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Stubble retention for control of wind erosion

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In Western Australia, the cropping systems most liable to wind erosion are lupin/cereal; field pea/cereals; and canola/cereal rotations.

At least 90 per cent of the Western Australian wheatbelt is vulnerable to wind erosion if the soils are mismanaged. However, the most susceptible areas are the northern and south coastal sandplains. These two areas are constantly under threat of strong winds and drying conditions, which substantially increase the potential for wind erosion.

The lupin/cereal rotation is suited to these light textured soils, which are inherently prone to wind erosion.

Field pea/cereal rotations are generally practised on heavier soils less prone to wind erosion. However, the fragile pea stubble is quickly broken up by grazing sheep and is blown away, leaving the soil bare and prone to wind erosion. Further grazing destabilizes the surface of the soil, which then erodes.

In the case of canola crops, the small seed requires a clean seedbed of fine tilth for best establishment. This requirement makes the lighter soils that are cropped to canola vulnerable to wind erosion.

The economic incentives and social justifications for minimizing wind erosion include:

- Preventing the loss of plant nutrients from the soil
- Preventing sandblasting of emerging crops
- Maintaining seed banks for subsequent pasture regeneration
- Maintaining depth of topsoil
- Preventing off-site damage to crops, pastures, community services (roads, power lines, etc)
- Aesthetics, conservation ethics, maintenance of land values, peer pressure.

However, wind erosion is still a problem in most parts of the wheatbelt and is a constant reminder that cropping practices are yet to be compatible with long term sustainable agriculture. In recognition of the continuing problem, we have focused research on two areas:

- the economic effects of wind erosion on soils and crops, and
- the critical amounts of ground cover needed to control and prevent wind erosion.

The surest way to control wind erosion in continuous cropping systems is to retain stubble.

Over the past ten years, Western Australian research has focused on the amounts of stubble needed to prevent that erosion.

Controlled burning of the header trails or windrows from raking has reduced the amount of stubble in this paddock at Esperance in April 1991. Seeding machinery was not blocked.

There are wind-eroded paddocks in this photo, but the stubble paddocks have not eroded. They are even helping to contain soil from the wind-blown paddocks.
Table 1. Methods used to reduce the amount of stubble in continuously cropped paddocks

<table>
<thead>
<tr>
<th>Practice</th>
<th>Actions involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal grazing</td>
<td>Trampling; grazing (ingestion); weathering</td>
</tr>
<tr>
<td>Active removal</td>
<td>Raking and burning; mowing and baling; total burning</td>
</tr>
<tr>
<td>Grain harvest techniques</td>
<td>Cultivation (burial, chopping); manipulating harvest heights with open headers;</td>
</tr>
<tr>
<td></td>
<td>spreading chaff with Straw Storms®; cutting stubble with second cutter bars</td>
</tr>
</tbody>
</table>

This latter approach was adopted so that stubble handling problems would be minimized.

Stubble retention for control of wind erosion

Research on stubble retention and wind erosion has concentrated on:

- The level of stubble needed to control wind erosion.
- The practicalities of managing stubble with existing or specially modified machinery.

Wind erosion begins on bare soil when the wind speed at the ground surface exceeds 1 km/h, a figure that corresponds to a wind speed of 30 km/h at a standard measuring height of 10 m above the surface.

Stubble reduces erosion by:

- reducing the wind drag on the soil surface
- physically protecting the surface from the impact of blown-in sand
- physically intercepting moving soil particles from the surface.

The amount of stubble present, and whether it is standing or flattened, both influence the amount of protection afforded by stubble. Soil loss can be related to the percentage ground cover. Bare ground can lose 10 times more soil than ground with 50 per cent cover. Increasing the cover to 100 per cent has only a small additional impact on erosion control.

Most stubbles are grazed over summer by sheep. This causes them to be trampled, eaten and knocked out of the ground. The prostrate stubble resulting from grazing will protect the soil surface, but it is prone to being blown away, unless it is anchored, leaving the surface bare and vulnerable to erosion. In wind tunnel tests, we have found that one third of the stubble should be securely anchored if the remaining stubble is not to blow away.

Most Western Australian crops will have stubble levels exceeding the minimum amounts required for control of wind erosion, so in most cases the stubble quantity needs to be reduced before seeding. The different methods used are shown in Table 1.

Each of the methods outlined in Table 1 can reduce the total stubble quantity, but care must be taken to leave at least 50 per cent ground cover. This represents about 750 kg/ha for cereal stubble and 1500 kg/ha for lupin stubble.

The most common method of reducing stubble is grazing by stock, combined with natural weathering of the stubbles. Weathering is greater in areas that receive summer rain.

Whatever methods are used, it is important not to remove more than the minimum cover level (50 per cent) and weights of 750 kg/ha for cereals or 1500 kg/ha for lupins. The best way to assess and manage stubble levels is to use photo-standards to monitor the levels of stubble left in the paddock. See Farmnote 40/90 ‘The amount of stubble needed to prevent wind erosion’.

Retaining stubble after seeding

The stubble levels specified in this article provide adequate protection from wind. Tillage during seedbed preparation will bury a large proportion of the stubble. However, because wind can still erode paddocks after seeding care should be taken to ensure the minimum amounts remain after the sowing of the next crop. Stubble levels before tillage need to be much greater than the minimum amounts stated above.
A vertical view of the quadrat shown in the photo on page 16, indicating the amount of lupin stubble needed to prevent wind erosion.

The short term penalty of soil loss is sandblasting of emerging crops, but the more insidious long term effect is decreasing soil fertility.

Firm guidelines now exist for the amounts of stubble cover needed to minimize wind erosion. Farmers can use photo-standards to determine these amounts. These levels are easily attained by most cereal crops.

Methods of reducing stubbles to levels that can be handled by seeding machinery are available. It is important for wind erosion control after seeding that adequate stubble remains on the surface after partial burial by tillage implements.

Further reading

Conclusions
Stubble retention systems are an essential part of cropping to control wind erosion and ensure the sustainability of farming.

The required amounts of stubble on the surface before cultivation depend on the machinery used. The data in Table 2 show a wide variation between different tillage implements in the proportion of stubble cover each implement will bury.

Ploughs reduce surface stubble cover the most, and so are the least desirable for the control of wind erosion. Even tined implements tend to bury about 25 to 30 per cent of surface stubble cover – so the amount of stubble cover needed must be increased. For an implement that buries about 30 per cent of stubble, the minimum amounts are about 1.0 t/ha for cereal stubble and 2.0 t/ha for lupin stubble.

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