Upper North Farming Systems

Stubble Management Guidelines

Managing stubble at harvest

Retaining stubble has a range of benefits, provided it is managed well. Photo: UNFS.

Key facts

- It is important to plan ahead to manage both high and low stubble loads.
- Managing high stubble loads starts at harvest, with adequate chopping and spreading of stubble residues.
- Heavy stubble loads decompose slowly, while lighter stubble loads decompose more rapidly, which can make management more difficult.
- It is important to maintain adequate groundcover, stubble anchorage and stubble height to minimise wind and water erosion.
- Standing stubble reduces wind speed and soil evaporation, and improves pre-emergent herbicide efficacy.

In mixed farming systems stubble retention has been demonstrated to improve soil health by maintaining or improving soil organic carbon levels and soil stability (reducing the risk and impact of wind and water erosion, and minimising the loss of soil nutrients through such erosion). Over time retaining stubble will improve crop yields and quality, and can reduce inputs to the farming system.

In average and low-stubble years management is often focused on maintaining adequate groundcover to protect soil from wind and water erosion, and to maintain soil structure and health. Photo: UNFS

As these benefits have become better understood, the adoption of conservation farming practices has increased. At the same time the proportion of pastures (and livestock) in these farming systems has reduced, with associated impacts on stubble management.

Project information

This *Managing stubble at harvest* guideline has been developed for the Upper North Farming Systems Group (UNFS) as part of the Maintaining Profitable Farming Systems with Retained Stubble Initiative, funded by the Grains Research and Development Corporation (GRDC UNF00002).

The Stubble Initiative involves farming systems groups in Victoria, South Australia and southern and central New South Wales, collaborating with research organisations and agribusiness, to address challenges associated with stubble retention.

The GRDC, on behalf of growers and the Australian Government, is investing $17.5 million in the initiative that has been instigated by the GRDC Southern Regional Panel and the four Regional Cropping Solutions Networks that support the panel.

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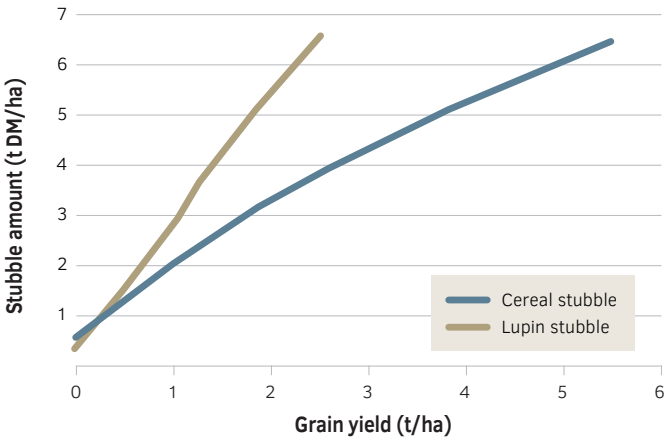
Figure 1. Relationship between the amount of grain and amount of stubble immediately after harvest (adapted from Perry, 1992)



How much stubble will I have at sowing?

The ratio of grain to straw varies and depends on a range of factors, including the crop type, variety and seasonal conditions. As a general guide, for every 1t/ha of grain yield there will be 1.5–2t/ha of cereal stubble remaining immediately after harvest (see Figure 1). Legume and canola stubbles will have even more variability in stubble levels relative to grain yields, with higher stubble ratios at harvest. Due to higher nitrogen content these are either grazed or break down quicker with often less stubble remaining at sowing.

Harvest management

In years with high stubble loads at harvest it is important to plan ahead. Stubble management needs to start at harvest to avoid blockages during sowing.

The amount of stubble that can be handled during sowing varies with the machinery type and the type of crop sown. Most new sowing equipment can handle significant stubble loads, but in the past many growers modified or upgraded their machinery to deal with high stubble loads.

Stubble spread

During harvest, ensure straw from thick stubble is evenly distributed across the header width (this is becoming more difficult as header fronts become wider). Many standard straw choppers and spreaders tend to concentrate chaff and straw directly behind the header, which can result in sowing equipment blockages, reduced crop establishment and poor herbicide efficacy.

The amount of stubble that can be handled during sowing varies with the machinery type and the type of crop sown. Photo: UNFS.

Vetch on crop lifters. Stubble management needs to start at harvest to avoid blockages during sowing. Photo: Andrew Kitto.

The newer-model headers often have an improved residue spreading pattern and there are several residue spreading units that can be retro-fitted to older model headers (for example Redekop MAV® straw chopper or PowerCast® tailboard). Despite these improvements, most straw spreaders currently have the capacity to spread residue evenly across the width of a 9–10.5m front (30–35 feet), although some manufacturers claim they can evenly spread up to 15m.

During harvest, ensure straw from thick stubble is evenly distributed across the header width. Photo: UNFS.

Chopped vetch stubble spread across a paddock. Chopping stubble into short pieces requires more power and can be difficult to distribute, but has benefits including faster decomposition and nutrient cycling. Photo: Andrew Kitto.

Spreading across wider fronts (12m or more) can be achieved by increasing the cutting height to reduce the amount of residue to be spread, or by adjusting rotor speed and vane settings to suit windy conditions or sloping paddocks.

Chopping the stubble into short pieces will speed up residue decomposition and nutrient cycling, but it requires more power and is more difficult to distribute the lighter residue pieces across the header width.

Mixing the straw and chaff together (such as can be achieved with Case 2388/8010/John Deere STS/Claas Lexion) and spreading it as one mass of material helps convey the lighter material and chaff, resulting in a greater spread of residue.

Light crops harvested on windy days present the biggest challenge for all brands of harvesters, so any chopper/spreader combination positioned closer to the ground is generally more effective, because the wind does not affect the material as much. Any chopper/spreader system that incorporates an air distribution principle is even better as it is easier to blow residue, rather than trying to throw it, especially during dry harvest conditions.

Other options to improve the spread of residue:

- Double spreaders distribute chaff much more evenly than the single spinning spreader.
- When wind speeds are high, try to harvest back and forward on the downwind side of the crop if possible, rather than into the wind. This will usually produce the best residue spread pattern.
- Keep knife blades on the chopper sharp to ensure even residue sizing and minimise power losses.
- A stripper front is an excellent option to increase harvester capacity, improve residue management and reduce fuel costs. Stripper fronts work well in high-yielding cereals, with only a small amount of the crop going into the harvester. The remaining stubble is relatively tall and requires further management or inter-row sowing the following season (Refer to the *Inter-row sowing stubble management guidelines*).

Stubble decomposition and grazing

In seasons with high stubble loads, cereal grain yields are usually well above average and the nitrogen content of stubble stem is low. This low nutritive value impacts on both livestock and the decomposition of stubble by microbes and other organisms. Under a heavy stubble load (more than 5t/ha), if left untreated, only about 20 per cent of the stubble will have decomposed by sowing.

In these seasons only the grain, chaff and leaf material (20–25 per cent of total stubble) provide any nutritive value, with the stem having very low nutritional value to livestock.

In comparison, following poor seasons with a hot dry finish, grain yields are low and a higher proportion of nutrients remain in the stubble (including the stem). Stubbles with higher nitrogen levels are more attractive to livestock and are also more readily broken down by micro-organisms.

In these seasons 40 per cent or more of the stubble can decompose by sowing and, when combined with grazing, stubble levels can quickly fall below desired levels for groundcover and protection from erosion (Table 1).

Legume stubbles and pasture residues also tend to contain more nitrogen and will be more readily grazed and broken down by micro-organisms. Carefully manage the grazing of legume residues to maintain adequate groundcover. Avoid grazing pea stubbles on sandy soils, or only graze after heavy summer rains, which germinate summer weeds, as stock graze and dislodge any attached residues, which break up and blow away leaving the soil bare. Ungrazed pea stubbles that are chopped and spread at harvest have a far lower risk of wind erosion.

Calculating grazing days on stubble

Grazing sheep eat or trample about 2kg of stubble per DSE per day. Use the following equation to calculate the total number of grazing days, to ensure sufficient stubble remains for adequate ground cover.

$$\frac{\text{stubble level (kg/ha)} - \text{critical ground cover level (kg/ha)}}{\text{removal rate (2kg/ha/day)} \times \text{stocking rate (DSE/ha)}}$$

Grazing sheep eat or trample about 2 kg of stubble per DSE per day. Ensure that sufficient stubble remains for adequate ground cover. Photo: UNFS

How much stubble should I aim to keep?

In average and low-stubble years management is focussed on maintaining stubble to ensure there is adequate groundcover to protect soil from wind and water erosion and maintaining soil structure and health.

Retaining adequate stubble cover will:

- return nutrients to the soil (each tonne of stubble contains approximately $9 of nitrogen, phosphorus and sulphur) plus potassium and trace elements
- improve long-term soil fertility
- reduce the risk of wind and water erosion
- reduce evaporation from the soil
- protect the surface soil structure from the impact of raindrops.

Protection from wind and water erosion

The degree to which plant residues protect the soil from wind erosion depends on a combination of the:

- percentage of total residue on the soil surface
- percentage of cover anchored to the soil surface
- residue height.

Adequate surface cover is required to protect the soil against water erosion with the amount required varying with paddock slope (Table 1).

There are a number of benefits in leaving standing stubbles including:

- reduced risk of wind erosion and protection of emerging crops — standing stubble reduces the wind speed at or near ground level. For example 5cm high stubble will reduce wind speeds 20cm above the ground by 35 per cent, but 35 cm high stubble will reduce wind speeds by 75–80 per cent. Lowering wind speed at the soil surface can also reduce evaporation of moisture from the soil
- reduced soil moisture evaporation and soil temperatures
- improved pre-emergent herbicide efficacy
- improved trash/stubble flow through the sowing equipment
- the ability to inter-row sow between the standing stubble — in heavy stubbles inter-row sowing is the key to effectively sowing into these stubbles without causing significant stubble clumping.

Benefits of retaining crop or pasture residues on the soil surface include:

- improvement in fallow efficiency by minimising the physical impact of raindrops on the surface soil
- maintaining structural integrity of soil
- improved water infiltration rates
- reduced water run-off and soil erosion
- slowing the flow of water on the soil surface, allowing more time for infiltration and slowing soil evaporation following rainfall events. However if conditions remain dry for an extended period (6–8 weeks), total evaporation will not be affected by residues.

It is important to note stubble architecture (standing or slashed) has negligible effect on soil moisture conservation.

TABLE 1. Minimum and desirable cover levels to protect soils from erosion

Erosion type	Soil characteristics	Minimum cover		Desirable cover	
		%	t/ha	%	t/ha
Wind	Loam	15	0.5	35	1.0
	Sandy loam	20	0.6	50	1.5
	Sand	50	1.5	70	2.5
Water	Level land	60	2.0	75	3.0
	Sloping land	75	3.0	85	4.0

Source: DWLBC 'Surface cover for protection against wind and water erosion' factsheet, 2008

Stubble architecture (standing – shown on left, or slashed – shown on right) has negligible effect on soil moisture conservation. Photos: UNFS.

Implementing changes improves stubble handling

Barry Mudge, Port Germein

Barry Mudge, who farms around Port Germein, harvested a 5t/ha barley crop in November, 2013 with a NH89 harvester, which had relatively poor straw spread. This resulted in high stubble loads directly behind the harvester, and Barry was unable to penetrate these heavy stubbles at sowing.

In response Barry purchased John Deere Conservapak, with greater stubble handling capability and upgraded his harvester by fitting a Redekop MAV® straw chopper. The straw chopper smashes the straw into small pieces and spreads it relatively evenly to a width of 9.5m, slightly short of the 10.5m comb width.

Barry has also improved his inter-row sowing capacity with the help of guidelines identified as part of the UNFS Stubble Initiative (See *Inter-row sowing stubble management guidelines*).

By implementing better stubble management and purchasing higher-capacity sowing equipment Barry can now manage high stubble loads at harvest and has improved his sowing efficiency, crop emergence and herbicide efficacy.

Upgrading his harvesting set-up with a straw chopper has allowed Barry to improve his stubble handing at harvest.

References and further information

» Hunt JR, Kirkegaard JA (2011) Re-evaluating the contribution of summer fallow rain to wheat yield in southern Australia, *Crop and Pasture Science* 62, 915-929.doi; 10.1071/CP11268. Click

» Perry, M (1992) *How much stubble?* WA J. Agric. 33 (1), 17. Click

Acknowledgements

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