

Maintaining profitability in retained stubble systems on upper Eyre Peninsula

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Guideline 11: Stubble management and weed control

Most growers on upper Eyre Peninsula implement stubble retention and reduced tillage, which has increased soil moisture conservation and improved timeliness of sowing. Retaining cereal stubbles in farming systems has also reduced soil erosion due to lower levels of soil disturbance and higher levels of soil surface cover, especially where livestock are still a major component of the farming system¹.

Retaining cereal stubble can have benefits to farming systems, but there may also be disadvantages. Cereal stubble management can impact on timeliness and cost of harvest, on weed control, soil erosion over summer, soil moisture conservation, nutrient status, frost risk, and pest and disease levels.

This guideline outlines a range of stubble management options for weed control in low rainfall farming systems.

Herbicide efficacy

The activity and weed control from herbicides can be influenced by the presence of stubble by reducing herbicide contact with weeds and binding the chemical to plant residues. The level of binding influences the movement of the herbicide through the soil profile with rainfall events. Soil texture and soil chemical properties can also affect chemical movement and availability in the soil profile².



Whole paddock burning

Weed management considerations

- Herbicide efficacy
- Burning stubble (whole paddock or narrow windrow)
- Chaff dumps
- Seed destruction
- Hay cutting
- Livestock and grazing

At Minnipa, different stubble management options were implemented over three seasons (2015-17). Stubble management did not generally influence herbicide performance, and most herbicides performed better than the nil control on low populations of grass weeds.

Options to increase herbicide activity in paddocks with high stubble loads include increasing chemical and water rates, using nozzles to increase spray coverage, and reducing the height of the spray boom or stubble height so that herbicides reach the soil surface more easily and cover the soil more evenly.

Herbicides are only one tool for weed control; growers should try adopting an integrated weed control package that includes non-chemical control methods such as harvest weed seed collection or hay cutting.

Weed management

Managing grass weeds and herbicide resistance may influence stubble management. Burning stubble for weed management is an option growers are currently implementing³, mainly for ryegrass management, especially when harvesting residues into narrow windrows, which are subsequently burnt. Not all weed seeds are captured at harvest due to low weed height resulting in weeds going under the harvester knife, weed seed heads breaking and stems falling over, and the shedding of weed seeds before harvest (especially for barley grass), so an integrated weed management approach is still required. Narrow windrow burning has been widely

adopted as a weed management tool in the SA/Vic Mallee region³. Other weed management options for stubble at harvest are using chaff carts for chaff and weed seed collection, which provides a valuable livestock feed option; harvest weed seed destructors, or baling hay or the stubble.

Whole paddock burning

Burning a whole paddock of cereal stubble is an option if the grass weed burden is very high, snails are an issue, or high stubble borne disease inoculum levels were present the previous season and the paddock is being cropped to another cereal.

Check your local council recommendations for broad acre burning. A suitable firebreak is essential (tilled around the paddock perimeter). Only burn during the fire season or obtain a permit. Ensure appropriate fire safety precautions are taken such as having a fire cart with the recommended amount of water, and extra people as required. Cool calm conditions are essential⁴.

On the day before you plan to burn access MetEye™ weather, on the Bureau of Meteorology website for the forecast and warnings for your local area – www.bom.gov.au/australia/meteye/. This will provide the weather conditions to expect in the coming two days. If the weather is forecast to be unfavourable for the day of your planned burn or the day after, the burn should be postponed until more favourable conditions are forecast. Wind speed is an important factor influencing a broad acre burn. Light winds, around 10-18 km/h, produce a consistent and complete burn with the fire being easier to control⁴.

Narrow windrow burning

With a narrow windrow burn ensure the same safety factors as a whole paddock burn. However cooler, calmer conditions with a light cross wind, around 10-18 km/h are required to achieve a successful windrow burn. Ensure a tilled or bare earth fire break is in place around the paddock perimeter. If the first two windrows are harvested around the outside of the paddock, burn these first as an extra firebreak. Light the windrows approximately every 200 m with extra people downwind to monitor the fire⁴.



Narrow windrow burning

If using narrow windrow burning for weed management, some issues to consider are;

- The cost is \$300-400 to fit windrow boards onto the choppers.
- Cut stubble low - 'beer can height' (15 cm) for over the windrows and even lower for the rest of the paddock.
- Ideally the windrows should be 500-600 mm wide.
- Timeliness of burning – as soon as possible when safe conditions occur in Autumn.
- Ideally burn with a light cross wind of 10-18 km/h.
- Have a tilled or worked firebreak.
- Harvest first two laps around paddock and burn these windrows first as an extra fire break.
- The slower the windrow burn, the longer the weed seeds will be exposed to higher temperatures.
- If windrows get summer rainfall, leave 2 to 3 weeks to dry out to achieve temperatures of greater than 400°C for 10 seconds for ryegrass weed seed kill⁵.
- Break crops (canola and lupins) will tend to burn hotter than cereal windrows. The windrows tend to act as a summer haven for snails, so a reduction in snail numbers may also be a benefit.
- Wheat varieties vary in the amount of chaff produced into windrows, and barley is hardest for containing burning to windrows due to greater stubble loads.
- Burning stubble will result in a loss of nutrients especially nitrogen, and some phosphorus, potassium and sulphur (Table 1).

Table 1: Nutrient content in stubble and % nutrient loss from burning⁵

Nutrient	Amount of nutrients in one tonne of cereal stubble (kg/ha)	Loss from hot burn (%)
N	5	82
P	0.5	44
S	0.5	80
K	10	40

Chaff dumps

Chaff dumps are towed behind the header and are a method of concentrating chaff and weed seeds from the header into a smaller area. The dumps are a potential source of feed for livestock. The dumps may have to be burnt depending on the time period between cropping rotations. Burning chaff dumps will be a longer process, over several days, so monitoring the burn area is essential during this time. Ensure a tilled or bare earth fire break is in place around the paddock perimeter and weather conditions are favorable for several days. Light and monitor one dump initially for burning conditions. Do not light more dumps than resources permit or people are available to monitor⁴.



Chaff dumps

Weed seed destruction

Harvest weed seed destructors or hydraulically driven cage mills are fitted to the header, and this technology enables a single-pass harvest operation without the need for chaff carts, windrowing or burning. Therefore it provides a great option in continuous cropping systems as it prevents the vast majority of weed seeds from entering the seedbank, and returns organic residue back to the soil that would otherwise have been lost to burning⁷. The Australian Herbicide Resistance Initiative (AHRI) has determined that the mills can destroy 93 to 99% of the weed seeds that enter them⁸. However as with other harvest-weed-seed management strategies, not all weed seeds are captured at harvest so an integrated weed management approach will still be required⁷.

For those with livestock, mills will pulverize not only weed seeds but also crop seeds, which will reduce the feed available to livestock grazing stubbles. It is also more difficult to assess harvest losses by observing crop seeds on the ground and/or using a tray thrown under the rear of the harvester to assess rotor losses⁸. Weed seed mills are an additional cost to the farming system, which need to be compared with the potential benefits to determine if they are suitable for your farming system.

Hay cutting

Cutting grassy paddocks for hay or baling straw may be a stubble management option to lower grass weed seed banks. Hay cutting before weed seeds mature will have greater weed seed bank reduction than baling straw after harvesting. The paddock may need another chemical grass weed control after removing the hay from the paddock to control late grass weeds and possible regrowth.

Livestock and grazing

The primary source of feed in stubbles is grain left behind from harvest⁹. Maintaining weight in livestock requires about 0.6 kg grain per dry sheep equivalent (DSE) per day and therefore 100 kg/ha of grain in the paddock would provide 100 DSE grazing days per hectare (assuming the last 40 kg/ha of grain is not utilized). Non-toxic summer weeds and volunteer cereals can also be a valuable source of feed in stubble paddocks. However research has shown that controlling summer weeds early, to conserve soil moisture rather than relying on grazing for summer weed control will provide greater benefits through increased grain yields in the following season. Table 2 shows that soil water, soil nitrogen and grain yields were all reduced when grazing alone was used to control weeds over summer at Condobolin in 2012⁹.

Summer weeds can also impede crop emergence¹⁰. Moderate to heavy uncontrolled weed growth can result in reduced crop emergence in minimum tillage systems due to an impenetrable layer of residues left on the soil surface. Wireweed for example, has long tough and wiry stems which can get caught in the tines at seeding.

Some weeds are allelopathic, which means that toxic substances are released directly from their roots, or during the decomposition of their residues. These toxic substances can inhibit subsequent germination of the crop. Allelopathic weeds (such as caltrop)

Table 2: Impact of grazing and summer weed control at Condobolin (NSW) in 2012. Source: Farmlink Manual 2012⁹

Summer stubble treatment	Stubble remaining after summer grazing (t/ha)	Fallow water storage (mm)	Mineral N at sowing (kg/ha)	Following year grain yield (t/ha)
Nil graze + herbicide	3.3	96	90	1.72
Heavy graze + herbicide	1.2	99	85	1.84
Heavy graze - herbicide	1.2	74	87	1.49

reduced subsequent wheat emergence by as much as 25% due to the chemicals that were exuded from the roots¹⁰.

Summer weed control can be expensive but is necessary to prevent problems with excessive growth and/or moisture and nitrogen loss from the soil. When using herbicides in summer¹⁰:

- Glyphosate, 2,4-D, metsulfuron, atrazine and triclopyr are the most common herbicides used for summer weed control. Where summer grasses are present, glyphosate at rates around 1.5-2 L/ha are generally required.
- Water rates should be kept high (at least 50-60 L/ha) and a surfactant should be used.
- Spray grazing can be effective at high stocking rates. 2,4-D controls a wide range of broadleaved weeds and is preferred if stock are available for spray grazing. The ester formulations are usually more effective for summer weed control because they are oil soluble and more able to penetrate the waxy surfaces or stubble. Moisture stress in weeds is

common in summer and reduces the effectiveness on most herbicides. This can be partially overcome by spraying early in the morning. However at this time of day, inversions may be present which could lead to excessive drift. Avoid spraying during still conditions.

At Minnipa the impact of livestock on paddock health in low rainfall farming systems has been assessed over nine seasons. The stubble management systems have been the same, but one system is grazed over summer and during the pasture phase. The benefits in the grazed treatments included fewer summer weeds (less spraying required), reduced snail numbers and the added benefit of value-adding to stubbles by grazing. Grazing at the rates imposed has not detrimentally reduced groundcover nor increased erosion potential. In a low rainfall mixed farming system livestock can help better manage the economic impacts of seasonal variability¹¹.

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