Key Points:

- ⇒ Planning required to ensure fallow activities are done correctly and don't impact on seeding process
- ⇒ Management will be strongly influenced by other factors including weed, pest and disease burdens
- ⇒ In high rainfall environments, under high stubble loads and moist soil conditions, additional N may be beneficial in encouraging breakdown of the stubble

Fallow Management in Retained Stubble Systems

Background

Reflecting grain yields, large stubble loads are often present immediately post-harvest[1]. Depending on the harvest process, including harvest height and remaining stubble, the management of the stubble over the fallow period can influence the following seasons seeding. Cereal crops and bean stubbles (particularly broad bean stubbles) can provide challenges at seeding time. The inability to seed through heavy stubble due to machinery blockages can result in growers burning stubble to allow the seeding process to occur in a timely manner.

Management during the autumn period and pre-seeding can assist in reducing problematic stubble loads. The management techniques employed can depend on weather conditions (if summer rainfall is present), pest pressures[2], weed management[3,4] and potential disease burden[5] of the stubble.

Management depends on the individual farming system. Soil type and the machinery system available to the farmer at the key stages - harvest, seeding and during the fallow period all influence fallow management. In some situations, full stubble removal can be a good agronomic option however, it does carry an increased risk of erosion and can impact on soil moisture retention during the fallow period. Removal of stubble through burning can have these negative impacts, with the added risk of fire escapes.

Introduction

This guideline has been developed for the MacKillop Farm Management Group (MFMG) as part of the project "Maintaining Profitable Farming Systems with Retained Stubble in the South-East and KI regions", funded by the Grains Research and Development Corporation (GRDC) as part of the Stubble Initiative.

The Stubble Initiative involves farming systems groups in South Australia, Victoria, southern and central New South Wales and Tasmania, collaborating with research organisations and agribusiness to address challenges associated with stubble retention, including weeds, pests, disease, nutrition and the physical aspects of managing stubble.

Recently and during the GRDC Stubble Initiative, speedtillers have become one popular technology, incorporating stubbles into the soil with the aim of promoting faster decomposition of retained stubble. There has been a focus on evaluating the outcomes of the use of speedtillers in higher rainfall environments to determine if incorporating stubble into the soil resulted in nutrient tie-up, and if there are any additional weed and pest control benefits.

Standing Stubbles

The aim of a disc seeder is to leave stubble standing upright with minimal trash on the ground to ensure ease of subsequent seeding[6]. Activities that increase the level of stubble on the ground such as grazing, rolling or cabling need to be avoided for paddocks planned for disc seeding equipment.

To reduce stubble loads in disc seeding systems, narrow windrow burning or baling can be used with minimal impact on the surface trash. Narrow windrow burning can also assist in snail control; snails use the windrow as a refuge over the summer period, the caveat being that the windrows need to be burnt prior to increased snail activity, where snails will move out of the refuge which is not always achievable.

Narrow Windrows

Narrow windrows which can be either burnt or baled are created during the harvest process. The creation of narrow windrows is most effective when a windrow chute is fitted. The windrow chute directs the chaff and straw into a narrow windrow that can then be managed later.

Narrow windrow baling

If narrow windrow baling options are being used to capture harvest weed seeds, baling needs to occur as soon as possible after harvest. This is because weed seeds can quickly settle to the bottom of the windrow. If the windrows are not baled immediately post-harvest this technique will not be as effective in removing weed seeds as narrow windrow burning. Work conducted at Furner (2015) found that windrow burning resulted in approximately 10 % improvement in weed control over baling residue 24 hours post-harvest.[7]

If harvesting crops high (i.e. 40 cm) for harvester efficiency, windrowing of stubbles post-harvest followed by baling is one method to remove or manage stubble loads. This method does come at additional financial and time costs, and the viability will depend on the economics of producing straw which is highly variable across seasons.

Narrow windrow burning

Narrow windrow burning (NWB) is best suited to canola crops where the stubble load is lower and fire escapes are less likely. However, it can successfully be conducted where wheat stubble loads are up to 5 t/ha providing there has been good preparation at harvest (particularly the harvesting of stubbles low (approx. 15 cm high). NWB should generally be avoided for heavy barley stubbles as they have much greater residual leaf area and the potential for fire escapes is much greater. Grazing of the windrows before burning can spread the stubble and consequently increase the potential for the fire to escape (Fig. 1).

Figure 1. Narrow wind burning of wheat (6T/ha stubble load) stubble fire escape at Furner (2015).

The ideal soil surface temperature of a fire to successfully kill Annual Ryegrass (ARG) seeds is 400 °C or hotter for at least 10 seconds[8]. This same temperature maintained for 30 seconds will ensure the destruction of wild radish seeds. Alternatively a hotter fire of at least 500 °C for greater than 10 seconds will also control radish seeds[8].
Refer to the GRDC publication "Nuts and bolts of efficient and effective windrow burning"[8] for further information on windrow burning.

Grazing

Livestock can be very effective in reducing stubble load through grazing and trampling the stubble. Trampling of stubble onto the soil surface may increase the rate of stubble breakdown. Mineralisation rates of remaining stubbles will increase through livestock consuming and excreting urine or faeces onto the soil. Livestock can assist in weed and pest management with hooves knocking snails onto hot soil surfaces. Livestock may also graze summer weeds, however care should be taken with potentially toxic species such as potato weed. It is important not to overgraze retained stubble, aiming for 50-70 % groundcover and an amount of at least 3 t/ha to ensure soil mineralisation activities are not affected. This is of particular importance on sandier soils, such as those in the upper South-East where the prevention of soil erosion and the conversation of water infiltration and soil moisture are important.

Mechanical

Slashing

Slashing the stubble and leaving it on the soil surface should only be done if it is done immediately post-harvest to give the residue time to break down. Slashing immediately after harvest allows stubble to have increased soil contact providing a greater time for stubble breakdown and mineralisation.

Cabling and Rolling

Cabling and rolling are commonly used over summer periods to "knock" snails off the stubble as part of the 'Bash 'Em, Bait 'Em, Burn 'Em'[9] strategy. This can be successful if soil temperatures are hot enough[2]. These activities will however leave more stubble laying on the soil surface which may affect ease of seeding. Figure 2 (a-d) shows the amount of residue that remains on the surface after rolling compared to other techniques. If rolling occurs early enough it can place more stubble on the soil surface and if moisture is present, this may facilitate stubble breakdown.

Mulching and Incorporation

Mulching with the use of a disc or speedtiller has increased in popularity. These technologies allow growers to maintain heavy stubbles while minimising the issues associated with seeding into heavy stubbles. This process involves shallow incorporation of the stubble to promote faster decomposition of the stubble.

When incorporating large amounts of stubble, additional rates of nutrients - particularly nitrogen may be required to assist soil microbes in breaking down stubbles as part of the mineralisation process and to avoid early crop nutrition deficits.

(a) Standing Stubble (b) Rolled Stubble

(c) Chained Stubble (d) Cultivated Stubble

Figure 2. 70 % groundcover after various treatments (Source: MSF Stubble Management Guide[10])

Figure 3. Applying incorporation treatments at Hatherleigh (2017)

Work completed at Hatherleigh (2017) showed an increase in subsequent canola yield in a retained wheat stubble harvested high and incorporated with the addition of nutrients targeting 30 % humification when compared to a standing stubble that wasn't incorporated. The humification rate required was determined based on the nutrient analysis and load of the stubble prior to incorporation. This data was entered into a humification calculator developed by CSIRO[11] and the nutrient application requirement for 20% and 30% humification of this stubble is shown below in Table 2. There was no difference measured in canola crop establishment between treatments.

Table 2. Nutrients required for humification at Hatherleigh, 2017

(a) 20 % humifcation

Stubble Humification Calculator					
Stubble load (t/ha)	10				
Humification required (%)	20				
Stubble nutrient concentration (%)		C	N	P	S
		45.0	0.700	0.077	0.089
Extra nutrients required (kg/ha)			7.0	1.5	2.8
Fertiliser type 1	Urea		46.0	0.0	0.0
	Single super			8.8	11.0
Quantity of fertiliser to supply exact nutrients (kg/ha)			15	17	25
Fertiliser cost ($/ha)			$16.6		
Fertiliser and spreading cost ($/ha)			$25.1		

(b) 30 % humification

Stubble Humification Calculator					
Stubble load (t/ha)	10				
Humification required (%)	30				
Stubble nutrient concentration (%)		C	N	P	S
		45.0	0.700	0.077	0.089
Extra nutrients required (kg/ha)			45.4	6.1	8.7
Fertiliser type 1	Urea		46.0	0.0	0.0
	Single super			8.8	11.0
Quantity of fertiliser to supply exact nutrients (kg/ha)			99	69	79
Fertiliser cost ($/ha)			$77.9		
Fertiliser and spreading cost ($/ha)			$86.4		

Effect of Fallow Management on other key aspects of Stubble Management

Nutrient management

The retention of stubble maintains nutrients in the system that would otherwise be lost with total stubble removal. Table 3 shows the amount of nutrient that may be removed with total removal of stubble.

Table 3. Nutrients removed (kg/ha) with total stubble removal[12]

	Stubble Type	
Nutrient (kg/ha)	4T Wheat	3T Canola
Nitrogen	20	12
Phosphorous	2	9
Potassium	60	75
Sulphur	2	3

Pest and weed control

Activities during the fallow period will have an impact on pest and weed control in the following crop. This is particularly important with regards to snail and slug management and the application of pre-emergent herbicides.

These issues are important consideration in the management of stubbles during the fallow period and are discussed further in the Stubble Initiative Pest Management, Weed Management and Herbicide Application guidelines.

Figure 4. Snails on canola stubble prior to fallow treatments

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Further Information

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