Applied Nitrogen

A Case Study from Tullibigeal
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Overview:
The maximum yield of a crop is determined by the most limiting factor. The most likely limiting factor is moisture, followed by nitrogen then phosphorous.
Tools used in making urea application decisions by Arrowvale & Co (Fyfes) at Tullibigeal include surface soil tests, deep nitrogen soil tests, sap nitrogen tests, nir tests, shoot and head density, water use efficiency, weather forecasts and experience.
The amount of nitrogen applied must be balanced with the moisture availability and yield potential; urea should not be applied where it is not warranted.
All the testing, monitoring and calculations are designed to make decisions which minimise risk and maximise returns.

Introduction

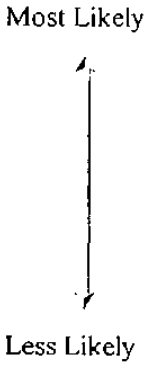
Nitrogen management is no different to other types of management. There are two key elements:

Minimise Risk
Maximise Returns

Yield limiting factors include:

Moisture
Nitrogen
Phosphorus
Root disease
Weeds
Timing of operations
Soil acidity
Leaf and stem disease
Other nutrients
Other soil properties

The maximum yield of a crop is determined by the most limiting factor. For example there is no use putting on enough nitrogen for 5 tonnes per hectare if there is only enough phosphorus for 2.5 t/ha or only enough moisture for 3 t/ha.



A Brief History

Arrowvale and Co at Tullibigeal started using urea in the early 1990's.

Initially urea was drilled preplant to part of several paddocks. Yield responses were observed in the treated area. Some yield response was also observed in the subsequent crop.

By the mid 1990s urea was being used regularly both preplant and topdress. However the decisions regarding paddock selection, rates and timing of application were made with very limited information. Tools such as deep soil nitrogen testing and tissue testing were just becoming available.

In July and August 1996 I first sampled paddocks for sap nitrate and total tissue nitrogen testing. There was a wide range in tissue nitrogen results and the suggestion was made that some paddocks probably did not require the urea that was applied while other paddocks could have used more urea. During 1996 I also noticed evidence of a phosphorus deficiency. In January 1997 we started a programme of soil and crop monitoring.

Tools Currently Used

1. Surface Soil Tests
Conducted in September or January prior to cropping.
Test principally to know pH (acidity), phosphorus level and cations.

The range of results in surface tests are:

pH (CaCl)	4.5	to	6.7
Aiuminium%	9.7	to	nil
Phosphorus (Colwell)mg/kg	<5	to	17

2. Deep Soil Nitrogen Tests
Conducted in March prior to cropping.
Prepare nitrogen budgets based on target yields and proteins.

Update budgets throughout the year as seasonal conditions and yield potential change.

In 1998 nitrogen budgets were prepared and updated as follows:-

16/3/98	precrop
9/7/98	first update coinciding with first tissue test
3/9/98	second update coinciding with second tissue test
22/10/98	final update after all fertilizer has been applied, yield estimates made.

3. Sap Nitrate Tests
Conducted in July around mid tillering.

4, Total Shoot Nitrogen
Conducted in July around mid tillering on the same plant samples as used for sap nitrate testing.
A second total shoot nitrogen test is conducted in late August or September if seasonal conditions are likely to be suitable for late topdressing.

5. Shoot and Head Density
Shoot density is determined when sampling for each tissue test.
Head density is determined in October.

6. Water Use Efficiency
This is one means of estimated an approximate yield potential. It uses the

assumption that if **nothing else** is limiting yield then you should be able to grow between 15 and 20 kg/ha of wheat for each mm of available moisture.

The Condobolin rainfall figures are used below as an example.

Yearly Average	426mm	April to October	235mm
January to April	145mm	May to October	204mm

Formula	Yield Potential at 15 kg/ha/mm	Yield Potential at 20 kg/ha/mm
1	19t/ha	2.5t/ha
2	2.1t/ha	2.8t/ha

Formula 1 uses April to October rainfall less 110mm.
Formula 2 uses one third of January to April rainfall plus May to October less 110mm.

7. Weather Forecasts
Subscription to Don Whites weather watch.
Fax and internet cloud charts.

8. Experience
This tool should never be under estimated.

Always sample and test a cross section of paddocks including the best paddock(s). You must know what the best paddocks are doing to know where the worst paddocks are going wrong. This adds greatly to your experience and decision making.

What Changes Have Been Made

Known yield limiting factors are being addressed before nitrogen is being applied. Examples include:

1. ***Phosphorus***
Phosphorus rates have been increased from 10 kg/ha to 15 kg/ha (50 kg/ha of MAP to 75 kg/ha of DAP). This should be enough phosphorus for 4 to 5 t/ha crops. Phosphorus deficiency can not be corrected during the growing season. It must all go on at planting.

2. ***Soil*** *Acidity*
On acidic paddocks replacing acid sensitive crops with less sensitive crops. For example using triticale instead of barley.

Liming the more acid paddocks then sowing canola followed by wheat. It is not a good idea to sow wheat after lime as the lime can increase the risk of takeall. Therefore canola is used as a break crop after liming.

3. ***Crop Rotation***
There is potential to increase the area of canola to reduce the level of root disease.

4. Matching *Nitrogen to Yield* ***and*** *Moisture*
Nitrogen application rates are being adjusted to match changing yield potentials and moisture availability throughout the year. This includes not applying urea where it is not warranted.

5. ***Shoot*** *Density as a Guide to Nitrogen Requirements*
Shoot and head density are also used as a guide to nitrogen requirements. We try to have enough nitrogen precropping to produce 350 to 450 shoots per square meter by the end of tillering. Then the aim is to have enough nitrogen to hold 300 to 400 heads per square meter through to harvest. Additional nitrogen can then be considered for protein, between head emergence and flowering, if **all** other conditions are favourable.

6. Timeliness of Operations

This can have a major impact on yield. Examples of changes made to operations include:

Potentially dry sow canola in the third week of April so that cereals can be sown on time when the break comes.

Use of a plane to topdress nitrogen so as to make the best use of suitable conditions.

Conclusion

Urea is not a magic white powder. Other yield limiting factors must be addressed before the full benefit can be obtained from nitrogen. The amount of nitrogen applied must be balanced with the moisture availability and yield potential. The balancing act is more difficult when trying to achieve prime hard protein levels.