Durum wheat variety response to nitrogen management and time of sowing – Tulloona 2015

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Key findings

Durum varieties displayed differential grain quality and yield responses to time of sowing (TOS) and nitrogen (N) management.

DBA Aurora(ф) appears to offer good yield potential, but exhibits an increased risk of screenings with increasing rates of N application at sowing or when N is applied before stem elongation (GS31). It also appears to have an increased potential for lower grain protein concentrations (GPC) due to yield dilution under high yielding situations.

A strategy involving a split application of N at sowing and either GS31 or GS39, could reduce the potential for screening issues in DBA Aurora(ф) while maintaining adequate GPC.

DBA Aurora(ф), due principally to its increased risk of screenings, would appear to offer less flexibility in terms of agronomic management to durum growers in northern NSW, compared with Jandaroi,(ф) Caparoi(ф) or DBA Lillaroi(ф).

Findings from this experiment further highlight the need to sow appropriate variety maturity types within their recommended sowing windows.

Introduction

Durum wheat (*Triticum turgidum*) production is generally targeted at high yielding environments with the potential to achieve grain protein concentrations (GPC) of 13% and above. In northern NSW and Qld, grain handlers receive durum which mostly needs to meet Grain Trade Australia (GTA) quality receival standards. Only varieties receiving a Wheat Quality Australia (WQA) classification can be delivered to receive Australian Premium Durum (ADR) grades other than feed. Price downgrades are generally associated with decreasing GPC and grain plumpness (screenings), with the lowest quality durum (DR3) accepted for semolina and pasta production having a minimum 10% GPC with a maximum of 10% screenings. Importantly, GPC is a primary receival standard for which growers are paid, and significant differential premiums are offered for higher grain protein levels.

For the major northern durum traders such as Cargill and GrainCorp, their emphasis is on maximising brand advantage and penetration of Australian durum into the Italian market. For GrainCorp, one of the main traders of northern durum, the market is essentially Italy, ex Newcastle terminal preferably meeting DR1 quality specifications (>13% GPC and <5% screenings), with DR2 (minimum 11.5% GPC and a maximum of 5% screenings) generally less desirable (GrainCorp pers. comm.). The concerns for export markets have been the need to improve consistency of supply of DR1 and DR2 grade durum, and to maintain the high quality standards of Australian durum wheat. The most common cause for grain quality downgrading at receival in newer cultivars has generally been due to screenings >5% and GPC below 13%.

The aim of this experiment conducted near Tulloona on the North West Plains of NSW, was to compare variety response with time of sowing (TOS) and nitrogen (N) management with the objective to develop variety recommendations and tactical agronomy guidelines. This should improve the potential for varieties to reliably achieve DR1 and DR2 receival specifications thereby enhancing variety adoption through improved yield and quality potential of new durum varieties.

Site details

Location:	**"Myling", Tulloona, North West Plains**
Co-operator:	**Jack Gooderham**
Previous crop:	**Long fallow out of sorghum**
Soil type:	**Black vertosol**
Starting N:	**Soil nitrate N of ~137 kg N/ha (0–120 cm)**
Starting water:	**~210 mm plant available water (PAW) to 150 cm when cored pre TOS 2 (4 June)**
Sowing date:	**7 May 2015 (TOS 1) and 6 June 2015 (TOS 2)**
In-crop rainfall:	**~190 mm (May to November)**
Fertiliser:	**70 kg/ha Granulock Z extra at planting**
Harvest date:	**10 November 2015**

Treatments

Durum wheat — Four commercially released varieties Caparoi(ф), DBA Aurora(ф), DBA Lillaroi(ф) and Jandaroi(ф), and an advanced breeder's line from the Northern Durum breeding program 190873 in a fully replicated, factorial design with six N treatments in total.

Nitrogen (N) rate 0, 40, 80, 120 and two split applications 2 × 40 kg N/ha either at sowing and GS31 or at sowing and GS39, all applied as urea (46% N). All treatments were side banded at sowing, apart from the split applications, which had half applied at planting and half at stem elongation (GS31) or at flag leaf emergence (GS39) (total 80 kg N/ha).

Sowing date 7 May and 6 June, in a split plot design with three replicates.

Results

- The yield response of varieties between TOS 1 and TOS 2 was variable. The quicker maturing varieties, Jandaroi and DBA Lillaroi, suffered yield losses of 44% (2.50 t/ha) and 14% (0.75 t/ha), respectively with TOS 1 averaged across N treatments, due most likely to frost-induced sterility from this earlier sowing date (Table 1).
- In contrast, the later maturing varieties DBA Aurora and Caparoi had yield increases of 19% (1.10 t/ha) and 7% (0.39 t/ha) in TOS 1 compared with TOS 2. The later maturity of these varieties most likely allowed them to escape frost damage in TOS 1 but increasing temperatures and moisture stress during grain fill associated with the later sowing date (TOS 2) would have restricted yield.
- Grain yield response to N application although positive, was relatively flat, with no varietal interactions apparent in either TOS. For TOS 1, yield averaged across varieties increased by 0.18 t/ha over the nil treatment at the 120 kg N/ha rate (5.21 t/ha vs. 5.39 t/ha). Whilst in TOS 2, there was a 0.22 t/ha yield increase over the nil treatment at the 80 kg N/ha rate (5.42 vs. 5.66 t/ha).
- In contrast to grain yield, grain protein concentration (GPC) showed a linear trend with increasing N rates. DBA Aurora failed to achieve DR2 specifications of >11.5% GPC with both the nil N treatments for TOS 1 and TOS 2 and was outside DR1 specifications of >13.0% GPC for all N treatments apart from TOS 2 with high upfront N rates of 80 to 120 kg N/ha (Figure 1).

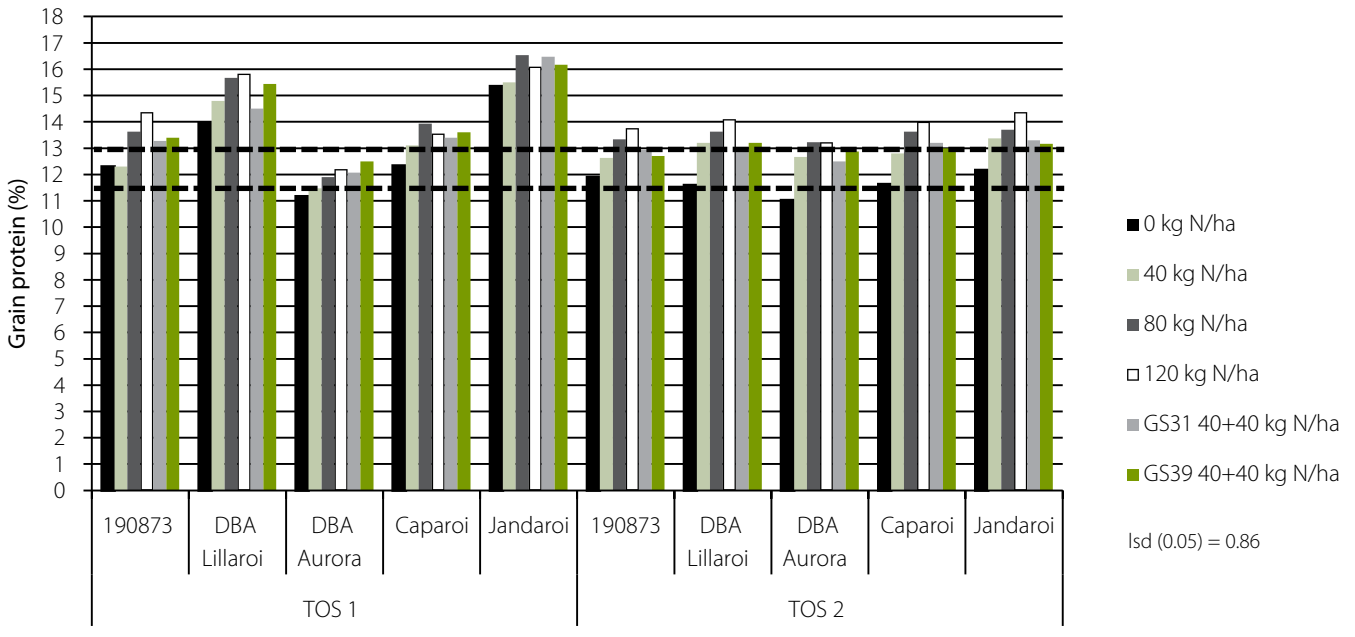

Figure 1. *Effect of nitrogen management on grain protein concentration (GPC; %) over two times of sowing – Tulloona 2015*
Note: DR1 >13% GPC (upper dashed line); DR2 >11.5% GPC (lower dashed line).

- With screenings (<2.0 mm), DBA Aurora was outside DR1 and DR2 specifications (i.e. >5%) with all N treatments in TOS 1 and exceeded DR1 and DR2 specifications at 40, 80 and 120 kg N/ha upfront N application treatments in TOS 2. The majority of other varieties were able to achieve DR1 and DR2 screening receival standards (data not shown).

- Although DBA Aurora appears to have a high yield potential, it also appears to have an increased risk of quality downgrading due to screenings (>5%) particularly under sub-optimal finishing conditions (e.g. increasing temperature and moisture stress during grain filling) and/or reduced GPC (<13%) due to yield dilution. When examining the influence of N management on screenings, it can be seen that with increasing upfront N application in TOS2, the percentage screenings increased in DBA Aurora (Figure 2).
- In contrast, Caparoi, DBA Lillaroi and Jandaroi were able to maintain lower screening levels with increasing rates of N application. The results from this experiment did, however, indicate that a strategy involving a split application of N at either GS31 or GS39, may reduce the potential for screening issues in DBA Aurora whilst maintaining satisfactory GPC (Figure 2). The other durum varieties all demonstrated relatively good grain stability and GPC across N rates.

Table 1. *Mean varietal grain yield (t/ha) averaged across nitrogen treatments for two times of sowing – Tulloona 2015*

Variety	Yield (t/ha)	
	TOS 1	TOS 2
Caparoi	5.68	5.29
190873	5.81	5.54
DBA Aurora	6.89	5.79
DBA Lillaroi	4.51	5.25
Jandaroi	3.11	5.57
LSD (P = 0.05)	0.18	

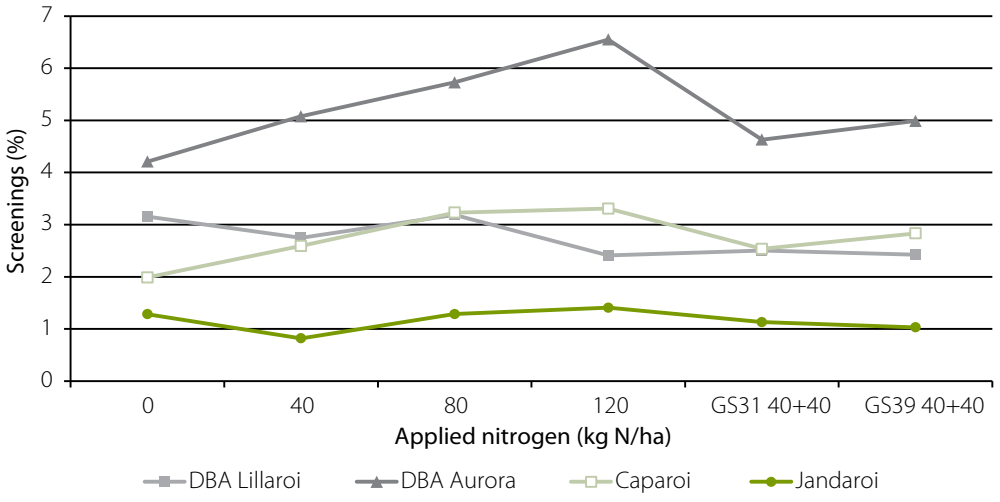

Figure 2. *Effect of nitrogen management on screenings (%) of four durum varieties – TOS 2 Tulloona 2015*

Summary

Results from this study indicate that durum varieties have different grain quality and yield responses to TOS and N management. DBA Aurora, although potentially high yielding, appears to have an increased probability of quality downgrading due to a higher risk of screenings and/or reduced GPC due to yield dilution. DBA Aurora, due principally to its increased screenings risk would appear to offer less flexibility in terms of agronomic management to durum growers in northern NSW compared with Jandaroi, Caparoi and DBA Lillaroi. Results did, however, indicate that a strategy involving a split application of N at either GS31 or GS39, could reduce the potential for screening issues in DBA Aurora, while maintaining satisfactory GPC.

Findings from this experiment also highlight the need to sow varieties within their recommended sowing windows. An earlier than recommended sowing date of 7 May resulted in yield losses of 44% (2.50 t/ha) and 14% (0.75 t/ha) averaged across N treatments for the earlier maturing varieties Jandaroi and DBA Lillaroi respectively, due to frost. In contrast, later maturing varieties DBA Aurora and Caparoi had yield reductions

of 19% (1.10 t/ha) and 7% (0.39 t/ha) when sowing was delayed until 6 June, most likely from increasing temperature and moisture stress during grain filling.

Given the export focus of the northern durum market it is assumed that varieties with good grain stability, namely a reduced risk of screenings and consistency in achieving the desired DR1/DR2 GPC specifications, will be preferred over varieties with an increased risk of quality downgrading.

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