Nitrogen management for wheat

Nitrogen management in the Holbrook area of southern NSW

Key messages

- Grain yields are increased for all wheat types by applying N fertiliser when the amount of starting soil N is up to 150 kg N/ha.
- Wheat grown on soil with high amounts of N at Holbrook still require N fertiliser to avoid N stress.
- The timing of early N applications (sowing to mid-tillering) makes very little difference to grain yields.
- Mid-season wheat tend to give a greater response to N fertiliser than the other wheat types
    - Split applications of N tend to be used more efficiently by wheat than single and later applications.

The importance of nitrogen

Nitrogen (N) is a major constituent of protein, the main building block of plants. It is essential for cell growth and chlorophyll formation. Chlorophyll is responsible for photosynthesis, the conversion of sunlight to carbohydrates, biomass and grain.

Nitrogen supply to wheat must match N demand to maximise grain yield. The amount (rate) of N needed by wheat and the best timing of application depends on starting soil N, the cultivar type and the season.

Growth Stages

The development of wheat is summarised into growth stages. Some growth stages are useful to know so nitrogen can be applied at the right time in a crop's life.

GS00 – at sowing
GS25 – mid-tillering (5 leaves)
GS31 – early stem elongation (also known as first node stage)
GS39 – flag leaf stage

More information about growth stages of wheat can be found in:
GRDC (2005) Cereal Growth Stages.
www.grdc.com.au

Rate and timing of nitrogen

The effect of various N rate and N timing strategies on grain production in wheat is assessed for the three types of bread and feed wheats (short, mid and long-season types) grown in south-eastern Australia.

These strategies are for the production in the Holbrook area and uses soil data from a farm on Ravlona Lane and 124 years of local climate data (1889-2012) at Holbrook sourced from Bureau of Meteorology.

Demand for nitrogen by wheat

Wheat needs N throughout the season however demand is high during growth stage 31 (GS31 – early stem elongation) and prior to flowering (nearing GS65). The figure below (Figure 1) shows how photosynthesis is reduced around these critical times when N is only supplied from soil.

Insufficient N around GS31 leads to reduced plant growth whilst insufficient N around flowering can translate into low grain protein. Thus N fertiliser tends to be considered early in the season when the aim is to maximise grain yield.

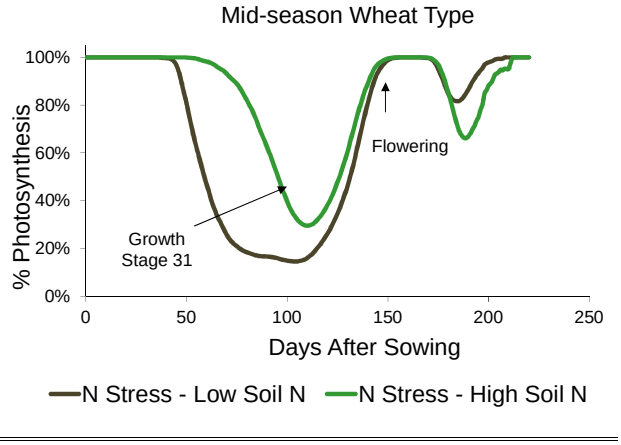

Figure 1: Nitrogen stress in a mid-season wheat type (cv Gregory) without N fertiliser. 100% photosynthesis is maximum efficiency and indicates no N stress. Curves are the average photosynthesis simulated using APSIM Version 7.3 over 124 years (1889 – 2012) with soil and climate data from Holbrook.

GRDC Grains Research & Development Corporation
Holbrook Landcare Network
Department of Environment and Primary Industries Victoria

Nitrogen management for wheat at Holbrook, southern NSW

Single applications		Short season wheat	Mid-season wheat	Long season wheat
		Increase in grain yield (kg/ha) at:		
N timing	Total N applied	low starting soil N		
at GS31	50 kg N/ha	1379	1698	1506
at GS31	100 kg N/ha	1560	1972	1934
at GS39	50 kg N/ha	583	949	1276
at GS39	100 kg N/ha	601	955	1284
		medium starting soil N		
at GS31	50 kg N/ha	1319	1993	1427
at GS31	100 kg N/ha	1526	2823	2194
at GS39	50 kg N/ha	522	1601	1407
at GS39	100 kg N/ha	549	1649	1500
		high starting soil N		
at GS31	50 kg N/ha	666	1961	1237
at GS31	100 kg N/ha	860	2826	1902
at GS39	50 kg N/ha	54	1772	1268
at GS39	100 kg N/ha	165	1784	1430

Split applications		Short season wheat	Mid-season wheat	Long season wheat
		Increase in grain yield (kg/ha) at:		
N timing	Total N applied	low starting soil N		
at GS00-GS25 + GS31	90 kg N/ha	2577	2822	2259
at GS00-GS25 + GS31	190 kg N/ha	3797	5282	4261
at GS00 + GS31 + GS39	120 kg N/ha	2912	3734	2955
		medium starting soil N		
at GS00-GS25 + GS31	90 kg N/ha	2327	3028	2269
at GS00-GS25 + GS31	190 kg N/ha	2911	5032	4062
at GS00 + GS31 + GS39	120 kg N/ha	2453	3855	2871
		high starting soil N		
at GS00-GS25 + GS31	90 kg N/ha	1329	3013	2062
at GS00-GS25 + GS31	190 kg N/ha	1459	4221	3407
at GS00 + GS31 + GS39	120 kg N/ha	1294	3583	2465

N fertiliser strategies

The tables show how much extra grain yield is attained for 3 wheat types grown with low, medium and high starting soil N.

The grain yields are calculated using 124 years of climate data and soil data from the Holbrook area. The numbers in the table are the *increase* in grain yield (kg/ha) above the grain yields obtained with only 10 k N/ha. The colours in the tables indicate the efficiency of N fertiliser use.

Nitrogen use efficiency

Applying N fertiliser always increased the average grain yield but often the increase in grain yield was low given the amount of N applied. In these situations, nitrogen use efficiency is said to be low and the gains in grain yield made by applying N fertiliser need to be considered alongside the cost of using N fertiliser.

Green has high N efficiency (>30 kg grain / kg N)

Yellow has moderate N efficiency (20 - 30 kg grain / kg N)

Blue has poor N efficiency (<20 kg grain / kg N)

Three wheat types simulated using APSIM Version 7.3 are represented by Crusader (short season), Gregory (mid-season) and Wedgetail (long season). The starting soil N contents are 50 kg N/ha (low), 100 kg N/ha (medium), 150 kg N/ha (high) to 100 cm depth.

Funded by Grains Research and Development Corporation and Department of Environment and Primary Industries, Victoria

Published by the Victorian Government Department of Environment and Primary Industries Melbourne, October 2013

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ISBN 978-1-74326-527-7 (print)
ISBN 978-1-74326-528-4 (pdf)

Accessibility

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