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Agronomic response of sorghum to nitrogen management – Tamworth 2014–15

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Key findings

Despite only 71 mm (0–150 cm) of plant available water (PAW) at sowing, in-crop rainfall of 392 mm substantially increased yield potential.

There was a significant grain yield response to applied nitrogen (N). Adding 40 kg N/ha resulted in a 0.9 t/ha or 10% increase in grain yield over the nil applied N treatment.

Optimum yield was achieved through applying 160 kg N/ha, which resulted in a 21% or 1.7 t/ha increase in grain yield over the nil treatment. There was a corresponding 10% increase in yield with the 40 kg N/ha treatment.

Maximum grain yields were achieved when grain protein was >9.0%, supporting previous observations that the critical grain protein value of sorghum is 9–10% to maximise yield.

These results highlight the need to consider yield potential in terms of probable and starting soil N values.

Introduction

The Northern Grains Region of NSW with its characteristic black/grey cracking clays (vertosols) relies heavily on stored moisture and subsoil nutrient reserves for crop production. Although PAW is the principal driver of yield potential, nitrogen (N) is considered one of the most important limitations of yield. Importantly, a crop's optimum N requirement depends on yield potential which, in turn, depends on plant available soil moisture. Furthermore, declining soil organic matter and/or N reserves has created an increased reliance on N fertilisers. Subsequently, as yield potential rises and soil fertility declines, N fertiliser management becomes more important. While there are N response guidelines for crops such as wheat, information for sorghum tends to be more limited.

Critical grain protein values can be used to help monitor how effective N management decisions are in crops such as sorghum. Optimum sorghum grain yields are generally achieved when grain protein concentration (GPC) levels of 9–10% are attained, with yield affected at levels below 9%. Conversely, at levels >10% grain protein, higher N rates might only increase grain protein and not yield, which is uneconomical when protein premiums do not exist for sorghum.

The aim of this research was to determine the agronomic response of sorghum to N management to help develop more robust soil test/crop response guidelines. Results from a dryland N response sorghum trial conducted at Tamworth in the 2014–15 season are outlined in this report.

Site details

Location:	**Tamworth Agricultural Institute (Paddock 3)**
Soil type:	**Black vertosol**
Starting N:	**Available soil nitrate N ~85 kg/ha (0–120 cm)**
Planter:	**Monosem double disc precision planter – row configuration 75 cm solid**
Variety:	**Hybrid, MR Bazley**
Target population:	**60,000 plants/ha**
Fertiliser:	**50 kg/ha Granulock Z applied at planting**
Sowing date:	**27 October 2014**
PAW at sowing:	**71 mm (0–150 cm)**
In-crop rainfall:	**392 mm**
Harvest date:	**6 March 2015**

Table 1. *Monthly in-crop rainfall 2014–15 season*

November	December	January	February	March	Total (mm)
44.0	146.8	165.2	29.3	6.0	391.6

Treatment

Nitrogen (N) rate 0, 40, 80, 120, 160 and 180 kg N/ha applied as urea (46% N) at planting, with five replicates per treatment.

Results

Although PAW at sowing was only 71 mm, excellent December/January rainfall (~312 mm) resulted in 391.6 mm of in-crop rainfall (Table 1). Plant establishment of ~ 61,500 plants/ha, when averaged across all treatments, exceeded the targeted population of 60,000 plants/ha.

Grain yield

There was a significant grain yield response to applied N. Adding 40 kg N/ha (~87 kg/ha of urea), resulted in a 0.9 t/ha or 10% increase in grain yield over the nil applied N treatment (8.67 t/ha vs 7.86 t/ha), with no significant difference between the 40, 80 and 120 kg N/ha treatments (Figure 1). Optimum yield was achieved by adding 160 kg N/ha (~348 kg/ha urea) resulting in a 1.7 t/ha or 21% increase in grain yield over the nil N treatment and a corresponding 10% increase in yield over the 40 kg N/ha treatment (9.55 t/ha vs 8.67 t/ha). Increasing the N rate to 180 kg N/ha however, resulted in no significant yield increase over either the 120 kg N/ha or 160 N/ha treatments, with a typical plateaued N response curve observed (Figure 1).

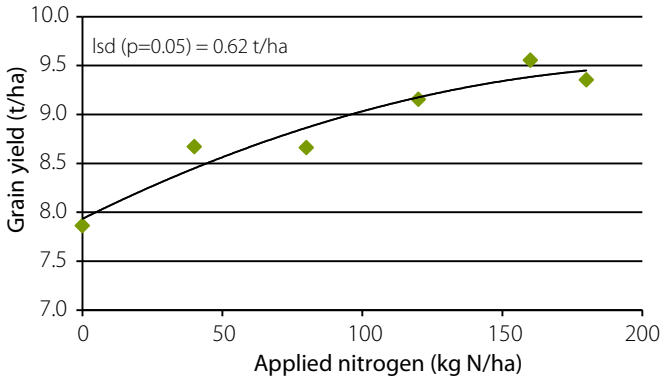

Figure 1. *Grain yield response to varying rates of applied N at Tamworth in the 2014–15 season*

Grain protein concentration (GPC)

Increased levels of grain protein were achieved through increasing applied N (Figure 2). At the nil rate of applied N, the GPC achieved in this experiment, was only 6.6%. Increasing N application to >80 kg N/ha increased GPC to >9.0%, with yield optimised at around 9.3% GPC at the 160 kg N/ha rate. Results from this experiment showed that grain yield tends to be maximised when GPC is >9.0%, supporting observations that maximum grain yield for sorghum is believed to be achieved when grain protein values are between 9–10%.

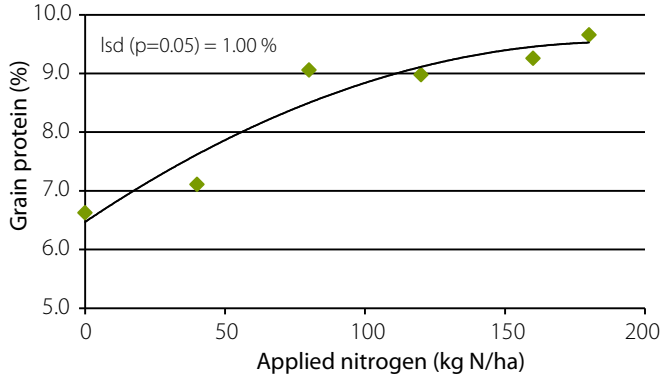

Figure 2. *Grain protein concentration response to varying rates of applied N at Tamworth in the 2014–15 season*

Summary

In water-limited/dryland environments, sorghum grain yield response to N application can vary, depending on starting soil N and PAW. The difficulty in predicting yield responses in dryland environments centres on PAW, the principal determinant of grain yield potential. In this instance with only ~71 mm (0–150 cm) of PAW at sowing, yield potential was considered low to average. However, as was the case in the 2014–15 season, with good in-crop rainfall, crop yield potential can increase substantially. In these occurrences, N supply can become an important factor limiting grain yield potential.

If grain yield, and hence fertiliser decisions for example, were made on PAW at sowing and only a conservative approach to N application was taken (i.e. only 50 kg/ha of Granulock Z applied) as per this experiment, 1.7 t/ha or 21% of grain yield potential would have been lost given the optimum N response rate (160 kg N/ha). Significantly, even at modest levels of N application (e.g. 40–80 kg N/ha) grain yield was increased by ~10% or 0.8 t/ha.

Critical GPC values were shown to assist a grower to evaluate the effectiveness of N management decisions. As per previous findings, optimum sorghum grain yields were achieved when a GPC of 9–10% were attained. Importantly, these results highlight the need to consider yield potential in terms of probable PAW and starting soil N values. If you have low starting soil available N reserves and/or potentially good PAW (starting plus in-crop rainfall), then grain yield responses to applied N are considered more probable, whilst critical GPC values are considered excellent for determining the effectiveness of N management strategies.

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