IMPROVING IN-SEASON NITROGEN DECISIONS

This project, undertaken by Wayne Pluske of Equii, investigated a novel way to determine optimum in-season nitrogen rates to increase nitrogen use efficiency and profitability. The impetus for the project is the ongoing and frustrating disconnect between what grain growers can do now logistically with fertiliser nitrogen and what they are actually doing.

Most growers have the means and capacity to apply nitrogen at different rates and multiple times during the season, thereby minimising the risk associated with such an expensive input, but they lack information on what rates of nitrogen they should be applying. This means returns from nitrogen investments (about 25% of total variable costs) are not being maximised and negative impacts of overuse of nitrogen, like soil acidity, are not being minimised.

The frustration between what can be done and what is being done with nitrogen continues despite an array of tools and services designed to improve nitrogen decisions. Soil and plant testing, various models, softwares and apps have been used for years but their practical usefulness is limited, evidenced by growers' ongoing calls for better solutions. Likely yield is the biggest determinant of nitrogen rate yet it is guessed in most decision tools. Usually a guessed yield is used for a whole paddock and even the whole farm despite yield maps clearly showing yields vary across paddocks year after year.

The inability of historical tools to use anything other than a rough estimate of likely yield, their inability to embrace and utilise known seasonal and spatial variability, plus the time required to determine a rough nitrogen rate for just one site within one paddock means better ways to determine nitrogen are being developed. This project looked at one of these, an integrated approach to in-season nitrogen decisions that combines known yield variability within a grower's paddocks and across seasons with proven crop responsiveness to nitrogen to deliver a practical outcome across whole paddocks and whole farms to increase profits and environmental care for landholders.

In this project on Peter Freeman's Eradu yellow sandplain, in-season nitrogen rates were calculated using this new approach and tested in three yield zones within a 230 hectare block in the challenging 2017 season. Three yield zones (low, medium and high) were determined using yield maps and other spatial information. The economic-optimum nitrogen rate for each yield zone was calculated by feeding 2017's rainfall to date and previous years' yield maps and rainfall records into a yield predictor, then using the outputs with knowledge of how nitrogen deficient crops respond to nitrogen, nitrogen cost and wheat price to determine the nitrogen rate.

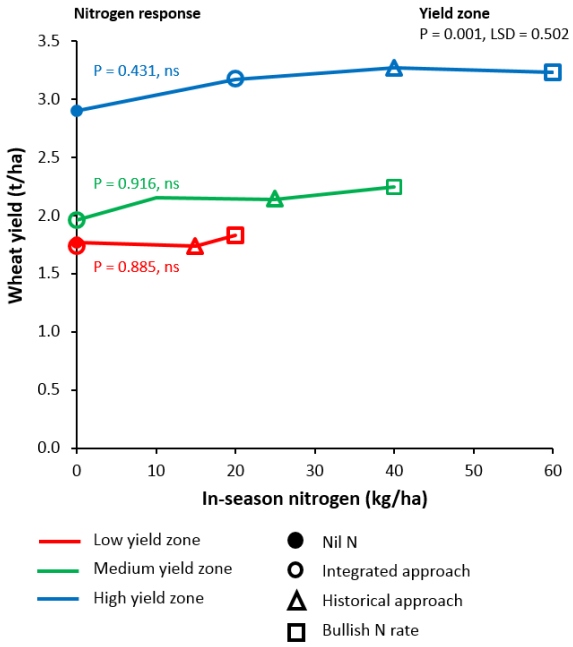
These in-season nitrogen rates (called the "integrated approach" hereafter) were tested by comparing them to "nil nitrogen", nitrogen rates calculated using an "historical approach" and "bullish nitrogen rates" in randomised and replicated 0.74 hectare strips in each of the three yield zones. The block had no legume history for at least the last 10 years and an average organic carbon of 0.4%.

The site was managed by Peter Freeman with agronomic and technical input support provided by Craig Topham of Agrarian Management. Ninja wheat was dry seeded at 70 kg/ha on 9 May with a total of 40 kg N/ha applied before and at seeding in DAP, sulphate of ammonia and UAN fertilisers.

The crop germinated on 25 May but only 18 mm of rain was received between then and late July when decisions were made on the nitrogen rates to be used. After this 138 mm of rain fell up until the end of September.

The in-season nitrogen rates that were calculated were:

- Integrated approach: 0, 0 and 20 kg/ha for the low, medium and high yield zones respectively
- Historical approach: 15, 25 and 40 kg/ha
- Bullish rate: 20, 40 and 60 kg/ha



Nitrogen was applied on 28 July as UAN liquid fertiliser by boomspray in 200 m long by 37 m wide plots and the plots were harvested using a John Deere S680 harvester on 27 November.

Harvest results (and mid-September NDVI too) revealed no significant response to nitrogen in any of the zones, but a significantly higher yield in the high zone than the low and medium zones (see figure left).

Grain protein was not measured, however the average grain protein concentration for the block was about 10.5% and all grain made the noodle segregation.

Key outcomes:

- Even though the rates calculated using the historical approach used lower yield expectations than were actually achieved (e.g. 2.5 t/ha rather than 3.1 t/ha in the high yield zone), historically-derived nitrogen rates were still too high. The highest nitrogen rate of 40 kg/ha equated to a waste of $44/ha and, if that nitrogen was leached it would have contributed another $2 – 3/ha to the soil's lime debt because about 150 kg/ha of lime would be needed to negate the acidity caused by nitrogen leaching.

- The nitrogen rates calculated using the historical approach would have been even more inappropriate if accurate yield expectations were used in late July and would have resulted in up to 70 kg N/ha ($77/ha) of in-season nitrogen being wasted. On this block in 2017 high in-season nitrogen rates were wasted and costly, both financially and environmentally. 40 kg N/ha applied before and at seeding was enough to achieve maximum yields in all three yield zones; yields that were very good given the unusual and unfavourable early seasonal conditions.

- The integrated approach to nitrogen decisions calculated only 20 kg/ha of in-season nitrogen was required in the high yield zone, which achieved close to maximum yield, and that nil in-season nitrogen was required in the low and medium zones, again achieving maximum yields.

- In this project, paddock variability had more impact on yield than nitrogen rate. Putting more effort into understanding paddock variability and causes thereof had more impact on yield and nitrogen use efficiency than calculating nitrogen rates using historical approaches. It is clear paddock and seasonal variabilities have a huge impact on the efficiency and profitability of fertiliser nitrogen, which is what the integrated approach that was being tested considers.

"Putting technology and science to the test to increase nitrogen use efficiency and environmental care" was delivered by The Trustee for Pluske Family Trust T/A Equii Pty Ltd. It was supported by NACC through funding from the Australian Government's National Landcare Program.