RiverinePlains

Stubble management guidelines for the Riverine Plains

NUMBER 01

Managing stubble at harvest improves sowing success

Key points

Calculating the stubble load at harvest supports a strategic approach to managing stubble at sowing, maximising the benefits of retained stubble while minimising the challenges.

For high-yielding crops, lowering the harvest height can reduce the overall stubble load while still maintaining the benefits of retained stubble.

Mulching or lightly cultivating stubble soon after harvest increases the soil–stubble contact and aids stubble breakdown before sowing.

While burning helps to reduce stubble loads at sowing, and can improve weed control and pre-emergent herbicide efficiency, it increases the risk of erosion and impacts on soil moisture retention during the summer fallow.

Retaining stubble after harvest can deliver multiple benefits in cropping systems. It can help: capture and store rainfall during the summer fallow, protect soils from wind and water erosion, and improve soil structure.

On the other hand, high stubble loads can increase the frequency of blockages in sowing equipment and the risk of disease carryover (see Stubble Management Guideline No 02). Retained stubble can also 'tie-up' early-season nitrogen (N) when soil microbes use it as a source of fuel to break down stubble, restricting the amount available for crop emergence and early growth (see *Stubble Management Guideline* No 03).

The best time to make decisions about managing stubble is before harvest. This provides ample time and opportunity to use the harvest process to produce stubble with the desired characteristics. Stubble can then be monitored and managed during the summer fallow period to address any issues that may impact on sowing or crop establishment.

Calculating potential stubble loads

Knowing the potential biomass (i.e. dry matter) as the crop matures provides a basis on which to estimate the stubble load after harvest (tonnes of stubble per hectare).

Stubble loads in the Riverine Plains region commonly range from around 6–9t/ha. Irrigated crops, and those grown in the high-rainfall zone, will have higher stubble loads than those grown in the low–medium rainfall areas of the region.

Traditionally, many growers in the Riverine Plains region have burned stubble. More recently, a combination of inter-row sowing, the optimised set-up of sowing machinery and strategic crop rotations have seen growers successfully retain stubble at much higher loads without burning.

The threshold level at which to consider burning will change according to the season and machinery set-up.

The following techniques provide alternatives to burning to reduce the risk of stubble management issues in crops with high stubble loads:

1. Lower the harvesting height

Research carried out by Riverine Plains Inc during 2014 as part of the GRDC-funded *Maintaining Profitable Farming Systems with Retained Stubble in the Riverine Plains Region* project, showed the increased yield of second wheat (wheat on wheat) when stubble height in the first wheat crop was reduced from 45cm to 15cm at the Dookie trial site (Figure 1). Wheat sown into the taller 45cm wheat stubble also had fewer tillers. In 2015, 2016 and 2017, there were no yield difference due to stubble height, however, dry matter production and early

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Calculating the stubble load

— before and after harvest

Before harvest:

1. Cut the plant matter within one square metre of a representative area of the crop (at the predicted harvest height) and remove heads (take 10 samples, each from a 10cm by 10cm quadrat).
2. Place a microwave-safe dish on a set of digital kitchen scales and zero (tare) them. The scales need to be accurate to at least 1 gram (g).
3. Weigh 100g of the crop to be tested into the dish (chop the plant material with scissors or shears before placing it in the dish). Ensure no moisture escapes from the sample before it is weighed, for example through drying out or sweating in a bag.
4. Place the dish in the microwave along with a glass of water. The water protects the microwave oven from damage when the crop is dry.
5. Put the microwave on full power for 5–10 minutes depending on the power of the oven and the estimated dry matter of the crop. Use a longer time for crops with high moisture.
6. Remove the dish and place on the scales. Record the weight.
7. Place the dish back in the microwave on high for another minute.
8. Repeat this process until two consecutive weights are the same. Ensure there is always water in the glass in the microwave oven.
9. The final weight is the dry matter (DM) content of the crop. Every 100g of stubble mass per square metre equals 1t/ha of dry stubble.

After harvest:

Stubble load (t/ha) = grain yield (t/ha) X (1-HI)/HI

The harvest index (HI) is the ratio of grain yield to total above-ground biomass (between 0.2 and 0.5 for winter cereals)

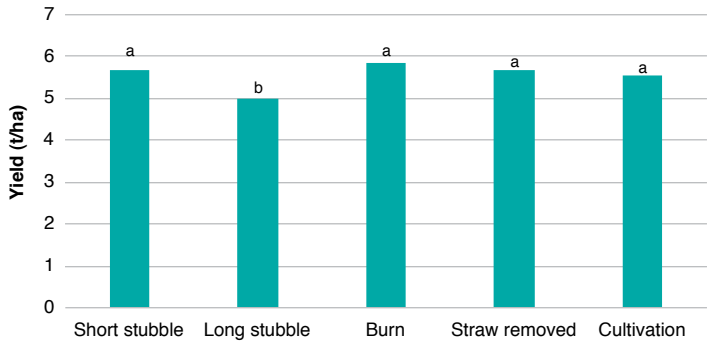

FIGURE 1 Yield of second wheat (wheat on wheat) when sown into different stubble treatments at Dookie, Victoria, 2014 as part of the *Maintaining profitable farming systems with retained stubble in the Riverine Plains region* project
Different letters denote significant difference.

growth has consistently been shown to be lower in longer stubble compared to shorter stubble. *Maintaining Profitable Farming Systems with Retained Stubble in the Riverine Plains Region* trials undertaken during 2016 and 2017 showed that light interception was reduced by more than 50% in long stubble (39cm) compared with short stubble (14cm) when measured in June. The ability to capture sunlight could therefore be a major factor in why there is a lag in DM production with long stubble compared to short stubble.

Dropping the height of the header bar increases the volume of material being processed by the harvester and necessitates a slower harvesting speed. Research by Southern Farming Systems (SFS) in Victoria during 2014 as part of the GRDC-funded *Maintaining Profitable Farming Systems with Retained Stubble Initiative* showed harvesting a 3t/ha wheat crop (cv. Bolac) at a height of 15cm was 20% slower than harvesting at a height of 30cm.

Consider the weather forecast before lowering the harvest height. If a slower harvesting speed isn't feasible, the same results can be achieved by returning to the harvested paddock with a slasher or mulcher. There is also the option of windrowing and baling the stubble after harvest.

2. Control residue spread at harvest

Ensuring harvest residue is spread evenly across the width of the header helps avoid large, uneven mounds of trash in the header rows. Mounds of stubble can block sowing equipment or lead to yield penalties as a result of poor crop emergence or nitrogen tie-up by microbes.

An alternative and innovative approach developed in Western Australia is the use of chaff decks to place chaff (and weed seeds) on wheel tracks in controlled traffic situations, while the straw is distributed evenly behind the header. While the effect of this system on herbicide-resistant weeds has not yet been rigorously evaluated, grower experience indicates it is an effective way to manage stubble, remove chaff dumps from the paddock and reduce the weed seedbank.

Short standing stubble Yarrawonga.

3. Stubble mulching or incorporation

Stubble mulching involves slashing stubble soon after harvest, leaving it laying on the soil throughout summer.

Mulch stubble as soon as possible after harvest to allow the longest possible time for stubble to decompose before sowing the next crop. The best response from stubble mulching occurs when there is sufficient summer rainfall to break down the mulched material.

Soil microbes need moisture to decompose crop stubble and a dry summer is likely to inhibit stubble decomposition. Stubble residue that has not decomposed can cause issues at sowing, with residue gagging and balling up under the sowing points.

Stock can be brought in to reduce residual stubble, however, grazing over summer can trample and flatten stubble and can increase the difficulty of sowing through the stubble.

Lightly incorporating stubble after harvest (shallow tillage) is becoming increasingly common. Shallow tillage aims to increase the soil–stubble contact, while only lightly disturbing the soil. While there are many and varied machines available, a key message from a *Strategic Tillage Machinery Day* held by Riverine Plains Inc during 2015 was to ensure the machine is set up correctly for soil type, moisture and stubble load. Correct set-up is as important, if not more so, than the actual machine itself.

Faba beans growing in wheat stubble as part of a large plot stubble trial at Coreen, NSW.

Burning risks soil loss: Dust storm on 29 April 2016 viewed from Springhurst, Victoria.

Strategically incorporating shallow tillage into the crop rotation could be an effective way of mixing nutrients and lime in the topsoil in systems that are otherwise no-till. Nutrients can accumulate in the surface soil under no-till stubble-retention (NTSR) systems and lime has poor solubility, meaning that it requires some incorporation to neutralise soil acidity below the surface.

4. Burn stubble

Although burning can efficiently remove stubble, mulching or lightly incorporating stubble soon after harvest can provide many of the same benefits and remove the pre-sowing rush to burn paddocks after fire restrictions are lifted. Additionally, mulching or light incorporation can be done in optimal weather conditions, and before the recommended sowing window. If burning is the most feasible option, delay burning for as long as possible after harvest to protect the soil during summer.

While burning can improve the efficacy of pre-emergent herbicides and reduce weed and disease burdens, restrictions around burning are likely to get tighter. It therefore makes sense to consider stubble burning as a strategic option, rather than as the first choice for managing stubble.

Strong winds across the Riverine Plains region during late April 2016 highlighted the benefits of retained stubble and the risks associated with widespread burning. Paddocks with retained stubble or those with burnt, narrow windrows, stayed relatively intact, while the topsoil from burnt paddocks was lost, creating a large dust storm.

5. Legumes in the rotation

Incorporating a legume crop into the rotation after wheat can also help manage stubble. If successfully inoculated, the emerging legume crop will provide its own nitrogen for early growth, through nitrogen fixation, and the 'stubble effect' experienced in a wheat-on-wheat rotation will be lessened.

As the legume crop grows, the wheat stubble acts as a 'trellis', keeping it off the ground, improving airflow and harvestability.

After the legume is harvested, the higher nitrogen content in the legume stubble residue means it breaks down faster than cereal stubble. Moreover, the higher nitrogen availability during summer supports greater soil microbe activity, helping to break down the previous year's wheat stubble. This enhanced stubble decomposition effectively 'resets' the paddock with minimum stubble carryover, while increasing the mineral nitrogen available to the following crop.

This effect was observed in the Riverine Plains Inc Coreen–Corowa large plot stubble trial where faba beans were planted to compare the performance of a legume crop after wheat to a second wheat

Comparing stubble treatments

The yield results from replicated large plot trials from the Riverine Plains Inc *Maintaining profitable farming systems with retained stubble in the Riverine Plains region* project has shown that over four vastly different seasons, there was little difference in yield between different stubble management practices at three different locations within the Riverine Plains region (Figures 2–4).

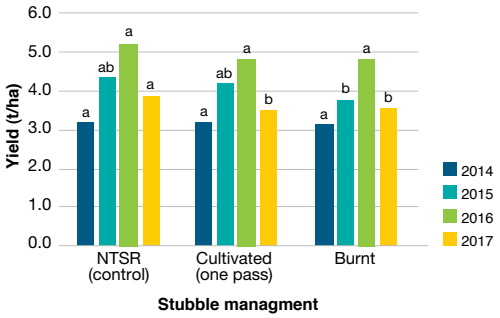

FIGURE 2 Comparison of stubble management on wheat yields in the Corowa–Coreen region, New South Wales, 2014–17

Yield bars for the same year with different letters are regarded as statistically different

Note: The four trials were carried out on the same farm but not on the same site. During 2014 the cultivation treatments were established with two passes of a multidisc, while in 2015, 2016 and 2017 a single pass was used.

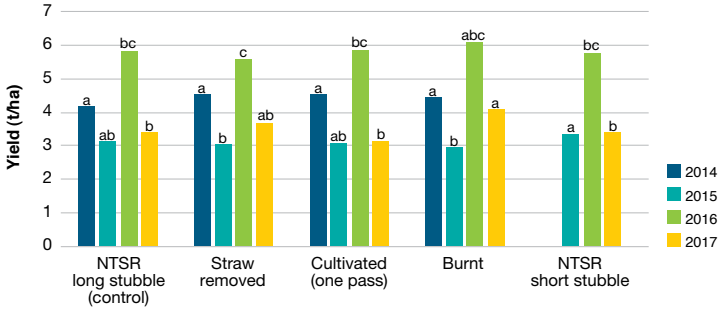

FIGURE 3 Comparison of stubble management on wheat yields at Yarrawonga, Victoria, 2014–17

Yield bars for the same year with different letters are regarded as statistically different

Note: The short stubble treatment was not part of the 2014 list of treatments.

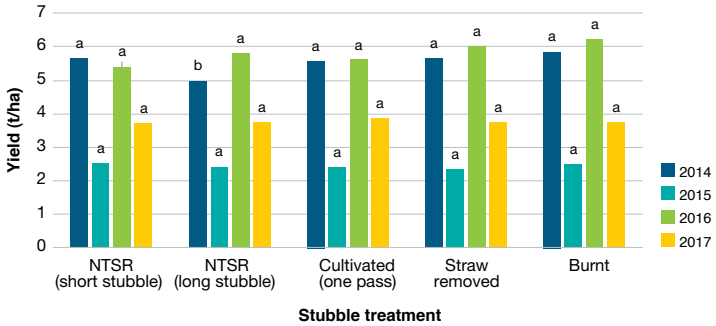

FIGURE 4 Comparison of stubble management on wheat yields (2014–16) and canola yield (2017) at Dookie

Yield bars for the same year with different letters are regarded as statistically different

crop (wheat on wheat). When sown into a first wheat stubble (2014) faba beans yielded 2.9t/ha and contributed to almost total breakdown of stubble (wheat and bean) before the 2015 season. When wheat was planted the following year (2015), the legume rotation showed a wheat yield gain of more than 2t/ha compared with a third wheat (wheat on wheat on wheat), where wheat yielded 5.6t/ha after beans and 3.4t/ha after burning wheat stubble.

To reduce the frequency of stubble burning, consider a wheat–barley–faba beans–canola rotation. Under such a system burning (if necessary) could be limited to the wheat stubble phase, if any burning is needed at all.

Acknowledgements

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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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Farmers inspiring farmers

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