weeds and disease.

Having the sorghum plant dead at harvest means that we can sow directly back into the stubble just by shifting the planter off the old sorghum row. Irrigators have been able to sow double-crop cereals or legumes back into 10 t/ha sorghum residues under this system.

The timing of sorghum spray-out has been relatively simple for early crops reaching maturity in March and April when day temperatures are still high. Crops tend to be more even in any case and reach physiological maturity (black layer) within 30-35 days of flowering.

As the sorghum sowing window has widened driven by both better midge resistance in hybrids and the increased reliability of no-till sorghum on sorghum, harvest dates are often now pushed back into May and June for a proportion of crops sown each year.

With later sowing and harvest dates comes much cooler dry down conditions and less even crop maturity across paddocks.

Questions on the earliest possible spray-out timing have been raised by growers and agronomists wishing to get crops off before harvesting conditions deteriorate. Pushing to spray out crops earlier runs the risk of pinching off some grain before physiological maturity possibly affecting test weights and yields. However leaving sorghum in the paddock runs the risk of rainfall events leading to weathering losses and wet harvest conditions which often result in deep wheel tracks in paddocks impacting on re-cropping options.

The current project activity by Northern Grower Alliance, in collaboration with NSW I&I, has been important to help confirm optimal sorghum spray-out timing, identify the cost implications of 'jumping the gun' whilst avoiding overly conservative decisions which cost time, soil moisture and can limit future crop options. Clearly the work has confirmed the role of using black layer as the key timing determinant and has given us confidence to continue spraying later crops right up until the occurrence of first frost.

Sorghum spray-out timing – The NGA View

By Richard Daniel NGA

Background
One of the summer projects raised by NGA local consultative committees has been to investigate and validate appropriate sorghum spray-out timing. In many areas of northern NSW, sorghum spray-out timing has often been regarded as overly conservative. As a result growers and advisers were interested in better understanding the 'best triggers' for timing and quantifying the risks and benefits to allow better on-farm decision making.

There were two key areas where growers believed an advantage might be gained:

1. To avoid being overly conservative and consequently bring harvest dates forward and limiting exposure to adverse weather issues
2. To maximise the chance of double cropping to chickpeas by stopping sorghum soil moisture use as early as economically practical

What was done?
This project was run in close collaboration with NSW I&I. In 2007/8 two trials were conducted on the Liverpool Plains with an additional 8 trials conducted in 2008/9 from southern Qld to the Liverpool Plains. The key goal was to evaluate the impact of spray-out timings on yield and grain quality and also to measure the impact of spray-out timing on soil moisture levels.

Key messages
The accompanying article by Dr Guy McMullen highlights the key trial results but some of the main messages are:

1. Dramatic negative impact of early spray-out timing on yield and grain quality
2. Little or no advantage from delaying past grain physiological maturity
3. Soil moisture benefits from early timing were erratic and not consistent enough to 'budget on'
4. ~35 DAF (35 days after flowering) is a good time to commence checking for crop maturity
5. Identify the latest heads/tillers that you consider important to take to harvest
6. Assess 'black layer' or physiological maturity **on grain in heads of that maturity** and schedule timing accordingly

Clearly being aggressive and going before physiological maturity is far too costly in terms of sorghum returns and is not warranted by the soil moisture conserved. However being overly conservative is also a production constraint to avoid. This was in fact seen at one trial site in 2007/8 where the commercial spray-out timing could have been considered 2-3 weeks earlier.

Conclusions
It is well known that sorghum grain or head colour is a poor indicator of actual maturity as it varies widely by both hybrid and environmental conditions. The rule of thumb used by seed

companies such as Pacific Seeds and Pioneer to start looking in field from about 35 DAF was a good starting point but will always need to be refined in individual paddocks. Hybrids with staygreen attributes may take longer to mature but also individual paddock timing will be heavily influenced by row configuration and particularly by the number of late tillers which can be taken successfully to yield.

Although sorghum spray-out can be a very useful management tool, it is unlikely to be appropriate in all cases. In situations with highly moisture stressed crops or with high stalk rot levels, sorghum spray-out may actually result in yield losses due to crop lodging. New research in this area is planned for 2009/10.

Certainly this project has confirmed the use of 'black layer' as the most practical tool for scheduling timing and reinforced the need to judge 'black layer' development on heads of the maturity you want to take to harvest. Although soil moisture benefits were recorded in some trials, the key approach should be to desiccate the sorghum as soon as practical after 'black layer' and treat any soil moisture benefit as a bonus.

Too early

Close to ideal

Later than necessary