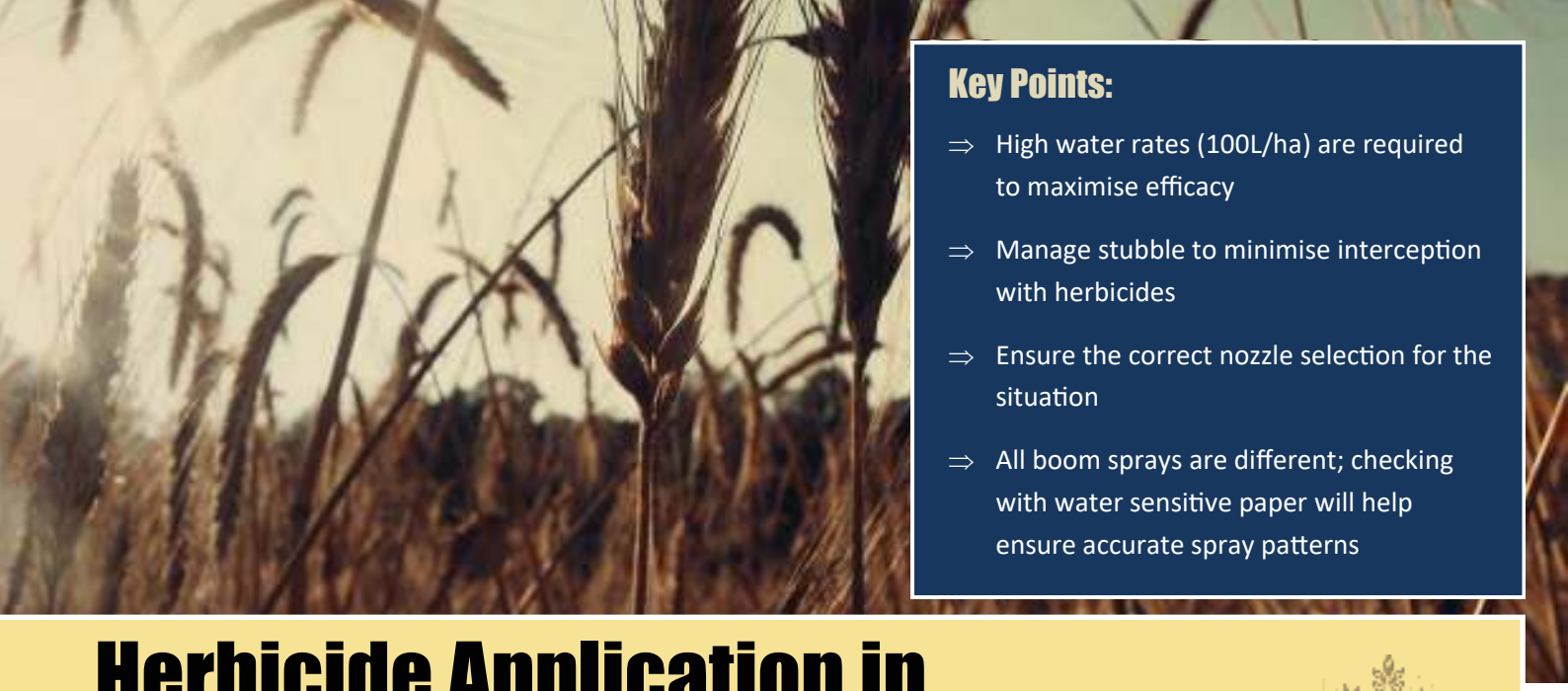


Key Points:

- ⇒ High water rates (100L/ha) are required to maximise efficacy
- ⇒ Manage stubble to minimise interception with herbicides
- ⇒ Ensure the correct nozzle selection for the situation
- ⇒ All boom sprays are different; checking with water sensitive paper will help ensure accurate spray patterns

Herbicide Application in Retained Stubble Systems

Background

Weed control continues to provide challenges for growers in retained stubble systems. Recent resistance testing has shown a large increase in herbicide resistance in annual ryegrass (ARG) to post-emergent weed control options[1]. It is becoming increasingly important to implement strategies to prolong the life of 'newer' pre-emergent chemistries.

Weed control is a numbers game[2] and ensuring effective herbicide application to achieve high level of control of weeds during the fallow period and effective pre-emergent control is essential in managing weed numbers. While these two activities (knockdown and pre-emergent spraying) are often conducted together, the spray outcomes required are very different. It is about finding the "sweet spot" – a compromise to maximise the coverage on the weeds whilst getting as much pre-emergent herbicide on the ground to provide residual control in crop.

Minimising the level of stubble interception is the most critical point in maximising efficacy of herbicides in retained stubble systems. Managing the stubble at harvest and over the fallow period[3] to achieve a low (15 cm) stubble height with minimal thatch on the ground creates the most favourable conditions for pre-emergent and knockdown herbicide application. Seeding machinery[4], herbicide selection, timing of application and environmental conditions (moisture stress, dust on leaves and / or frost) are all factors that need to be taken into account when spraying into stubble.

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.

A key factor in obtaining effective herbicide application is understanding where the spray is being deposited and why. Often small adjustments to the boom spray or application technique can result in large improvements to the level of spray deposition and effectiveness of the application.

Product Selection

The presence of stubble in retained stubble systems acts as a physical barrier that can affect the level of contact of herbicides on the target. With pre-emergent herbicides, the target is the soil, and although there are variations in the different solubilities of different pre-emergents (Table 1), they still need to be deposited on the soil to be effective. The water solubility influences how far the herbicide will move in the soil profile in response to rainfall events. Herbicides with very low water solubility (e.g. Trifluralin) are unlikely to move far from where they are applied. Herbicides with high solubility such as Triasulfuron are at greater risk of being moved into the crop seed row by rainfall and potentially causing crop damage.

Table 1. Pre-emergent herbicides and some of their characteristics (Preston 2015[5]).

Herbicide	Common Trade Name	Water Solubility		Soil Sorption		Degradation half-life
		mg L-1 (at 20 C and neutral pH)	Rating	mL g-1 (in typical neutral soils)	Rating	(days)
Trifluralin	Triflur X	0.22	Very low	15,800	Very high	181
Pendimethalin	Stomp	0.33	Very low	17,800	Very high	90
Pyroxasulfone	Sakura	3.5	Low	223	Medium	22
Triallate	Avadex	4	Low	3,000	High	82
Prosulfocarb	Boxer Gold	13	Low	2,000	High	12
Atrazine	Atrazine	30	Medium	100	Medium	75
Diuron	Diuron	36	Medium	813	High	76
S-metolachlor	Dual Gold	480	High	200	Medium	15
Triasulfuron	Logran	815	High	60	Low	23
Chlorsulfuron	Glean	12,500	Very high	40	Low	160

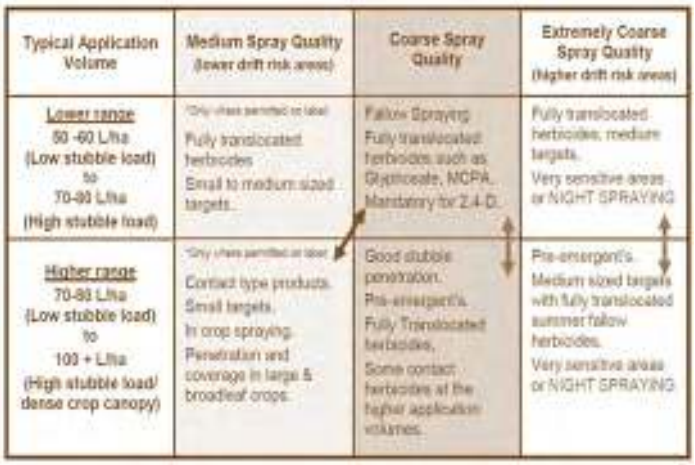
Herbicides with greater water solubility typically need less soil moisture to be activated for absorption by the germinating seed. However, other soil factors, such as pH and soil organic matter, can have a major effect on herbicide availability.

Soil sorption indicates how the herbicide binds to clay components or organic matter (e.g. stubble). The less soluble the more likely the herbicide is to bind to organic matter and therefore less herbicide will be available to move into the soil solution.

Knockdown herbicides need to contact the plant to be effective. Chemistries with different modes of action vary in the quantity of product that needs to be deposited on the leaf and therefore these modes of action have different application requirements. Contact herbicides (e.g. Paraquat and Diquat products) require a larger amount of chemical being deposited on the leaf when compared with translocated herbicides (eg. Glyphosate).

Table 2 shows suggested spray quality required under these different herbicide regimes.

Table 2. Recommended spray quality for different herbicides at varying stubble loads (B.Gordon[7])



Understanding where the product is making contact and where the losses are occurring is critical in ensuring effective fallow and pre-emergent herbicide application. The use of water sensitive paper is the most effective way to quickly understand how the sprayer is working and where and how the product is being deposited (Figure 1). Once the spray pattern and level of contact and deposition is understood, adjustments to the sprayer setup can be easily made to improve the deposition on the target area.

To use water sensitive paper, place one sheet on each side of the boom spray (horizontally underneath the wing span) and mount one on a stand or attach one to some stubble vertically in the centre of the span. The paper on the horizontal will show the deposition of chemical on the ground and the vertical paper will show the level of contact achieved on the plants where a knockdown is required.

Figure 1. Water sensitive paper

Sprayer Setup

The key factors that may be affecting the spray pattern and level of deposition may include;

⇒ **Droplet size**
The higher the stubble load, the coarser the spray quality required / the larger the droplet size required. This will however have a direct negative impact on the number of droplet

⇒ **Number of droplets**
Larger droplets usually require greater application volumes (greater than 80 L/ha) to ensure uniformity of the deposit.

⇒ **Height of target**
In retained stubble systems, the stubble height becomes the target height, so ensure that the boom is set at a height that will achieve double overlap above the stubble height.

⇒ **Canopy penetration and stubble density**
If stubble is standing erect, or fallen on the ground/thick chaff it will have an effect on the penetration of herbicide that is achieved

⇒ **Target size, orientation and leaf size of weeds**
Larger, broadleaf weeds sitting prostrate on the ground are often easier to contact with the knockdown herbicide when compared to small, fine-leaf grasses that are upright.

Local trial work conducted across the South-East region in 2014 and 2015 has found that higher water rates (100L/ha) consistently resulted in improved levels of weed control by the pre-emergent herbicides when applied in retained cereal stubbles.

At Sherwood in 2014 (Figure 2), the efficacy of Sakura on ARG control increased with increasing water application rates when compared to the untreated control.

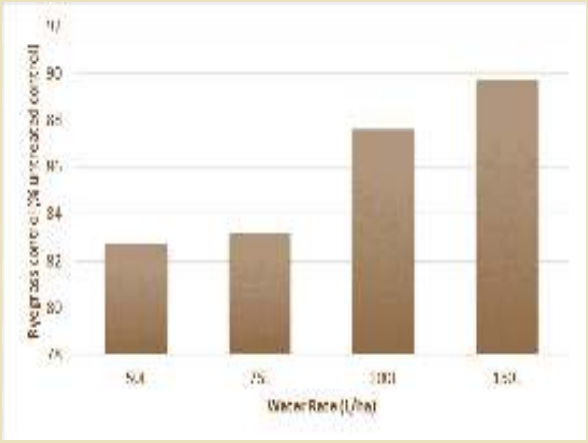


Figure 2. Effect of increasing water rate with Sakura on (% ARG control). Sherwood, 2014.

Similar results were received at Wolseley in 2015 under different season conditions. ARG control increased with increasing water rates of Sakura.

Improving deposition in retained stubble systems

In stubble systems, there are a few other tips and tools that may be useful for assisting with deposition and providing adequate coverage. These were discussed by Bill Campbell (Farmanco[6]) at workshops held across the South-East and on Kangaroo Island in 2016.

1. **Minimise stubble interception**
   Harvest low if you have a tyne seeder and harvest high if you have a disc seeder but ensure residues are spread evenly across the swath width. Avoid/limit grazing of tall stubble to minimise lodging potential. Speedtillers or disc chains may be an option to mulch stubble so that maximum soil contact can be achieved
2. **Cross wind**
   Wind direction is a big factor affecting deposition onto the soil.
3. **Nozzle selection**
   Use nozzles at the smaller end of the coarse spectrum
4. **Nozzle spacing**
   Narrower nozzle spacing (25cm spacings instead of 50cm)
5. **Rates**
   Increase product and water rates
6. **Sprayer boom**
   Optimising boom height (but must be at least double the overlap)
7. **Travel speed**
   Reduce travel speeds

The importance of minimising stubble interception on weed control has been highlighted at a long-term trial at Frances in the South-East. The site evaluated different stubble treatments. The treatments included hay, burning, high standing stubble height (and grazed), stubble disced in and stubble slashed during the fallow period with the trash remaining on the surface. The weed populations have been monitored throughout the duration of the trial. Figure 5 shows the 2015 ryegrass plant populations across the site and the negative impact on weed control of having a thatch on the ground (in the slashed treatment - Figure 5).

Figure 3. Bill Campbell showing nozzle pressure at Furner, 2016

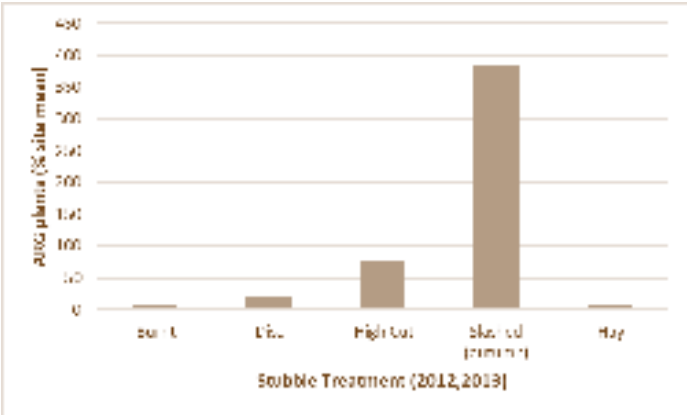


Figure 4. Annual ryegrass plant populations (% site mean), 2 years after application of stubble treatments at Frances in 2015.

Figure 5. Slashed treatment at Frances showing the trash laying at the surface.

Water quality

Understanding the quality of water you are using, the potential issues with the water and how to alleviate these issues will all help to improve the efficacy of herbicide applications.

In the South-East it is really important to know the quality of all water sources being used on the farm as water quality can vary greatly between bores.

On Kangaroo Island, growers should be aware of the potential impacts of spraying with dam water - particularly the turbidity with herbicides that are prone to binding with clay particles such as paraquat and diquat.

Key things to look out for when sampling water include:

⇒ Total Dissolved Salts
⇒ Water hardness
⇒ pH
⇒ Salinity

Case Study

Chad Makin farms with his wife Kylie and father Kym at Keith in the Upper South-East. They run a mixed farming operation across their 1260 ha with around 40 % of the farm going into annual crops and 60 % into pasture or feed for their livestock operation.

In 2016, Chad attended the Bill Campbell spray workshop at Cockatoo Downs. He found the day very informative, reinforcing a lot of what they were doing, as well as providing some reminders about sprayer set up that should not be overlooked.

"Annual ryegrass is a key weed on the farm. About five years ago we changed the sprayer from coarse droplets back to fine nozzles to try and improve the spray coverage. This has been effective in improving control, but we have had to be more aware of spray drift. At least we know we are on the right track."

Good sprayer maintenance and regularly checking the pressure gauge at both the front of the sprayer and also at the manifold before the spray lines has now become a priority to ensure that good, even coverage of pre-emergent herbicide occurs.

Figure 6. Kym and Chad Makin, Keith (2018)

The key change that Chad made after the workshop was to improve the way that he managed his spray water quality. The bore water that had been used for spraying was very salty and in recent times, they had noticed issues with the efficacy of their dry flowable (DF) herbicides.

"Since learning about the impact of water quality on herbicide activity, we have changed over to rainwater when spraying DF's and have noticed a significant increase in weed control - particularly in our legume crops. The improved pre-emergent control has reduced the pressure on the post-emergent applications and is helping with the management of herbicide resistance on the farm.

Acknowledgements

- Bill Campbell Farmanco, Western Australia. Bill ran a series of workshops in 2016 and much of this information was derived from his presentation.
- Andrew Ware, Amanda Pearce and SARDI New Variety Agronomy Team, Struan
- Jenny Stanton, Keith Bolto, AgKI

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Further Information

Guideline produced by Felicity Turner for the MFMG

fturner@mackillopgroup.com.au

www.mackillopgroup.com.au

www.agki.com.au