4.6 Striving For High Protein Wheat In Southern Environments

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Aim
Can the lessons learnt in growing Prime Hard wheat in southern NSW be extended to the high rainfall grain regions of Southern Victoria?

Background

Prime hard and Australian hard grade wheat has been successfully grown in higher rainfall areas of southern NSW over the last two seasons. AH receival sites have been established in SA & WA in recent seasons where adequate quantities of high protein wheat are grown. Given the success in recent times in southern NSW, it is believed that the Western Districts of Victoria & the south east of South Australia is the next region with potential to grow high protein, high quality wheat.

The Western Districts has gone through some major changes over the last five years with the down turn in the traditional wool industry forcing farmers to diversify their operations. Given the reliability of climate in this area, the cropping area has rapidly expanded. A major issue for growers in this area is water logging during the normally wet winter & spring period. This issue is now being addressed through the adoption of cropping on raised beds which provides better drainage & soil aeration.

There are a number of potential benefits of growers pursuing high protein wheat in this area: (i) traditionally Victorian wheat yields have been limited through nitrogen deficiency as evidenced by the low protein wheat delivered to silos - once grain is below a threshold protein (thought to be 10%), yield will be sacrificed. (ii) Historically, higher protein grades of wheat have attracted a price premium which translates to better grower returns. (iii) With a strong pasture history across the Western Districts, residual soil nitrogen levels tend to be high - this is of benefit to growers who incur large start up costs with the transition to cropping - it is thought that the initial years of cropping will not require high rates of nitrogenous fertilizers despite high yield potential.

In 1999, sites were selected at Southern Farming Systems Gnarwarre & Streatham (Victoria).

MATERIALS AND METHODS

Management Schedule:

	Gnarwarre	Streatham
Pre-plant herbicide Date of application	2 fallow sprays glyphosate October 98/March 99 Glyphosate 3 L/ha at plant	At planting: Glyphosate 3 L/ha Tank mix: 35g/ha Logran + 500 mL/ha Dual
Planting date	02/06/99	27/05/99
Basal Fertilizer & Rate	Trifos at 200 kg/ha	Trifos at 150 kg/ha
Post-emergent herbicide	24/8/99 (separate sprays) 1.5 L/ha 2,4-D Amine 150 mL/ha Topik 240 + 500 mL/ha Uptake Oil	4/8/99 (tank mix) 800 mL/ha MCPA amine + 150 mL/ha Lontrel L
Top dressing 1 Z13 Top dressing 2 Z41 Top dressing 3 Z65	21/07/99 27/09/99 25/10/99	21/07/99 01/10/99 25/10/99
Harvest Date	18/12/99	18/12/99

SITE HISTORY:

	Gnarwarre	Streatham
Previous Crop	Persian Clover 2 years	Canola 1998

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DESIGN AND TREATMENTS:

Each site was designed to assess rate x split x timing of nitrogen application as per the following table. The design was randomised block with three replicates. At each site two varieties of wheat were paired with Janz as the benchmark variety at all sites. The alternate varieties were Kellalac at Gnarwarre and Chara at Streatham. Treatment 17 was omitted from Gnarwarre.

			Topdressing Stage kgN/ha		
Treatment No.	**TOTAL N Kg/ha**	**Pre-plant N kg/ha**	**3 leaf Z13**	**Booting Z41**	**Flowering Z65**
1	0	0	0	0	0
2	40	40	0	0	0
3	40	0	0	0	40
4	80	80	0	0	0
5	80	0	0	0	80
6	120	120	0	0	0
7	120	60	0	0	60
8	120	0	60	0	60
9	160	160	0	0	0
10	160	120	0	0	40
11	160	80	0	0	80
12	160	80	0	40	40
13	160	40	0	60	60
14	160	0	80	40	40
15	160	0	40	40	80
16	160	***160****	0	0	0
17	160	***80****	0	0	80
18	80	80	0	0	0

**Indicates PCU43.5Nin lieu of urea*

Soil Measurements

Each replicate was shallow (0 - 10 cm) & deep (10 - 60 cm) sampled prior to sowing. 12 shallow cores & 3 deep cores were taken from each replicate. Samples were analysed for texture, pH (water & $CaCl_2$), OC%, ammonium & nitrate nitrogen, Olsen P, exchangeable cations (Ca, Mg, K, Na & Al), EC_{se}, Cu, Zn, Mn, Fe & B.

At the Streatham site, pre-plant nitrogen fertilizer bands were sampled on a fortnightly basis commencing 2 weeks after application (at sowing) until mid-September. This was done by removing the top 5 cm of soil prior to taking 12 cores in each plot sampled (0, 80 & 160 kgN/ha mid row banded at planting).

Plant Measurements

Emergence counts were taken approximately 3 - 4 weeks after sowing. Tiller counts were taken at DC30 on selected plots (0, 80 & 160 kgN/ha) across both varieties.

Application of Nitrogen Treatments

Pre-plant N treatments were applied as urea on 444 mm row spacings using a knife type opener. Top dress N treatments were applied as ammonium nitrate (Nitram®) spread by hand.

Yield, Protein & Quality Data

Yield was measured at each site by harvesting the inner six of the eight rows sown in each plot. Grain protein was determined at Incitec's Gibson Island laboratory using the Kjeldahl method of nitrogen determination. Grain quality attributes are to be assessed on selected samples based on grain protein.

RESULTS

Soil & plant data

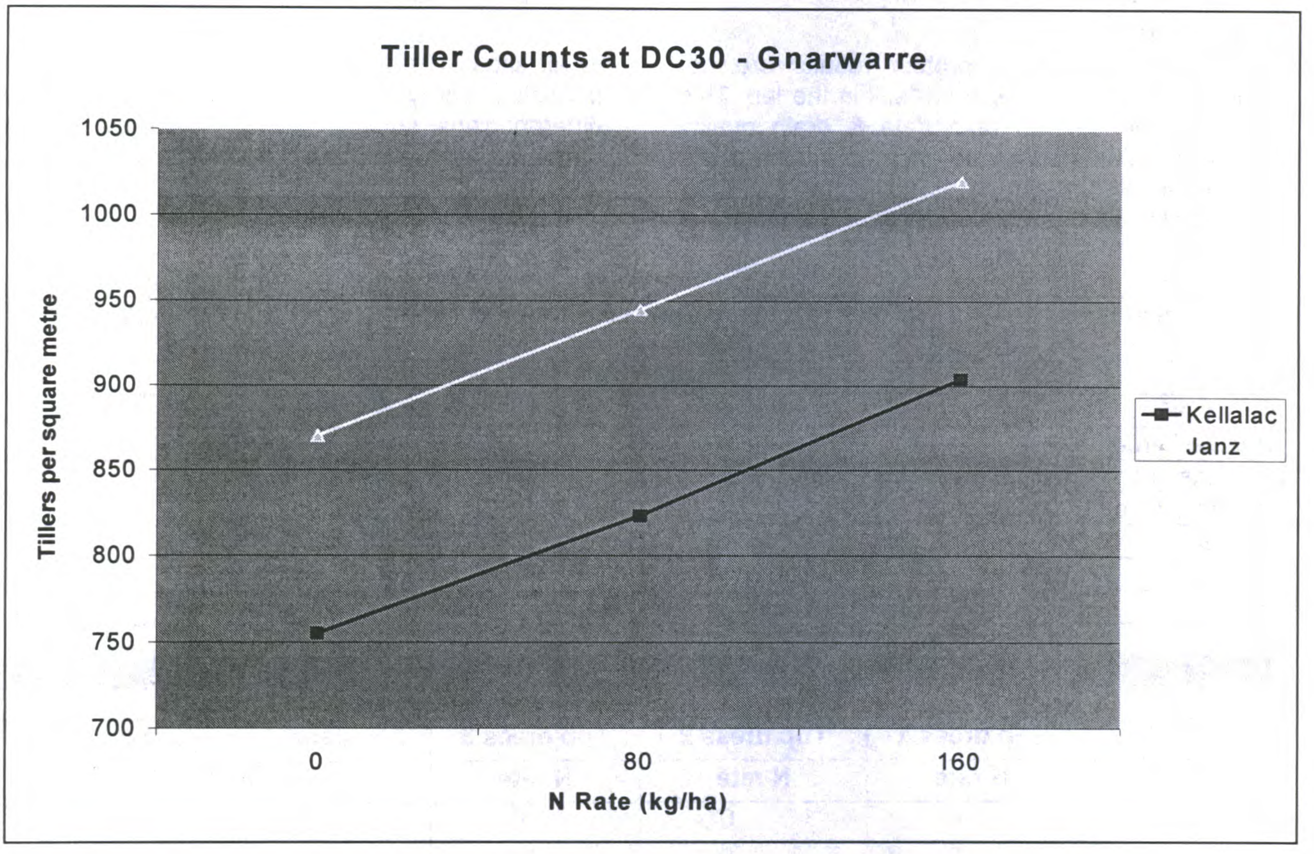
At the time of writing, protein results are not available as grain samples are still in the lab. This precludes nitrogen off take data & grain quality analysis which will be based on grain protein of the various samples. It should be noted that the 1999 growing season was very much drier than average at all sites. The Streatham site had evidence of herbicide spray drift at around boot stage & different reps suffered varying degrees of frost damage - rep 2 was totally frosted, rep 3 30 - 95% frosted

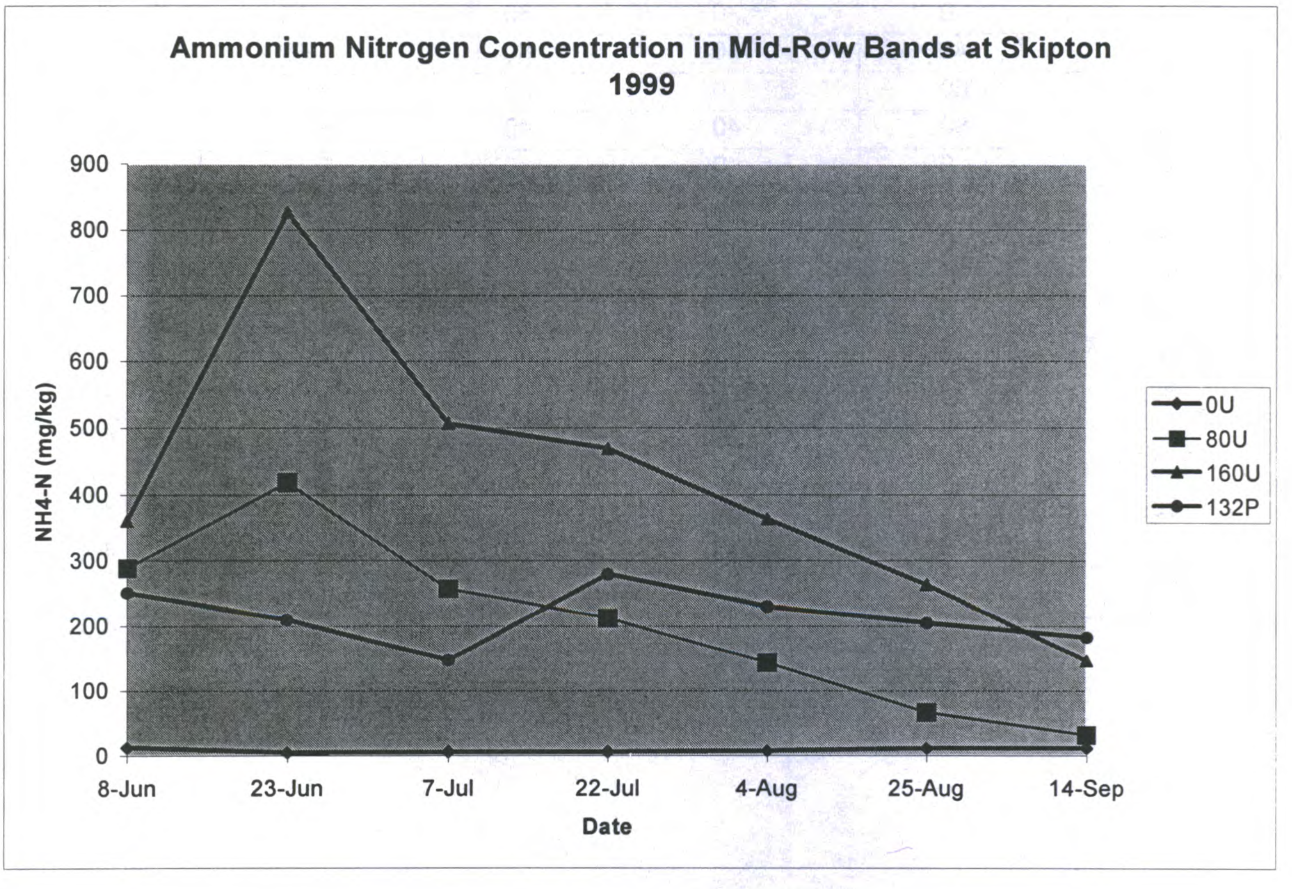
	Gnarwarre	Streatham
Plant Establishment	Janz 254 plants/m^2 Kellalac " "	Janz 174 plants/m^2 Chara 141" "
Texture	Light Clay	Clay Loam
pH (water)	5.5	4.6
Organic Carbon %	2.8	3.4
Mineralised N	80.0	80.0
Inorganic N kg/ha (0 – 60 cm)	234.0	159.0
P Olsen	21.0	16.0
Al %	0.3	17.7
Na %	1.5	6.0

YIELD DATA

Pre-N	Top dress 1	Top dress 2	Top dress 3	Janz	Kellalac
	N rate	N rate	N rate	yield t/ha	
0	0	0	0	5.97	4.52
0	0	0	40	5.90	4.47
0	0	0	80	5.26	4.57
0	40	40	80	5.58	3.72
0	60	0	60	5.50	4.23
0	80	40	40	5.31	3.66
40	0	0	0	5.76	4.38
40	0	60	60	5.70	4.37
60	0	0	60	6.16	4.62
80	0	0	0	5.79	4.58
80	0	40	40	5.79	4.28
80	0	0	80	5.81	4.53
80	0	0	0	5.64	4.55
80	0	0	80	5.38	4.67
120	0	0	0	5.73	4.38
120	0	0	40	5.67	4.19
160	0	0	0	5.75	4.73
160	0	0	0	4.72	4.39
Average Yield for Varieties				5.63	4.38

SHOOT COUNTS





DISCUSSION

Soil and plant data

While the Gnarwarre site was a very fertile basalt soil, performance at the Streatham site was constrained by a number of factors. Severe acidity in particular is likely to have limited yields and the availability of some nutrients. Both sites it should be noted had high residual nitrogen levels in the profile indicating that yield response from nitrogen is unlikely although a protein response would still be expected.

Yield

No clear trends were established in terms of yield response to nitrogen application as expected although it should be mentioned that 60 kg/ha N pre-plant followed by 60 kg/ha N top dressed at flowering provided best yields for both varieties at Gnarwarre. This result is consistent with results from southern NSW where a significant pre-plant application followed by a late top dress results in optimum yields at high protein levels. Given the loss through frost at Streatham, yield will not be considered here.

A significant difference was observed between varieties - most of this difference can be attributed to an outbreak of rust during spring in the variety Kellalac.

Shoot Counts

Tiller counts are a useful indication of the adequacy of nitrogen in cereals - cereals will produce tillers in response to nitrogen. While guidelines have not yet been established for southern Victoria, the trends displayed this season would appear to vindicate the usefulness of this tool in seasons where moisture is not limiting. In future, the idea is to assess tiller populations once a crop is fully tillered in order to make a decision on nitrogen top dressing.

Nitrogen Banding

Measurements taken at the Streatham site during the season have indicated the usefulness of mid-row banding nitrogen. The concept is to apply nitrogen in highly concentrated bands which constrains the biological processes by which plant available nitrate nitrogen is liberated from nitrogenous fertilizers. The net effect of this cultural practice is to delay the availability of nitrogen from fertilizer in order to obtain a better matching of nutrient availability with plant requirement.

This has obvious benefits in terms of improved nitrogen use efficiency, but may also play an important role in securing nitrogenous fertilizers from losses in raised beds - bear in mind, nitrogen in the ammonium form is immobile in the soil, protecting it from leaching & denitrification losses.

CONCLUSION

A full write up on these experiments will be available in the near future. At this stage it is useful to sum up with the following lessons learnt from the season:

If high quality wheat is to be grown in the region, grain drying facilities will be necessary.
Given high organic matter & nitrogen status of many of the soils in the region, additional costs of growing high quality wheat will be limited to those associated with good management.
Soil acidity (and sodicity) in the region will need to be addressed as this potentially is already limiting yields and quality.

In terms of white wheats, few suitable varieties are currently available - the main reason why this needs to be addressed is to allow earlier sowing in order to optimise yield while reducing frost risk. Later sowings are compromised by cold temperature and the risk of water logging before the crop is established.