# Nitrogen management for wheat

## Nitrogen management in the Woomargama area of southern NSW

**Key messages**

- Grain yields are increased for all wheat types by applying N when the amount of starting soil N in up to 150 kg N/ha.
- Wheat grown on soil with high amounts of N at Woomargama 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.
- Different wheat types respond differently to the same N management.
    - Both single and split applications of N can efficiently increase grain yield, particularly with the mid-season wheat type.

### 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 wheat production in the Woomargama area and uses soil data from a local farm 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.

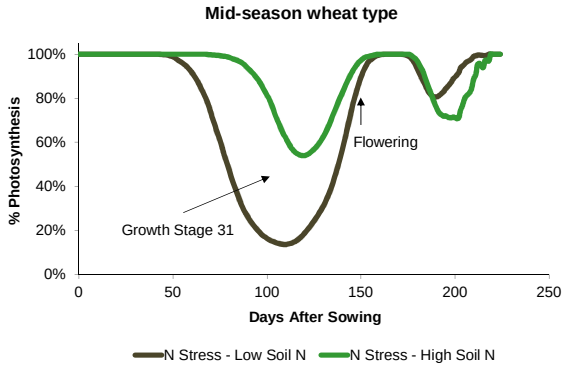


Figure 1: Nitrogen stress in a mid-season wheat type (cv Gregory) without N fertiliser. 100% photosynthesis is maximum efficiency and indicates no N stress. Curves are the average photosynthesis simulated using APSIM Version 7.3 over 124 years (1889 – 2012) with climate data from Holbrook and soil data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

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# Nitrogen management for wheat at Woomargama, southern NSW

| Single applications | | Short season wheat | Mid-season wheat | Long season wheat |
|---|---|---|---|---|
| N timing | Total N applied | Increase in grain yield (kg/ha) at: low starting soil N | | |
| at GS31 | 50 kg N/ha | 1516 | 1528 | 1077 |
| at GS31 | 100 kg N/ha | 2324 | 2415 | 2014 |
| at GS39 | 50 kg N/ha | 1334 | 1385 | 1214 |
| at GS39 | 100 kg N/ha | 1363 | 1406 | 1439 |
| | | medium starting soil N | | |
| at GS31 | 50 kg N/ha | 1521 | 1775 | 985 |
| at GS31 | 100 kg N/ha | 2624 | 3134 | 2237 |
| at GS39 | 50 kg N/ha | 1626 | 1963 | 1168 |
| at GS39 | 100 kg N/ha | 1914 | 2400 | 1928 |
| | | high starting soil N | | |
| at GS31 | 50 kg N/ha | 1288 | 1753 | 1101 |
| at GS31 | 100 kg N/ha | 2184 | 3096 | 2187 |
| at GS39 | 50 kg N/ha | 1375 | 1903 | 1221 |
| at GS39 | 100 kg N/ha | 1705 | 2563 | 1899 |

| Split applications | | Short season wheat | Mid-season wheat | Long season wheat |
|---|---|---|---|---|
| N timing | Total N applied | Increase in grain yield (kg/ha) at: low starting soil N | | |
| at GS00-GS25 + GS31 | 90 kg N/ha | 2452 | 2488 | 1874 |
| at GS00-GS25 + GS31 | 190 kg N/ha | 4146 | 5091 | 4147 |
| at GS00 + GS31 + GS39 | 120 kg N/ha | 3076 | 3564 | 2774 |
| | | medium starting soil N | | |
| at GS00-GS25 + GS31 | 90 kg N/ha | 2506 | 2799 | 1886 |
| at GS00-GS25 + GS31 | 190 kg N/ha | 3614 | 5134 | 4104 |
| at GS00 + GS31 + GS39 | 120 kg N/ha | 2998 | 3892 | 2755 |
| | | high starting soil N | | |
| at GS00-GS25 + GS31 | 90 kg N/ha | 2068 | 2841 | 2009 |
| at GS00-GS25 + GS31 | 190 kg N/ha | 2448 | 4441 | 3856 |
| at GS00 + GS31 + GS39 | 120 kg N/ha | 2390 | 3732 | 2747 |

## 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 Woomargama area. The numbers in the table are the *increase* in grain yield (kg/ha) above the grain yields obtained with only 10 kgN/ha. 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.

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