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

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Key findings

Durum varieties (Caparoi$^{(b)}$, DBA Aurora$^{(b)}$, DBA Lillaroi$^{(b)}$ and Jandaroi$^{(b)}$) displayed differential grain quality and yield responses to time of sowing (TOS) and nitrogen (N) management. Increased screenings (>5%) were the most common cause of quality downgrades.

DBA Aurora$^{(b)}$, due to increased risk of screenings (>5%) in part because of reduced grain size, would appear to offer less flexibility in terms of agronomic management, specifically delayed sowing and N management.

The newly released Northern Durum breeding program variety DBA Lillaroi$^{(b)}$ appears to offer excellent grain size and grain stability, achieving low screenings from a delayed sowing and high N rates.

Results also highlight the need to sow varieties within recommended sowing windows. An earlier than recommended sowing date of May 19 for the Liverpool Plains resulted in yield losses of ~25% averaged across N treatments for earlier maturing varieties such as Jandaroi$^{(b)}$ and DBA Lillaroi$^{(b)}$, with possible grain quality implications (e.g. increased screenings).

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, 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 receival downgrading in newer cultivars has generally been due to screenings >5% and GPC below 13%.

The aim of the experiment was to compare variety response to time of sowing (TOS) and nitrogen (N) management to develop variety recommendations and tactical agronomy guidelines. This should improve the potential of varieties to reliably achieve DR1 and DR2 receival specifications, thus enhancing variety adoption through improved yield and quality potential of new durum varieties. The experiment was conducted near Tamarang on the Liverpool Plains in 2015.

Site details

Location:	**"The Point", Tamarang, Liverpool Plains**
Co-operator:	**David Ronald**
Previous crop:	**Long fallow out of sorghum**
Soil type:	**Black vertosol**
Starting N:	**Soil nitrate N of ~200 kg N/ha (0–120 cm)**
Starting water:	**~130 mm PAW to 1.2 m when cored pre-sowing (11 March), with 70 mm of rain received after coring and prior to TOS 1**
Sowing date:	**19 May 2015 (TOS 1) and 9 July 2015 (TOS 2)**
In-crop rainfall:	**290 mm (TOS 1)**
Fertiliser:	**70 kg/ha Granulock Z extra at planting**
Harvest date:	**30 November 2015 (TOS 1) and 7 December 2015 (TOS 2)**

Treatments

Durum wheat	Four commercially released varieties Caparoi$^{(b)}$, DBA Aurora$^{(b)}$, DBA Lillaroi$^{(b)}$ and Jandaroi$^{(b)}$, 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 kg N/ha 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 19 May and 9 July, in a split plot design with three replicates.

Results

- For both times of sowing, there was no positive grain yield response to N application, with only a GPC response to increasing rates of N application. This was most likely due to high starting soil N levels, estimated at ~200 kg N/ha.
- All varieties experienced a yield reduction for TOS 1 vs. TOS 2 (Table 1), due primarily to frost-induced sterility at flowering and/or frost impact during grain filling with TOS 1. The 19 May (TOS 1) is generally considered earlier than ideal for this region, with the 4th week of May considered suitable for mid-season varieties such as Caparoi, and the 1st week of June more appropriate for the earlier maturing varieties, such as Jandaroi. The earlier maturing varieties, Jandaroi and DBA Lillaroi, suffered the greatest yield losses with TOS 1 at 1.51 t/ha and 1.64 t/ha, respectively when averaged across N treatments compared with yield obtained from TOS 2 (Table 1).
- In comparison yield losses of 0.89 t/ha and 0.82 t/ha occurred for the later maturing varieties DBA Aurora and Caparoi, respectively with TOS 1.

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

Variety	Yield (t/ha)	
	TOS 1	TOS 2
Caparoi	5.35	6.17
190873	5.23	6.36
DBA Aurora	5.11	6.00
DBA Lillaroi	4.94	6.58
Jandaroi	4.75	6.26
LSD (P = 0.05)	0.41	

- The grain quality parameters of screenings and, to a lesser extent, GPC were affected in TOS 1, with DBA Aurora and DBA Lillaroi downgraded to DR3 across all N treatments due to screening levels >5%. Caparoi only exceeding 5% screenings at the highest N rate of 120 kg N/ha (data not shown).
- An increase in screenings for DBA Lillaroi in TOS 1 compared with TOS 2, was most likely due to a frost event during grain filling. Interestingly, the split application of N at GS39 for DBA Aurora did show a reduced trend in screenings at this sowing time.
- TOS 2, sown on 9 July, although later than preferred (outside the optimum sowing window) was nevertheless considered acceptable. All varieties achieved significant ($P<0.001$) increases in grain yields over TOS 1 (Table 1), with all varieties, apart from DBA Aurora, achieving DR1 grain receival specifications. DBA Aurora was downgraded to DR3, due to screenings being >5% across all N rates (Figure 1). The difference in variety responses to N application rates averaged across treatments highlights the issues that DBA Aurora has in terms of potential for downgrading due to higher screening levels (Table 2).

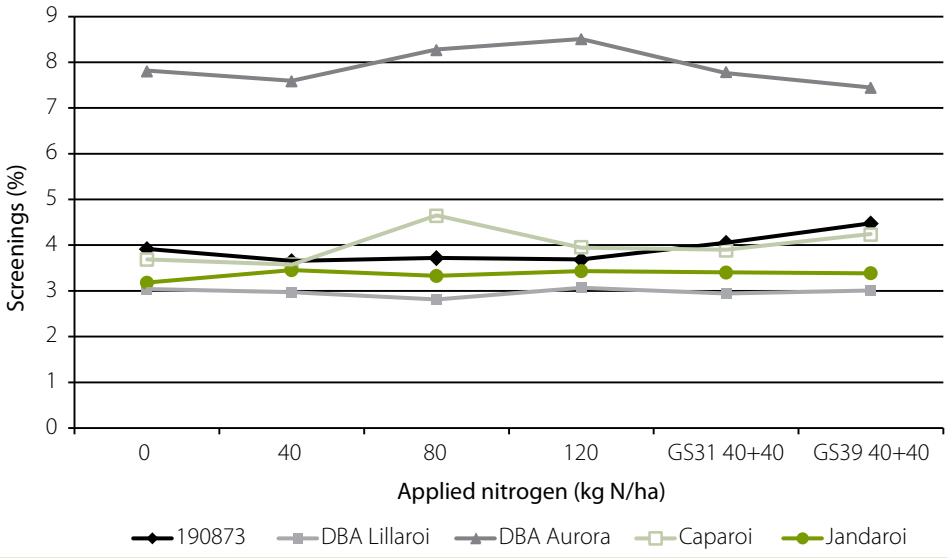

Figure 1. *Varietal screenings (%) response to nitrogen application with delayed sowing (TOS 2)*

- Averaged across N treatments, DBA Lillaroi achieved the highest thousand grain weight (TGW) of 41.0 g, which was greater than either Jandaroi or Caparoi, with DBA Aurora at 33.0 g significantly lower than the other durum varieties (Table 2).
- The experimental line 190873, which has an ADR classification, performed comparably with commercially released northern varieties in terms of yield and grain quality specifications.

Table 2. *Mean varietal grain yield (t/ha), grain protein concentration (GPC; %), grain nitrogen yield (GNY; kg N/ha), test weight (hL/kg), screenings (%), and thousand grain weight (TGW; g) averaged across nitrogen treatments TOS 2 (9 July) – Tamarang 2015*

Variety	Yield (t/ha)	GPC (%)	GNY (kg N/ha)	Test weight (g)	Screenings (%)	TGW (g)
Caparoi	6.17	13.8	150.2	84.7	4.0	36.0
190873	6.36	14.1	157.6	85.1	3.9	36.0
DBA Aurora	6.00	13.5	142.6	82.9	7.9	33.0
DBA Lillaroi	6.58	14.6	169.8	84.9	3.0	41.0
Jandaroi	6.26	14.7	161.4	84.2	3.4	36.7
LSD (P = 0.05)	0.22	0.2	8.5	0.5	0.5	1.2

Summary

Results from this study showed that durum varieties had differential grain quality and yield responses to time of sowing and N management. The most common cause for quality downgrading in this experiment was due to increased screenings (>5%), with only ~43% of variety by N treatment combinations meeting DR1/DR2 specifications for TOS 1. However, it should be noted that varieties were affected to varying degrees by frost events during flowering and or grain filling with TOS 1. Importantly, only DBA Aurora was outside DR1/DR2 screening specifications (>5%) for all N rates at TOS 2 (Figure 1). From these results, it would appear that DBA Aurora, due to its increased risk of screenings (partly due to reduced grain size), offers less flexibility in terms of agronomic management considerations regarding sowing date and N management. In comparison, the newly released Northern Durum breeding program variety DBA Lillaroi appears to offer excellent grain size and grain stability, achieving low screenings from a delayed sowing time and high available N rates.

Findings from this experiment also highlight the need to sow varieties within their recommended sowing windows for a given environment. An earlier than recommended sowing date of May 19 for the Liverpool Plains region result in yield losses of ~25% averaged across N treatments for earlier maturing varieties such as Jandaroi and DBA Lillaroi, with possible grain quality implications also observed (e.g. increased screenings).

Given the export focus of the northern durum market, it is assumed that varieties with large, plump grain and reduced risk of screenings, that can consistently achieve DR1/DR2 specifications, will be preferred over varieties with an increased risk of quality downgrading.

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