Late N for boosting grain protein

The 2013, a trial showed some promise in the use of late application of N at full flag leaf emergence or later to increase grain protein. While there was a trend to higher protein, the protein increases were statistically not significant.

The trial was repeated in 2014, with an increase in the number of treatments.

This trial was sown on May 8th with Chara wheat. The trial was split topdressed with 50 kg N/ha in late June and 50 kg N/ha in July as per the normal 6 t/ha strategy. At the time of the second topdressing (23rd July), the crop had been suffering from waterlogging and yellow leaf spot. The trial was sprayed with tebuconazole (145 ml/ha) and as the site dried out in late July/August, crop health improved. The trial was irrigated on August 25th, September 19th and October 15th.
The following treatments were applied:

Treatment	Product and Rate	Application Stage
No Late N	N/A	
Late Topdress	22 kg N/ha as Urea	Z39
Late Topdress	44 kg N/ha as Urea	Z39
Late Topdress	22 kgN/ha as KNO3	Z39
Foliar N	22 kg N/ha Ranger	Z39
Foliar N + Flowering Foliar N	22 kg N/ha Ranger 22 kg N/ha Ranger	Z39 Z65
Foliar N + Post-Flowering Foliar N	22 kg N/ha Ranger 22 kg N/ha Ranger	Z39 Z72

According to Yara, there is research results that suggest that 15 kg N/ha applied between the start of flowering and 10 days post flowering will result in a protein increase of 1% for a 6t/ha crop. However the N status of the crop is a variable that may affect the protein result ie was the crop a 9 or an 11% protein crop to start with.

Treatments were applied at Z39 or full flag emergence, as this would be when a foliar fungicide for stripe rust control is generally applied and the addition of the N would be convenient. The “Urea” and “KNO3” treatments were granular products spread by hand, and the foliar treatments were using the Yara product Ranger.
The growth stage Z65 is mid flowering and Z72 just after flowering when the developing grain is extending.
No leaf burn was noted after the foliar applications, but applications were made on a relatively cool and overcast days.

Yield and grain quality response to late N application:

Treatment	kg N/ha applied	Yield (t/ha)	Protein %	Screenings %	Test Wt kg/hl	Protein kg /ha
Topdress Urea @ Z39	44	7.55^{a}	8.6^{b}	0.8	80.6^{b}	646^{a}
Foliar N @ Z39+65	44	7.26^{ab}	8.6^{ab}	0.6	81.6^{a}	627^{ab}
Topdress Urea @ Z39	22	7.26^{ab}	8.3^{cd}	0.7	79.6^{c}	605^{b}
Topdressed NO_3 @ Z39	22	7.22^{ab}	8.5^{bc}	0.7	80.1^{bc}	613^{b}
Foliar N @ Z39+72	44	7.12^{b}	8.7^{a}	0.6	81.4^{a}	622^{ab}
Foliar N @ Z39	22	6.99^{bc}	8.2^{de}	0.8	78.9^{d}	572^{c}
No late N	0	6.62^{c}	8.1^{e}	0.7	79.7^{c}	535^{d}
	p	0.027	<0.001	0.116	<0.001	<0.001
	lsd	0.408	0.1704	NS	0.622	32.4

Yield, protein and test weight figures with similar superscripts are not significantly different.

Late application of N had an effect on yield, grain protein and test weight. The yield effect demonstrates the much lower N status of the trial compared with last season, and the result of waterlogging on soil N. Also, apart from the very late application at Z72, the more N added tended to promote more grain yield (by Z72, grain numbers have already been set and so would not be influenced by added N). But if you look at total protein produced (kg/ha), by multiplying grain weight by the percent protein, the more N produced more protein.

Looking at the economics, 44 kg N/ha gave rise to between 0.6 and 0.9 t/ha yield improvement. If the average was 0.75 t/ha, then the return was $180 for a $50 investment which is a good return.

Looking at the three treatments delivering 22 kg N/ha by foliar urea, granulated urea and as potassium nitrate, all three had similar yields and approximately 0.5 t/ha yield improvement over the control, or about $120 return on $25 invested, an even better return.

These returns reflect the N deficient status of the crop – a crop with a better nutrient status would be unlikely to have much of a yield increase with topdressing past 4th node. Last season's trial saw no yield benefit from late topdressing and yielded 7.7 – 8.5 t/ha.

In terms of which product to use, the granular products were as effective as the foliar application.

Looking more closely at the grain protein levels that we were trying to improve, the statistical analysis found significant differences between treatments. However from a practical point of view, the range was from 8.1% to 8.7%, which I would regard as insignificant. The quality improvement was not enough to obtain a better grade, and the AWB Rewards system offers no premium payment for increasing protein in ASW wheat.

If similar results could be obtained in getting ASW to APW, the for $50 worth of urea (plus application), the reward would have been around $70/ha. To improve the grain protein amount in an APW category would have returned about $7.50/ha. So again while the late application of N to increase protein may work, the economics behind the decision makes it a marginal choice. Rotational choice should be the starting point of chasing higher grain protein.