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Stubble handling machinery

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Farming in Western Australia, and in Australia, has undergone a revolution over the past 15 to 20 years.

Two significant changes have been the cessation of ploughing to kill weeds, that is, the change from discs to tines, and the reduction in tillage through the use of agricultural chemicals. These have been important changes that have had conservation benefits.

However, to handle stubble to best effect, further changes in machinery, newer machinery and combinations of machines will be needed.

In this article, the author discusses current and possible future practices.

There is an underlying belief amongst farmers that they can repair, modify and make do with tillage and seeding implements, but they cannot make do with an old harvester or tractor.

Yet the most fundamental practice of good crop production is to be able to place the seed in the ground in the right location in a timely manner. This cannot be achieved without the appropriate implement. What this implement is will vary, depending upon the soil types, farming systems and erosion hazards faced by a particular crop producer.

The last few statements suggest that stubble handling must be solved by the use of new tillage or seeding implements. This is not entirely true. Implements can be designed and built to seed into the heaviest stubbles imaginable, but they would be costly and for other reasons may not fit the farming system. Instead, stubble handling is an integral part of farming practice.

Stubble management at harvest

Stubble retention

The ideal is to leave a short standing stubble together with chopped-up material evenly spread across the entire paddock surface as a mulch (see Photo 1). To achieve this, the stubble can be cut at the desired height and the material passed through the harvester.

Straw choppers and chaff spreaders can be used to distribute that material as wide as the original cut width. The use of straw spreaders alone reduces the amount material in the header trail, but that may not be enough to avoid problems when spraying for weeds, or direct drilling.

The passage of large amounts of straw through the harvester will slow harvest speed and increase wear. The alternatives are to use a second cutter bar at the required height, or to slash the stubble again, leaving the standing stubble at the desired height.

In Europe, crop producers use stripper fronts that remove only the grain from the standing straw. This leaves full length standing stubble, which must be processed after harvest by slashing or cutting and removal.

All photos except one on page 31 are from John Deere.
Removal of stubble

The proposal to establish straw-based pulp mills in Western Australia is likely to increase grower interest in removing stubble to some predetermined level. The objective now is not to spread, but to concentrate the straw. This can be done in two ways.

- If the heads are stripped or the minimum amount of straw taken, the capacity of the harvester will be increased, there is no energy requirement to chop the straw and there is only the chaff to spread behind the harvester. The use of a second knife behind the platform cutting at the required height will leave the straw where it can be raked into windrows and then baled (see Photo 2).

- A windrow front followed by a baler could eliminate the need for the raking. Windrowing in the appropriate way can bring together 20 m swaths that a round or square baler can handle easily. Or the stubble can be cut low to the required height and the straw left in a prepared windrow that can be baled directly. The harvester merely has to spread the chaff; a straw chopper is not needed.

Stubble handling at seeding

Once the stubble is managed at harvest, herbicide applications can be more uniform. This helps in the reduction of tillage. It also means that designers of tillage and seeding equipment can concentrate more on the preparation of a seed bed and the placement of the seed than handling large amounts of material.

An implement usually blocks when it crosses or tracks along a header trail. Elimination of this header trail by any of the methods mentioned previously may not be a complete solution. However, the dollars invested in managing stubble before the tillage and seeding operation will offer the farmer greater returns in efficiency. An attempt to manage stubble with seeding equipment can compromise its design.

How can we manage stubble at seeding? There are three broad seeding methods: zero tillage, direct drilling and multi-pass systems.

Zero tillage

Zero tillage can be achieved with tined or disc type implements.

Tines are usually fitted with narrow points. If they are used in a heavy pasture stubble or if there is a lot of long straw lying on the ground, the use of coulters in front of the tines can improve trash flow significantly (see Photo 4).

Many Western Australian soils lack strength to hold the plant’s roots in the ground. This bulldozing of material, often on the second or
Photo 3. The John Deere BioMax No-Till Drill module. Notice the large yellow press wheel that helps achieve accurate depth control.

The 45 cm (18-inch) diameter silver disc is mounted at a 7-degree angle to make a furrow. The press wheel that follows the sowing boot presses the seed firmly into the soil, while the last disc, set at an angle, covers the seed. Photo: Pam Burgess, Esperance

Photo 5. Above Right: Discs can handle heavier stubbles than tines and their individual contour following ensures better seed depth.

third rows of the machine, causes blockages with trash levels of only half that on heavier soils where roots are well anchored.

The use of a coulter may cut the straw, but in very soft soils the coulter may only 'hair pin' the material into the ground and the following point will pick it up again. A solution is the use of side bands or a gauge wheel alongside the coulter to trap the straw between the side band and the ground and enhance the cutting capability. Scalloped, waved or bubbled coulters may also help.

The spacing between tines to overcome straw bridging is also important. A wide spacing significantly enhances trash flow, but in the case of wheat may well lead to yield losses.

Wide spacing between tines without wider rows can be achieved with more ranks of tines from front to rear. However, this in turn can be a problem for fore-and-aft depth control. On air

seeds it can also lead to the problem of twinning when turning corners, since the front tines may be tracked for a period by the rearmost tines.

Zero tillage can also be undertaken by disced machines. The triple disc seeder or the single disc seeder, such as the Uni-Drill or John Deere 750 BioMax No-Till Drill (see Photo 3), have excellent trash flow characteristics. Some double disc opener units such as the Great Plains (see Photo 7) also handle stubble. Disc units can also 'hair pin' straw into the ground unless some other means of trapping the straw is attached to the side of the lead disc. This may not happen when a depth control wheel is used alongside the disc.

The rolling elements in the form of the discs can cope with higher trash levels than tined implements (see Photo 5). This means that closer spaced rows and compact design can be maintained with discs. Discs usually need less horsepower to pull them though the soil and their contour-following capability leads to more accurate placement of seed.

However, as an offsetting feature, discs must be much heavier to obtain adequate penetration.

**Direct drilling**

Direct drilling is classed as a one-pass seeding operation that includes simultaneous cultivation.
The types of machine that can be used for this depend upon the soil and trash. In very light sandy soils it may be possible to run a very narrow point through the ground to place the seed and use a rotary harrow behind the implement to pull the weeds out of the disturbed ground. This combination may not be appropriate on heavier soils or where roots are anchored firmly.

Six-row drills should be considered for direct drilling, though a six-row drill is really only a three-row cultivator in conjunction with a three-row seeder. The three cultivating rows of tines can be removed and wider points used on the seeding rows, or narrow points fitted and a rotary harrow used to kill weeds. Halving the number of tines will increase the trash flow.

When air seeders are fitted to cultivators (see Photo 6), today's cultivators are usually a 4-bar pattern, with superior trash handling ability to even a six-row seeder, providing the cultivator tines have not been placed too close to tyres. Farmers who operate seed drills may well consider the use of 4-bar cultivators of equivalent width, coupled with a small mounted or trailed air seeder, to achieve improved trash flow.

The use of wider spaced rows with cultivation can be considered when splitter/spreader boots are used, for example, chisel ploughs. The rough paddock finish could be smoothed with rotary harrows or rolling packers.

If seed depth placement is not as high a priority as handling trash, it is possible to seed with the use of a culti-trash implement, either on a seed drill or as an air seeder rig, or even seed with the use of offset or tandem discs.

**Multi-pass systems**

Some farmers are forced into more than one pass with their machinery because the need to control plant diseases or the soil type requires several passes to create a good seedbed. In this case, they have several choices.

In very heavy stubbles the offset or tandem disc will chop stubble into a reasonable length, with some incorporation into the soil. If incorporation of residue material is undesirable, blade ploughs, chisel ploughs or wide spaced scarifiers can be used to kill weeds with the initial cultivation. In difficult years, when all else fails, the one-way disc plough may be useful.

Once a primary tillage machine has been through the paddock, it is usually easier for a seed drill or air seeder to handle the stubble, providing the machines follow in the same direction of working.

**Conclusion**

There is no best way or one system to manage stubble.

I have outlined the types of machines available to farmers that provide a range of stubble handling methods. Farmers must first recognize the type of cropping system being undertaken as part of their whole farming operation. Only then can they choose the most appropriate stubble management system.

Sustainable agriculture poses a wide array of challenges, of which stubble management is but one ingredient.