Growing Profitable Irrigated Durum Wheat

A target yield and nitrogen budget are necessary tools for crop management, however if the target is incorrect the N applied may be incorrect to achieve DR1 specification.
The 2017 trials exceeded yield expectations and so applied N was insufficient to meet DR1.
Following faba beans offers a disease break and “free” nitrogen, however the amount of N supplied is variable and may lead to insufficient N being topdressed.

The aim of the trial is to examine various treatments that may assist in ensuring high protein, high yielding durum wheat on irrigation.
The key to successful durum production is grain quality – DR1 requires greater than 13% protein as well as meeting grain colour and vitreous kernel specifications.
The trial examined several aspects of durum agronomy based on previous trial experience that may impact yield and grain quality and was supported by GRDC in 2017. GRDC investment enabled two trials to be sown, one at the Trial Block and the other at Dhuragoon (near Moulamein) under overhead sprays.

Micro-nutrients
In discussion with the SADGA, and previous work by Barry Haskins (ex-NSW DPI at Hay), there may be an interaction between some of the micro-nutrients and the ability of the plant to shift the N contained in the plant to the developing grain so as the meet the 13% protein requirement. Micro-nutrients that may assist N transport include calcium, sulphur and zinc.
The trace elements were applied as a foliar spray at Z32 (second node) using TimacAgro “Vital” at 3.0 l/ha.
“Vital” has a range of macro and micro-nutrients in it including Nitrogen, Phosphorous, Potassium, Boron, Copper, Iron, Manganese, Molybdenum and Zinc.

Nitrogen Management
Growing high yielding cereals requires large amounts of nitrogen to produce high grain protein. The first management strategy we have chosen is to follow a pulse crop for the “free” nitrogen fixed and then released in the following seasons. Another reason to follow fabas is for disease control as the durums are very susceptible to crown rot.
Based on the results from 2016, it was estimated that the previous faba bean crop had contributed 120-125 kg N/ha to the nitrogen budget. This was the assumption used when calculating the N budget for 2017.
An alternative source of N apart from artificial fertiliser or crop residues is fixation by microbes other than rhizobia. The 2017 trial included the product “NitroGuard”, (http://www.twinn.com.au/nitroguard.php) which includes microbes that have the ability to fix nitrogen from the atmosphere. Working with the local distributor, it was assumed the NitroGuard treated plots would fix an extra 30 kg N/ha as a result of the biological activity and this treatment received 30 kg N/ha less than the control at the first topdressing.

We have tried various strategies based on the assumption of durum wheat requiring 50 kg N/t (compared with APW at 40 kg N/t and used for the “bread” treatment):

1. Standard: N applied throughout the season, starting late tillering, aiming to maximise yield.
2. Late N: A late application at head emergence aiming to increase grain protein.
3. High N: Similar to the standard, but at higher rates to ensure an adequate supply of N.

A fourth “zero applied N” treatment was included in the trial in an effort to assess the N mineralised from the faba residues rather than as an N strategy.

Nitrogen budget for the standard (control) treatment at the Trial Block:

Yield Target	7.5	t/ha
N Required/t	50	kg N/t
N Required/ha	375	kg N/ha
soil N	76	kg N/ha
starter	20	kg N/ha
mineralised N	120	kg N/ha
Topdressing required	160	kg N/ha

*The control N strategy was applied to the “Trace” and “PGR 39” treatments as well.

The budget for the trial under a centre pivot was calculated in a similar fashion, using 101 kg N/ha as the soil N at sowing.
Target yield was 7.5 t/ha. The major weakness of preparing a nitrogen budget is getting the yield target wrong. If yield exceeds the target, the result is lower protein than expected.

Plant Growth Regulator

Some durum varieties tested in the past have lodged badly. Previous experience at the Trial Block had demonstrated the susceptibility of Aurora to lodging under high yielding conditions, and the positive response to using the PGR, Moddus Evo, (trinexapac-ethyl) from both a reduction in lodging and subsequent yield increase. In 2017, all plots were sprayed with Moddus Evo at 400 ml/ha at Z31 and one treatment received a second application of 200 ml/ha at Z39.

Time of Sowing

Two time of sowing strategies were tested at the ICC Trial Block in 2017. After consultation with the Northern Durum Breeding Program, it was suggested to delay sowing until the third week of May as durum wheats are more sensitive to frost. The other effect delayed sowing may have is to limit vegetative growth (shorter period to heading and reduced tillering) therefore leaving more N for grain protein.
The intention was to have the first time of sowing (ToS) at a similar time to that of the main wheat trial (ie 1st week of May) and then again in late May. Unfortunately rain and field conditions saw the early ToS washed out, and the trial resown in late May and the second ToS was then in June.

Results

Part 2: Overhead Irrigation

There was a single time of sowing – June 1st, delayed by rain in mid-May – at 145 kg/ha targeting 175 plants/m^2.

Initial grass control was poor from using 500 g/ha Achieve on July 21st. Only partial control was achieved and the trial suffered from high ryegrass numbers.

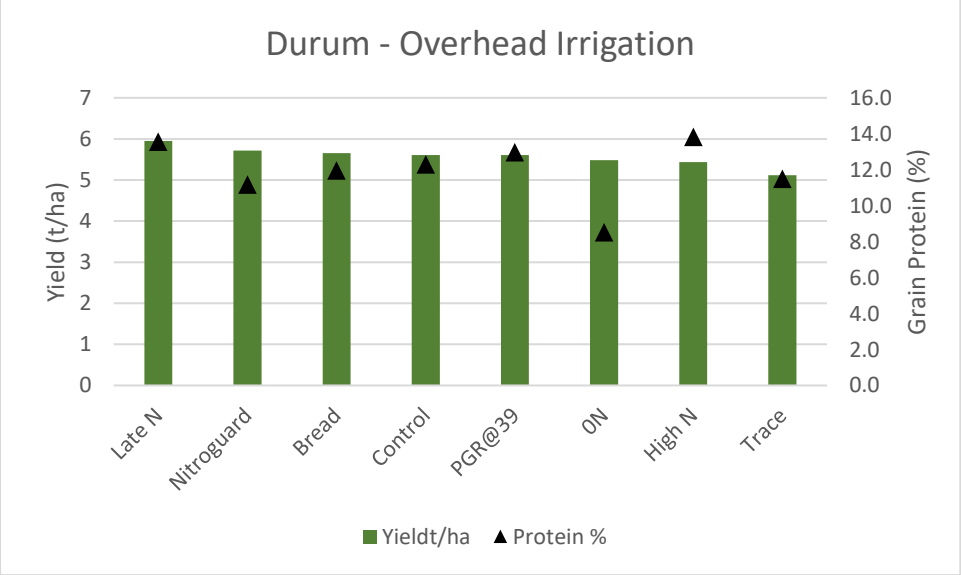
Topdressing N Strategies

	Growth Stage	Application date	Control	Late N	High N
			kg N/ha	kg N/ha	kg N/ha
Topdress 1	<30	9-Aug	40	40	60
Topdress 2	31	20 Aug	40	40	60
Topdress 3	39	19-Sep	50	20	60
Topdress 4	59	9-Oct		80	
Total N Topdressed			130	180	180

Although there was little foliar disease, the trial received a foliar fungicide at full flag emergence (Z39).

The trial was harvested on December 15th.

Results



Yield was below the target, most likely due to ryegrass competition. No treatment, including the “0N” were not statistically different for yield.

DURUM		5.8	t/ha				
Price	$	330	/t				$ 1,914
		number		cost $		cost $/ha	
Pre-sowing	spray	1	operation	25	/ha	25	
	cultivation		operation	35	/ha	0	
	pre-irrig	0.5	Ml/ha	140	/Ml	70	
Sowing	machinery	1	operation	43	/ha	43	
	fertiliser	150	kg/ha	600	/tonne	90	
	seed	145	kg/ha	500	/tonne	72.5	
Post sowing	herbicide	1	operation	22	/ha	22	
	fungicide	1	operation	10		10	
	topdress	390	kg/ha	450	/tonne	175.5	
	PGR	1	operation	32	/ha	32	
	irrigation	2.5	Ml/ha	140	/Ml	350	
Harvest	header	1	operation	72	/ha	72	
	transport	1	operation	65	/t	377	
					Total Variable Cost	$ 1,339.00	/ha
					Variable Cost - water	$ 919.00	/ha
					Gross Margin	$ 575	/ha
						$ 192	/Ml

Grain protein did exceed the 13% minimum in the “Late” and “High” treatments, but only the “High” was statistically significantly different from the control N treatment. Nitrogen efficiency was poor for the site, with only approximately 35% of the N available ending up in the grain. This could have been as a result of the ryegrass competition.

What does it mean?

Durum wheat can be grown under irrigation and be a profitable crop and the N required is quite high.

A Nitrogen budget is essential, but a weakness is in the yield forecasting where underestimation can result in failing to meet grain protein requirements.

Erring on the side of “a bit extra” N is cheap insurance compared to missing out on durum spec ($1800/ha) and having the grain relegated to lesser grade ($700/ha as feed).

Growing durum after a legume makes sense due to the N contribution of the stubble and the disease break, but the estimating the N contributed to the N budget is still an educated guess. More information on the amount and release pattern of the nitrogen contained in faba stubble needs to be researched.

Growing durum wheat after a breakcrop is highly recommended as a strategy to reduce the risk of crown rot.

Applying N “late” at head emergence has been demonstrated to increase grain protein.

Late sowing in this trial did not result in a yield penalty, which is contrary to most late sown trial results. Late sowing did have the benefit of improving grain protein

compared to the May sowing, but I would regard this as a risky strategy compared with adding more N to the budget.
Profitability of irrigated durum would improve considerably if local receival was available.