Managing & retaining large irrigation stubbles

Results of a 2009 survey

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IN A NUTSHELL

- Better soil moisture retention and better soil health as a result of stubble retention are worth the effort to overcome barriers to adoption.
- Straw spreading at harvest is crucial for effective management of stubble at the next sowing.
- Microbial stubble digestors and the use of compost may have a place in irrigation cropping systems and need further investigation.

Large cereal stubble loads can be a major problem when it comes to getting the paddock ready for the next crop. Management options include burning, removal or retaining the stubble.

In some cases it may be better to remove stubble for sale and over the last few years there has been a market for cereal fodder. Another interesting approach is to remove stubbles and compost them and later return them to the paddock. Although this requires more work and handling, it has the benefit of providing food for soil microbes and will lead to reduced fertiliser requirements in subsequent crops.

Is there a hard and fast system for successful management of high stubble loads in the irrigation areas of the southern Murray-Darling Basin? This article presents a summary of a stubble management trial run for six years and responses from several growers about their stubble management practices.

Six-year stubble management trial

A six-year maize trial at Whitton conducted by CSIRO Land and Water, which finished in 2006, quantified some of the benefits of good stubble management by incorporation. The maize stubbles were large at 12 tonne of stubble per hectare and needed to be incorporated correctly by thoroughly mixing the soil and plant matter with strategic mulching and ripping. Timing and direction of mulching the stubble were critical to get good breakdown. Correcting any nutrient deficiencies such as sulphur and nitrogen also assisted stubble breakdown.

The incorporation of such large masses of stubble can also improve soil structure. Soil aggregation tests found that the soil structure improved during the trial which resulted in a decrease in soil strength compared with burnt stubbles. The tractor required 30% less power to rip the stubble incorporated beds than the stubble burnt beds.

The stubble management trial showed a yield increase of around 0.5 t/ha in four of the six years from the stubble incorporated beds. Stubble retention increased the water infiltration and water holding capacity of the soil.

The researchers also found that farms that use stubble incorporation emit 56% less greenhouse gases than farms where stubble was burnt. A total of 2.6% of the nitrogen fertiliser was lost as nitrous oxide from the burnt stubbles while the incorporated stubbles lost only 1.4% of applied fertiliser. This fact alone may have big implications for the proposed Carbon Pollution Reduction Scheme.

The results of the trial demonstrated that stubble incorporation not only increased the volume of microbes in the soil but also increased the proportion of beneficial bacteria that enhance soil fertility.

On-farm stubble management

We all know there are gains to be made by good stubble management. In many cases it could be just a mindset change to allow the on-farm technical problems to be overcome. As shown in the IREC case study book *Lifting irrigated cropping profitability and water use efficiency*, a number of growers are overcoming barriers to stubble retention and focusing on the soil health benefits of retaining stubbles. A number of these growers were surveyed by the authors of this article, Andrew Schipp and Kieran O'Keeffe, district agronomists with NSW DPI, about their stubble retention practices and additional comments were gathered from other irrigation farmers in the Murrumbidgee Valley.

Craig & Helen Reynolds, Congupna, Victoria

How are you retaining stubbles over 4 t/ha?

- Stubble management commences with variety selection (in the case of winter cereals) with shorter varieties favoured such as Baudin barley. For the same harvest height there is less stubble going through the harvester compared with some other varieties.

- The crop is harvested at lowest possible height but not to jeopardise grain retention, ie we will still strive for optimal harvest efficiency and not allow too much grain loss due to trying to process too much straw through the machine.
- We harvest with a rotary machine (New Holland TR99). Originally fitted with an aggressive straw spinner but this proved inadequate, especially if the straw was damp and the machine now has a Canadian-built Redekop straw chopper fitted.
- Straw spreading is crucial for effective direct seeding into stubble. Trash rows can't be present otherwise seeding will be compromised.
- Seeding is performed with a 6 m wide machine that I developed using home-made (tynes), DBS (seed placement) and Primary Sales (coulters) components. It is basically a tyned machine fitted with coulters. I believe the coulters are a very important component and complement the 2 cm Autofarm guidance system.
- We are developing a disc seeder unit (NDF discs) that will be used in future – specifically for crops such as maize and possibly soybeans.
- The guidance system allows inter-row sowing (10" row spacing) and I have found that the single row of front mounted coulters creates a groove that allows the rigid tynes to follow (path of least resistance), reducing the machine's tendency to "crib" off-line. A rear wheel steering mechanism allows the machine to track around corners better allowing more efficient sowing of headlands.

Are you able to retain every stubble or do some stubbles still need to be burnt? If so why?

- All stubbles can be handled at this stage. Maize stubbles are treated (chopped) similarly to winter cereals. The unknown at this stage is how hard it will be to handle less brittle stubbles in wetter times.

What benefits have you found?

- Better moisture retention – to the point that some temporary waterlogging was evident at the first watering of a soybean crop direct drilled into a six tonne barley stubble.
- Timeliness. Working stubbles in used to take a lot of time and energy.
- Increased soil carbon levels.

What disadvantages have you found?

- None although stubble retention requires a different mindset.

Are there some issues or barriers we still don't have the answers to?

- Most answers are there already or can be worked out on farm.

Why aren't other farmers adopting stubble retention?

- They have a different perspective and some want paddocks to look nice.

Lindsay & Helen Gronow, Yarawalla, Victoria

How are you retaining stubbles over 4 t/ha?

Lindsay is retaining all stubbles and no longer needs to burn any prior to seeding. Lindsay treats his stubbles with commercially available microbial solutions that break down the crop residues and allow planting without seeders blocking up.

- The first step is to cut the crop (ie a winter cereal) fairly low at harvest. Most recently a John Deere rotary harvester fitted with a straw chopper has been used. Depending on how well this goes I may also need to mow the stubble. The objective is to get the stubble laying flat on the ground.
- Stubbles are then sprayed with a microbial solution. Because I am not double cropping, the stubble has until the following autumn to decompose.
- Microbial solution is fermented in milk vats, strained and then sprayed with a conventional boomspray onto the standing stubble.
- A tyned seeder is used (Agrowdrill) to direct drill all crops. Despite being on 7" row spacings, there is little trouble with trash handling. On occasion a set of Philips rotary harrows has been used to break up stubble further, always with the intention of increasing stubble-soil contact.

Lindsay has good anecdotal evidence that the system works. In one instance a tractor operator missed spraying an area with the microbial solution. During seeding, some months later, the only area where there was a combine blockage was in the unsprayed area.

Are you able to retain every stubble or do some stubbles still need to be burnt? If so why?

- All stubbles are retained however I am not double cropping and mostly focus on winter cereals. Hence there is a greater period for the crop residues to break down.

What benefits have you found?

- Better soil structure and improved moisture holding capacity – no need for cultivation anymore.

What disadvantages have you found?

- None – although there is some farmer and agronomist scepticism of this system.

Are there some issues or barriers we still don't have the answers to?

- Conventionally trained agronomists have barriers to appreciating some parts of the organic/microbial system.

Why aren't other farmers adopting stubble retention?

- It's to do with attitudes and aspirations rather than technical obstacles.

Tony Hamilton "Warili" Forbes, NSW

How are you retaining stubbles over 4t/ha?

- I am still learning to manage large stubble loads and recently changed to a Baldan single disc seeder. Yet to fully test the seeder in heavy stubbles but I feel it should work if the stubble is dry. Row widths have been widened out from 190 mm to 220 mm. This fits in with bay widths and allows more stubble flow.

Are you able to retain every stubble or are there some stubbles you still need to burn? If so why?

- I will keep all dryland stubbles and on irrigation some years will keep stubbles and other years will bale if there is a market. The move to direct drill allows roots/root channels to be retained anyway.

Figure 1. A single disc seeder is central to managing large stubble loads in a direct drilling program at Forbes. Row widths have been widened to fit in with bay widths and allow more stubble flow.

- Will still burn if needed to re-laser bays, or to help reduce resistant ryegrass weed seed burden to some extent.

What benefits have you found?

- Too early to tell yet. It is clear that stubbles need to be retained in dryland cropping for moisture retention reasons.

What disadvantages have you found?

- Hair pinning. Excessively wet under header trails and too dry in rest of area means compromise with sowing timeliness. This can be overcome however with even straw spreading at harvest.

Are there some issues or barriers we still don't have the answers to?

- Hair pinning. Also there could also be more disease potential if stubbles are retained in wetter winter seasons.

Why aren't other farmers adopting stubble retention?

- Lack of suitable machinery, not clearly demonstrated advantage in long term stubble retention. A clear economic advantage needs to be shown for increased adoption.

Comments from other farmers

How are you retaining stubbles over 4 t/ha?

Harvest

- How stubble is handled during the previous harvest operation is critical to successful direct seeding.
- Straw choppers are essential and often these are aftermarket machines that have improved chopping and spreading ability.
- Height of cutting at harvest needs to be balanced with harvest efficiency.

Stubble treatment

- Flattening with a knife roller in summer when stubble is brittle, making sure stubble is laying in the same direction of travel as the proposed sowing operation.

Sowing

- 30 cm row spacings, even on irrigation.
- Double disc system – farm built with wheels spaced to suit tramlining.
- Previously inter-row sowed but have gone away from it. Inter-row sowing does not suit beds.

Figure 2. Good stubble management at Coleambally, showing that a wheat crop can be sown and established successfully in a full maize stubble in the same season.

Irrigation

- Type of irrigation system can influence success. Sprinkler systems are much more flexible. With flood irrigation, more stubble means more moisture is held and so pre irrigation needs to be earlier and watering up runs more risk of waterlogging.

Are you able to retain every stubble or are there some stubbles you still need to burn? If so why?

- Do not need to burn any stubbles
- Can sow canola into a 10 tonne durum stubble.
- Double cropping still relies on quick removal of stubble.

What benefits have you found?

- Better moisture retention.
- Better water infiltration.
- Increased organic matter levels (labile fraction).
- Achieving two tonne wheat grain per megalitre of irrigation water.

What disadvantages have you found?

- Different weed spectrum – more grass weeds such as brome grass.
- Cost in $ and time setting up and modifying machinery and learning a new system.
- If stubbles are removed, compaction issues can be a problem.

Figure 3. On this Yenda property, stubble is retained and breakdown is enhanced by the application of compost, which contains manure, straw, clay and water.

Are there some issues or barriers we still don't have the answers to?

- Main barrier to adoption is the farmer himself – lack of skills or lack of motivation to learn new skills.

Why aren't other farmers adopting stubble retention?

- Fear of change
- Fear of spending money

Success in stubble management

A small and widespread group of farmers was interviewed so, understandably, there was considerable variation in their farming systems. However there were some common themes identified across all farms, not only in the mechanics and challenges of handling large stubble residues but also the reasons that motivated the farmers to retain stubble.

Benefits worth the 'cost'

Perhaps the overriding theme is that the benefits derived from retaining stubbles come at some cost. Some farms certainly incurred large capital costs setting up their system but the main 'cost' was an extra level of management, timeliness and attention to detail required tying the whole system together.

The farmers were motivated to retain stubbles because of perceived soil health benefits (eg increased soil carbon). The main outcome observed from this 'better soil health' was moisture retention. This may have been due to several factors: less evaporation due to increased soil surface shading, reduced surface sealing, better soil structure and increased organic matter.

Interestingly, when asked about the challenges of retaining large stubbles, a number of the farmers cited personal rather than physical constraints. In other words they thought that it was a lack of knowledge combined with apprehension about making major changes and investments rather than a fully quantifiable cost:benefit ratio.

Common features of a successful system

The common practical features of the farming systems handling large stubbles were:

- further processing stubble at or shortly after harvest
- seeding systems with trash handling capability
- suitable rotations.

These three areas are interrelated. The best trash-handling seeder wasn't so important if the stubble had been finely chopped and evenly spread over the width of the harvester track. Likewise if stubble had only been partially chopped, a seeder with wider row spacings and higher frame clearance for improved trash flow may have been the answer.

Intensive rotations that included double cropping placed higher demands on stubble processing and the seeding system. Farms that mainly grew winter crops and were in higher rainfall areas needed less sophisticated stubble handling because residues had more opportunity (time + moisture) to decompose.

Other key points

- Large stubbles in double cropping situations are still a challenge.
- Stubble management systems need to be flexible so that basic agronomy principles (especially establishing plant populations) are not forgotten in the quest to retain stubble.
- Harvesters equipped with stubble choppers and spreaders were highly rated.
- Disc seeders were being used or investigated.
- Guidance systems that allow inter-row sowing can assist but not essential.
- Shorter stature cereal varieties have a valuable role.

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