Durum agronomy – varietal response to nitrogen

An SA Durum Grower's Association initiative, funded by GRDC
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Key findings

- Varieties responded similarly in yield and many quality measurements to applied nitrogen, but showed large differences in grain screenings.
- Large amounts of early applied nitrogen predisposed WID803 with inherent small grain to quality downgrading due to high screenings, varieties with inherent larger grain (Tjilkuri and Caparoi) were not downgraded across N treatments.
- The strategic approach to nitrogen management was a more effective method to maintain grain size and achieve 13% protein rather than applying all nitroen at stem elongation.

Why do the trial?

Over the last few years, it has been difficult to achieve the required 13% protein for DR1 in new durum varieties due to their higher yield potential, suggesting they require more nitrogen (N). However, when higher nitrogen rates and earlier applications of N are used it can often lead to increases in grain screening levels. This trial has examined appropriate management combinations of variety, nitrogen rate and timing, to achieve 13% protein and to minimise downgrading due to excessive screenings.

How was it done?

Plot size 1.4m x 10m **Fertiliser** 28:13 + 2% Zn IBS @ 100 kg/ha
Seeding date 27th May 2011

Trial was a randomised complete block design consisting of 3 replicates, 4 durum varieties and 7 nitrogen treatments.

4 varieties - Caparoi, Tjilkuri, WID803 (breeder line), Hyperno.

7 nitrogen treatments (applied as urea) – Nil, 40kgN, 80KgN, 120kgN, 180kgN (all at GS31), Strategy 1 (60kgN@GS31 + 40kgN@GS59), and Strategy 2 (60kgN@GS31 + 80kgN@GS59).

Results

Varieties responded similarly in grain yield to nitrogen treatments. Averaged across the trial WID803, Tjilkuri, and Caparoi all yielded similarly, while Hyperno was lower at 2.5t/ha (Table 1). The nitrogen treatments also had no significant effect on grain yield (Table 2).

Table 1. Grain yield, grain weight, protein, and test weight averaged across all nitrogen treatments for durum variety at Hart 2011.

Variety	Grain Yield (t/ha)	1000 Grain weight (mg)	Protein (%)	Test Weight (kg/hL)
Caparoi	2.7	38.8	13.8	83.0
Hyperno	2.5	32.3	14.3	78.7
Tjilkuri	2.7	34.5	13.8	79.0
WID 803	2.8	28.0	13.9	78.0
LSD (0.05)	0.12	0.94	0.28	0.62

Varieties responded similarly to applied N for grain weight, protein, and test weight. However, these grain quality measurements were affected by differences within varieties (Table 1) and the additive effect of nitrogen treatments (Table 2).

Table 2. Grain yield, grain weight, protein, and test weight averaged across all varieties for nitrogen treatment at Hart, 2011.

Nitrogen Treatment	Grain Yield (t/ha)	1000 Grain weight (mg)	Protein (%)	Test Weight (kg/hL)
Nil N	2.7	36.8	10.5	82.0
40kgN@GS31	2.7	34.0	13.2	80.3
80kgN@GS31	2.7	32.7	14.2	79.4
120kgN@GS31	2.6	32.1	15.0	78.5
160kgN@GS31	2.6	31.5	15.7	78.2
Strategy 1 (60kgN@GS31 + 40@GS59)	2.7	33.5	14.3	79.4
Strategy 2 (60kgN@GS31 + 80kgN@GS59)	2.7	33.3	14.7	79.7
LSD (0.05)	NS	1.0	0.38	0.84

Caparoi had superior grain and test weights and Hyperno the highest protein (Table 1).

The effect of increasing N rate at GS31 was detrimental to grain size and test weight in all varieties. The highest N application rate reduced grain weight by 5.3mg, and test weight by 3.8kg relative to nil N. However, there were no significant differences in grain size between the strategic and the lowest N treatments despite the application of 60 and 100 more units of N, suggesting the later timing of N was not so detrimental to grain size.

Averaged across all varieties grain protein was 10.5% when no nitrogen was applied and increased to 13.2% with 40kgN applied and on average, increased 0.83% with every extra 40kgN thereafter at GS31. Strategic 1 and 2 produced 14.3% and 14.7% protein respectively, only a 0.4% increase in protein with the extra 40kg.

In contrast to other quality measurements, varieties responded differently to applied nitrogen for grain screenings (Figure 1). Caparoi screenings remained unchanged across all N treatments averaging 0.6% while, Tjilkuri and Hyperno remained relatively stable but incurred a small increase of 1% at the highest N rate relative to no applied N, reaching 2.3 and 4.6% respectively.

WID803 produced 3.5% screenings in the nil N treatment but increased by 1% with every extra 40kg of N, to reach 9.8% in the highest N treatment (160kgN).

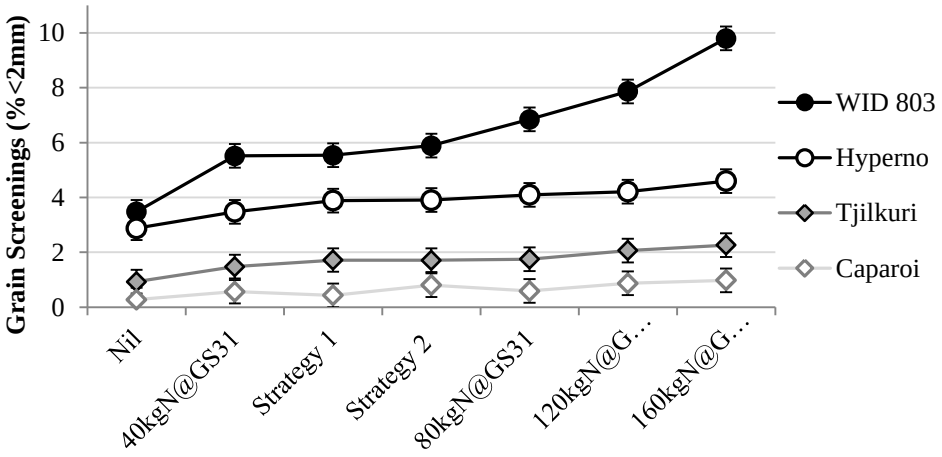

Figure 1. Durum varietal interactions with nitrogen treatments on grain screening levels (% < 2mm sieve) at Hart, 2011

The two strategic treatments which applied 100kg and 140kg of N respectively, split between two timings, had no effect on screenings (compared to no applied N) in Caparoi, Tjilkuri, and Hyperno but raised screenings in WID803 (5.5% & 5.9%). However, when compared with the other N treatments that applied similar amounts of N but all at GS31 (ie 80kg, and 120kg) in WID803, the strategic approach resulted in lower screening levels.

Summary

In terms of grain yield, the trial site was unresponsive to applied N.

On similar sites, previous experiments have shown that under optimal growing conditions, varieties are not likely to differ in their yield and quality response to N. However, dry conditions during September and high temperatures during grain fill at Hart in 2011 were conducive to higher than expected proteins and grain screening levels. Whilst not yield responsive, additional N was still required in order to achieve 13% protein, all varieties required an extra 40 kgN to reach the target protein (13%). However this extra N predisposed WID803 which has inherently smaller grain, to quality downgrading due to high screenings. There is a significant relationship between screenings and protein, highlighting the difficulty in increasing protein whilst maintaining grain size in small grained varieties such as WID803.

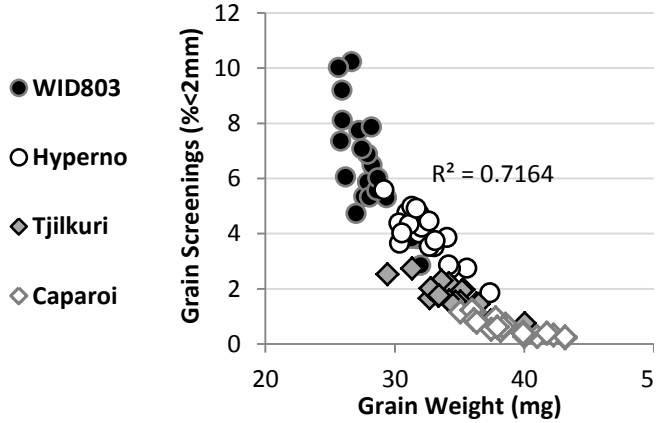

Figure 2 Relationship between grain weight and screenings in new durum varieties at Hart, 2011

The influence of variety was still very significant, as varieties with inherently smaller grain size such as WID803 and Hyperno were still more prone to excessive small grains at any nitrogen treatment. This research showed that grain shape rather than grain weight is more correlated with grain screenings levels. Tjilkuri and Hyperno are similar in grain weight but under similar conditions Tjilkuri has consistently less screenings than Hyperno (Figure 3) ie. Tjilkuri has a longer and thinner grain shape compared with Hyperno.

Due to the strong link between N supply and available soil moisture on grain size and protein, varieties with inherently larger grain size such as Tjilkuri and Caparoi are less likely to be downgraded for grain screenings in unfavourable finishing conditions. Large amounts of early N should be avoided on small grained varieties like WID803 to avoid possible quality downgrading in paddocks high in background N and in less favourable environments. From these results it can be concluded that variety choice and the strategic application of N (ie. withholding N until later in the season and using split applications) are the most effective methods to increase the chance of achieving Durum 1 grade in environments that typically can experience harsh finishing conditions.

Acknowledgements
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Hart Spring Walk 2011