Canola stubble retention

The influence of canola stubble management on wheat production in the Holbrook area of southern NSW

Key messages:

- Retaining high stubble loads reduces the amount of nitrogen available to the next crop.
- Reduced available nitrogen in soil can be overcome by applying nitrogen fertiliser.
- Lower amounts of nitrogen fertiliser are needed to overcome immobilisation when stubble is left standing.
- Higher amounts of nitrogen fertiliser are needed to overcome immobilisation when over 5 t/ha of stubble is mulched or incorporated.
    - No more than 50 kg N/ha is needed to overcome the detrimental effects on grain yield of retaining heavy stubble loads.

Stubble management

Stubble is commonly mulched, grazed or burnt in windrows. Each management practice has its own advantages and disadvantages for whole-farm management. The way stubble is managed determines how much stubble is left in the paddock at the next sowing time and whether it is in contact with the soil.

Benefits of stubble

In the long-term, retaining stubble enhances soil structure, soil water holding capacity and reduces the risk of soil erosion (see 'Changing soil organic carbon' fact sheet by DEPI). In the short-term, retaining stubble can increase the risk of crop disease and may interfere with emergence of the next crop.

Influence of stubble on the supply of nitrogen to the next wheat crop

The impact of stubble management on nitrogen (N) and hence grain yield is explored through crop modelling using soil data from a farm on Ralvona Lane, Holbrook and 124 years of climate data from Holbrook as sourced from Bureau of Meteorology.

The short-term impact of retaining stubble on N is for less N to be available to the following crop due to N immobilisation. This occurs because the amount of available N is reduced as micro-organisms break down the stubble and use the resulting mineral N for their growth and survival.

Nitrogen immobilised is more likely to occur when:

- there is more stubble,
- stubble has a high C : N ratio (ie wheat, barley),
- stubble is in contact with the soil,
- soil is at a temperature and water content suitable for soil micro-organisms.

The least amount of immobilisation occurs when stubble is burnt thus burnt stubble is the benchmark for considering the effects of stubble management practices (Figure 1).

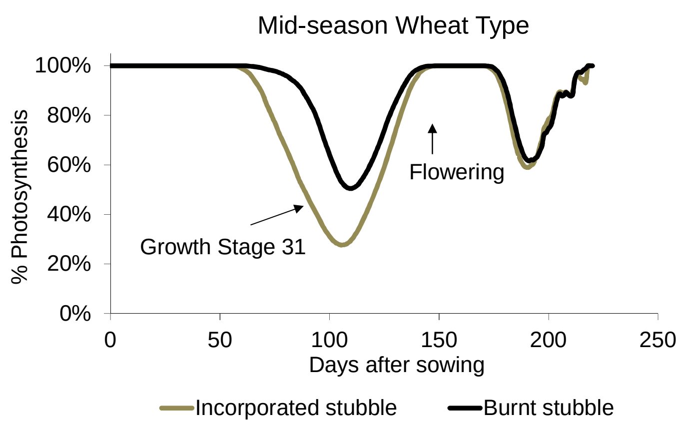

Figure 1. Nitrogen stress in unfertilised wheat (cv Gregory) after a canola crop which has been either burnt or incorporated (10 t/ha). 100% photosynthesis is maximum efficiency and indicates no N stress. Curves are the average photosynthesis efficiency simulated using APSIM Version 7.3 over 124 years (1889-2012) with climate and soil data from Holbrook.

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Immediate effects of canola stubble on N management in the next wheat

When stubble is retained at Holbrook, some N is immobilised and the crop is subjected to additional N stress (see incorporated stubble in Figure 1). The detrimental effect of the additional N stress on grain yield is overcome by applying N fertiliser.

The amount of N fertiliser needed to bring the grain yield up to the benchmark attained after a burnt stubble varies with each stubble management practice.

At Holbrook, the benchmark grain yield without N fertiliser averaged 3.4 t/ha over 124 years of simulations.

Applying 25 kg N/ha to wheat at Holbrook mitigated the detrimental effects of stubble retention in the less intensive systems (Table 1A). Black text in the table shown where 25 kg N/ha produced grain yields equal or better than those obtained after burning stubble without N fertiliser.

Table 1A	Burnt	Standing	Incorporated	Mulched
Stubble load	wheat grain yield (t/ha) with 25 kgN/ha after canola			
0 t/ha	4.2			
1 t/ha		4.1	3.8	4.0
3 t/ha		4.0	3.6	3.6
5 t/ha		3.9	3.4	**3.0**
7 t/ha		3.8	**3.2**	**2.8**
10 t/ha		3.7	**2.8**	**2.7**

Table 1. Median grain yields of mid-season wheat (represented by Gregory) grown with 25 kg N/ha (1A) and 50 kg N/ha (1B) after canola when 0 -10 t/ha of stubble was retained using one of four management practices. Tabled grain yields are compared with the median grain yield attained without N on a burnt canola stubble (3.4 t/ha). Grain yields less than 3.4 t/ha are shown in red text. All grain yields are simulated using APSIM Version 7.3 over 124 years (1889 – 2012) with climate data and soil data from Holbrook.

Up to 50 kg N/ha needs to be applied to mitigate the detrimental effects of stubble retention when higher stubble loads are retained using practices that result in stubble being in contact with the soil (Table 1B).

Table 1B	Burnt	Standing	Incorporated	Mulched
Stubble load	wheat grain yield (t/ha) with 50 kgN/ha after canola			
0 t/ha	5.0			
1 t/ha		4.9	4.6	4.8
3 t/ha		4.8	4.4	4.3
5 t/ha		4.6	4.2	3.8
7 t/ha		4.5	4.0	3.6
10 t/ha		4.4	3.7	3.5

Although applying N fertiliser compensates for reductions in available N due to immobilisation, fertilised wheat grown immediately after a burnt stubble still attains higher average grain yields than wheat grown after the other stubble management practices. This is due to less N fertiliser being needed after stubble burning to compensate for N immobilisation and therefore more N fertiliser being available for additional plant growth and yield.

Seasonal variation

It must be noted that grain yields simulated at Holbrook varied markedly between seasons for the same stubble management strategies (eg range was 0.8 – 5.0 t/ha for burnt stubble without N). This seasonal variation meant grain yield was often not effected by stubble management practice even with heavy stubble loads.

Further Reading:

GRDC (2011) Stubble management fact sheet. pp8.

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