THE EFFECT OF NITROGEN AND PHOSPHORUS FERTILISERS ON BARLEY IN SOUTHERN AUSTRALIA

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Abstract

By applying fertiliser N prior to sowing (PN), significant (P<0.05) yield increases were achieved over when fertiliser N was applied as a top-dress (TN) at early tillering. The addition of 160 kg/ha of N, PN or TN, significantly increased protein at the 5% level of probability, but there was no application timing effect on protein. A significant 3-way interaction between N rate, P rate and application time on yield, showed the significant benefit to P fertiliser, by applying PN. Soil sampling suggested negligible N losses due to leaching 10 weeks post sowing after 175 mm of rain.

Over the past 50 years, nitrogen (N) fertiliser research in the Wimmera and Mallee has been influenced by the regions traditional rotation incorporating a legume pasture phase from which the bulk of N required for non leguminous crops was met. However, in recent years, with the onset of continuous cropping, rotations have started to tighten frequently at the expense of the pasture phase. This has had a major impact on yield, protein and farm N inputs and responses to phosphorus (P) fertilisers.

Materials and methods

The 3 way factorial experiment (5 N, 4 P and 2 N times - pre-sown or top dressed at early tillering) was conducted on a Wimmera grey clay. The site was sown to barley (*Hordeum distichon* L.) cv skiff.

Results and discussion

Nitrogen and yield:

Whilst both application times produced significant yield increases to N fertiliser (Table 1), PN produced significantly (P<0.05) more yield than TN. The yield difference between PN and TN was most likely due to the superior early vigour of PN over TN as early N applications promote early growth (Angus *et al* 1980).

Nitrogen and protein:

There was no significant grain protein difference between PN or TN, but the protein differences between rates of N were significant (P<0.05) and predominantly affected by large differences between 160 N and remaining treatments (Table 1). The lack of any real significant difference (P<0.05) between 0 N through to 80 N, reflects the impact of the low soil N and yield dilution effect of yield on grain protein.. It is hypothesised that yield was not maximised in the experiment as there was no plateau detected for yield or protein even at the highest rate of N at both N application times.

Phosphorus and Yield

There was a significant yield difference (P<0.05) between PN P treatments and also between TN P treatments (P<0.05) (Table 1). For PN treatments, the significant trend increased from 0 through to 18 kg/ha P where the response plateaued suggesting that 18 kg/ha P was the optimum agronomic P rate for feed barley when N was applied pre sowing. There was no significant difference between 160 kg/ha PN and 160 kg/ha TN at 0 kg/ha P (Fig.1). However, when 160 kg/ha PN was used in conjunction with 18 kg/ha P, it produced significantly (P<0.05) more yield than 160 kg/ha TN. This emphasises the importance of using N at or prior to sowing in order to obtain the best yield response to P fertiliser.

Nitrate movement and location

Figure 2 shows N movement in the 10 week period after sowing (period rainfall 175mm) of selected PN treatments. It indicates an N bulge located in the 10 - 30 cm profile, and negligible movement past 60 - 90 cm, reinforcing the results of Ford *et al* (1974). The majority of the N was therefore well within the root zone. Further analysis of the soil N data, considering an estimate of mineralised N and N removed by the plant, suggests that there may have been a small N loss, presumably as a result of denitrification.

Table 1 Effect of PN and TN and phosphorus rate on barley yield and protein.

?	?	?	PN	?	?	LSD (P<0.05)	?	?	TN	?	?	LSD (P<0.05)
P Rate (kg/ha)	0	9	18	36	?	?	0	9	18	36	?	?
Yield (t/ha)	2.87	3.14	3.54	3.49	?	0.33	2.44	2.75	2.66	3.07	?	0.39
N Rate (kg/ha)	0	20	40	80	160	?	0	20	40	80	160	?
Yield (t/ha)	1.67	2.02	2.78	4.17	5.65	0.37	1.35	2.04	2.63	3.25	4.39	0.43
Protein (%)	8.32	8.14	7.81	8.19	9.56	0.38	8.43	8.33	8.13	8.38	9.34	0.33

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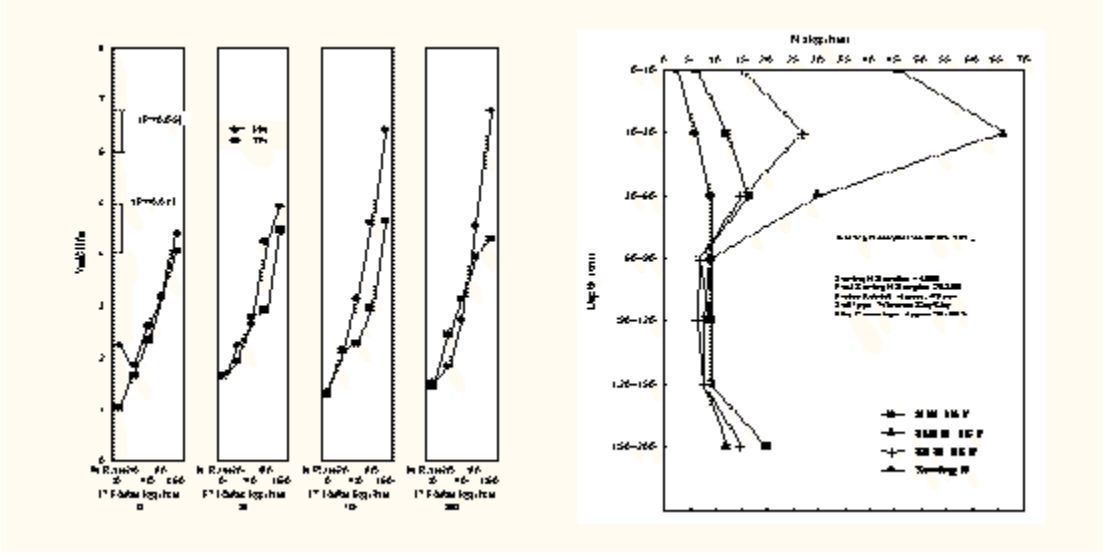
Fig 1. Effect of N, P and timing on barley yield

Fig 2. Soil profile N concentrations for 3 N treatments



Conclusion

Due to the low soil N at sowing, and season water availability (GSR 350 mm), the site was extremely responsive to N fertiliser. However the results suggest to obtain the best response to N fertiliser in a continual cropping rotation, N fertility at sowing must be optimum and P rate needs to be adequate and vice versa. Results also suggest that growers who use N fertilisers on similar soils should feel confident of negligible N losses via leaching down the soil profile.

References

1. Ford, G.W., Jessop, R.S., and Martin, J.J. 1974. *Aust, J. Soil Res.,* **12**, 45 - 58.

2. Angus, J.F., Nix, H.A., Russel, J.A. and Kruizinga, J.E. 1980 *Aust, J. Agric. Res.,* **31,** 873 -886.