BENEFITS OF RETAINING STUBBLE

JENNIFER CARSON & KEN FLOWER, THE UNIVERSITY OF WESTERN AUSTRALIA

Key points

- In the past stubble has been burnt to control weeds but retaining stubble has several advantages for soil fertility and productivity.
- Retaining stubble can decrease soil erosion and increase soil water content.
- Retaining stubble can increase labile carbon, which increase the biological fertility of soil.
- If controlling weeds is the aim, burning windrows is more effective than burning standing stubble and also decrease erosion risk.

Background

Historically, stubble has been burnt because it improves weed control and creates an easier passage for seeding equipment. However, the practice of burning stubble has recently declined due to concerns about soil erosion and loss of soil organic matter. Instead of being burnt, stubble is increasingly being retained which has several advantages for soil fertility and productivity.

Reducing erosion risk

One of the main benefits of stubble retention is reduced soil erosion. Retaining stubble decreases erosion by lowering wind speed at the soil surface and decreasing run-off. To minimise erosion approximately 50% ground cover is required and adequate stubble needs to be maintained for 6 - 8 weeks following seeding (Leonard, 1993). It is generally considered that 50% ground cover is achieved by 1 t/ha of cereal stubble, 2 t/ha of lupin stubble and 3 t/ha of canola stubble.

Image: Inspecting stubble after sowing with a disc opener.

Increase in soil water content

Another advantage of retaining stubble is that it increases soil water content by decreasing run-off and increasing infiltration. However, the potential benefits of decreased run-off and increased infiltration will depend on the timing and intensity of rainfall as well as the quantity and orientation of stubble. Late summer-early autumn rains have more chance of improving the germination and establishment of the next crop. In addition, increased infiltration of water over summer can result in greater nitrogen mineralisation and availability for the subsequent crop.

Increase the biological fertility of soil

Retaining stubble increases the input of carbon to soil. Stubble is approximately 45% carbon by weight and therefore represents a significant input of carbon to soil. It can take decades for retaining stubble to increase the amount of total organic carbon in soil. A field experiment in Merredin, Western Australia found that retaining stubble for 17 years only increased the total organic carbon content of the soil by 31% (2.1 tonnes carbon per hectare, table 1). However, retaining stubble can have a larger effect on the carbon in the microbial biomass in soil. When stubble is retained, the greater inputs of organic carbon to soil increase its biological fertility. Microorganisms in soil require organic carbon to obtain the C, nutrients and energy they need to live. Labile carbon is a particularly important form of organic carbon for soil microorganisms. Management practices that increase inputs of organic carbon to soil, such as retaining stubble, can increase the number of microorganisms in soil and also cause them to be more active (table). The Merredin field experiment found that 17 years of retaining stubble increased the carbon in the microbial biomass by 42% (table).

BENEFITS OF RETAINING STUBBLE CONT...

Soil property	Stubble retained	Stubble burnt
Total organic carbon (t/ha)	8.7	6.6
Water content at field capacity (10kPa,%)	23.2	19.7
Microbial biomass carbon (0	203	143
Microbial respiration (kg carbon /ha/d)	30.2	13.7

Table: The effect of retaining or burning stubble on soil properties after 17 years, from a field experiment at Merredin, Western Australia (Hoyle and Murphy, 2006a, 2006b)

Reasons to consider burning stubble

The main reason for burning stubble is to control weeds. Burning windrows in paddocks can be a useful way to control weeds, especially populations of weeds that are herbicide resistant. Burning chaff in windrows is more effective for controlling weeds than burning whole paddocks. This is because the weed seeds are exposed to higher temperatures for a longer period (Walsh and Newman, 2007). For example, 20% of ryegrass seeds emerged when standing stubble was burnt but only 1% emerged when windrows were burnt (Walsh and Newman, 2007). However, without a high temperature fire, viable weed seeds will be concentrated in strips. Also, when chaff is collected in windrows, less of the field is burnt. This means more stubble is retained and the erosion risk is decreased. When chaff is collected in narrow windrows of 50 - 70 cm, only 10% of the field is burnt. Burning whole paddocks can decrease stubble borne diseases in several cereal crops including wheat (yellow spot - *Pyrenophora tritici-repentis*, septoria nodorum blotch - *Phaeosphaeria nodorum*, septoria tritici blotch - *Mycosphaerella graminicola*) and barley (net blotch - nettype *Pyrenophora teres* f.sp. *teres*, net blotch - spot-type *yrenophora teres* f.sp. *maculata*). However, stubble-borne diseases can be managed without burning by use of resistant cultivars and crop rotation. In addition, burning whole paddocks has little effect on soil borne diseases.

Further reading and references

Hoyle FC and Murphy DV (2006a) Temperature and stubble management influence microbial CO2-C evolution and gross N transformations. *Soil Biology & Biochemistry* 38: 71-80.

Hoyle FC and Murphy DV (2006b) Seasonal changes in microbial function and diversity associated with stubble retention burning. *Australian Journal of Soil Research* 44: 407-423.

Leonard (1993) *Managing for stubble retention*. Bulletin 4271, Department of Agriculture Western Australia.

Thomas GA, Orange DN and King AJ (2008) Effects of crop and pasture rotations and surface cover on rainfall infiltration on a Kandosol in south-west Queensland. *Australian Journal of Soil Research* 46: 203-209.

Walsh MJ and Newman P (2007) Burning narrow windrows for seed destruction. *Field Crops Research* 104: 24-30.