WEEDS IN COASTAL GRAIN FARMING SYSTEMS FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

NORTHERN REGION
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High rainfall, rapid weed growth, limited spraying opportunities and diversity of cropping, soil type and land use presents unique challenges for weed management in coastal farming systems.

Coastal farming systems can be diverse, with many unique challenges.

KEY POINTS

- The farming system employed dictates weeds present
- Weed control in the next crop starts with management decisions in the current crop
- Utilise all available weed management tactics to drive down the weed seedbank
- Residual herbicides and crop competition are the critical foundation of weed management systems
- Utilise post-emergent herbicides, inter-row cultivation and chipping to clean up escapes

Photo: Mark Congreve

Farming systems dictate weed species present

Weed species that are well adapted to the farming system being practiced will dominate over time. For example, constantly wet areas of a paddock or farm are likely to host species adapted to waterlogged soils (for example sedges, reeds, paspalum, barnyard grass, torpedo grass, sesbania and aquatic broadleafs). If drainage is improved, these species may reduce over time.

Farming systems with regular cultivation will mix weed seed to the depth of cultivation and therefore often favour weeds that can emerge from depth (for example often larger seeded species such as wild oats, sesbania, Johnson grass). Weeds that are spread by rhizomes or tubers can be particularly problematic as the cultivation assists their dispersal (for example Johnson grass, torpedo grass, nut grass).

Conversely, in a no-till system, weeds well adapted to surface germination will become dominant (for example feathertop Rhodes grass, barnyard grass, fleabane, sowthistle). These surface-germinating weeds often produce very large volumes of small seeds that are suitable for wind and surface-water dispersal. Moving to a no-till farming system where glyphosate is regularly applied, will over time also reduce problem weeds like nut grass.

In green cane trash blanket systems, the heavy layer of crop residue usually reduces the frequency of grasses and other small-seeded surface germinators that cannot emerge through the trash blanket. However these systems can often become dominated by vines.

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Objectives of weed control

Weeds aggressively compete with the crop for nutrients and soil water. The immediate objective of weed control is to provide a non-competitive environment for the crop to establish, which ultimately protects potential yield.

Many coastal crops such as soybean, mungbean and winter cereals can provide excellent weed suppression after canopy row-closure. Weed control objectives in these crops should include ensuring weeds are well controlled in the preceding fallow; planting into a weed-free situation and keeping the crop free of weeds for approximately 6 to 10 weeks after sowing until at least canopy row-closure. Typically this requires a combination of pre and post-emergent herbicides and potentially cultivation.

Crops such as sorghum or maize grown on wide-row/skip row configurations do not provide the same level of crop competition, with higher levels of weed escapes expected as a result.

The longer-term objective of weed control programs should be to reduce the weed seedbank in the soil over time. Substantially reducing the weed seedbank provides greater cropping flexibility.

The small seeds of many surface-germinating weed species typically do not have viability for more than 1 to 3 years when left on the soil surface. Prevention of any new seed set can rapidly drive down seedbanks of these species.

Weeds that have their seeds in pods, or those with hard seed coats, typically have longer seedbank persistence. It takes more years with no new weed seed set to effectively reduce the seedbank of these weed species.

In general, burying seeds via cultivation increases seedbank persistence for most species.

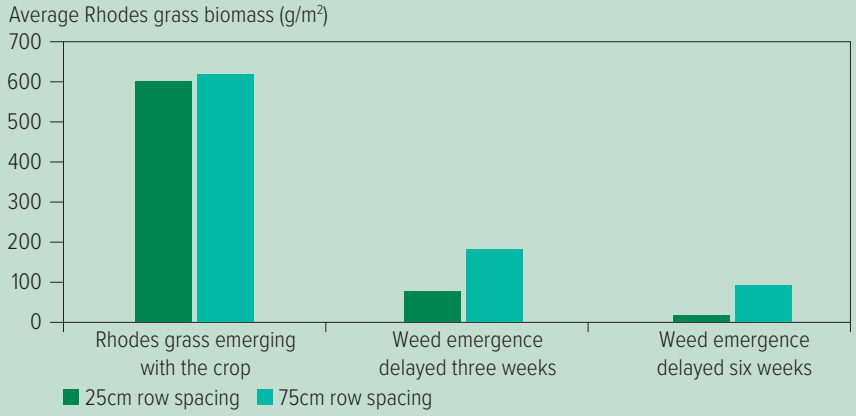
The concept of reducing the seedbank of short persistence, surface-germinating weeds such as fleabane and feathertop Rhodes grass is generally most effective where growers have a commitment to no-till farming for more than five years and a mentality to 'do whatever it takes' to avoid any weeds setting set. This includes complete control both in crops and fallow.

Strategies to eliminate weed seedbank can be more difficult to implement in coastal farming systems where weeds are constantly emerging; cultivation is often a regular part of the farming system; and/or climatic conditions or other on-farm and off-farm activities may disrupt the timely application of herbicides or other weed management techniques.

CROP COMPETITION

Competition is a highly valuable weed control technique that is often underrated. Narrowing row spacing typically provides strong correlation with reduced biomass and weed seed set in most crops (see Figure 1). In some situations, increasing plant population within the row may also be of additional benefit. Ensure plant stands are even. Gaps in the crop are likely to become overrun with weeds.

Figure 1: Rhodes grass biomass in soybean (Average 2 years; 2015 and 2016. Gatton, Queensland).



Source: Adapted from Rasool et. al. (2017) https://doi.org/10.1071/CP17229

Delaying weed establishment by at least three weeks resulted in >70 per cent reduction in weed biomass (in the absence of any herbicides), with narrow rows (25cm) being more beneficial than wide rows (75cm). In commercial situations, growers typically apply residual herbicides to achieve a 4 to 6 week 'weed-free' period, until the benefits of crop competition can take over.

Photo: Mark Congreve

Uncontrolled vines in summer pulses can disrupt harvest. There are limited post-emergent herbicide options in these crops, so control of vines in the preceding crop is a priority.

Setting up for effective weed control

Weed control strategies for the next crop start with decisions made in the current crop.

When considering herbicide selection, be mindful of the next crop to be planted

in that paddock and select herbicides with re-cropping intervals that suit the following crop. As an example, the labelled plant-back period to soybean and mungbean is 24 months following application of either amicarbazone (Amitron®) or hexazinone + imazapic (Bobcat® i-MAXX) in sugarcane; or 18 months following high application rates of atrazine used in crops such as sorghum, maize or sugarcane. Conversely plant-back periods of up to 27 months apply for some following crops where imazethapyr (Spinnaker®) has been used in soybean, peanuts or mungbean. Always read and follow label directions. Failure to do so can result in potential crop, injury and/or a less vigourous crop which may have reduced competitiveness against weeds.

If weeds are approaching maturity in a crop, take decisive action to ensure the plant does not produce mature seed.

- If weed numbers are low, employ chippers to remove these before seed is shed.
- If patches are too large for chipping, consider early termination of the crop and weeds for example, ploughing in the affected area or spraying with a non-selective, knockdown herbicide. The cost of the weed seed blow-out that will need to be managed over several more years is often greater than the cost of the lost yield.
- In some situations, herbicides registered for crop desiccation may assist with late season weed suppression and/or seed reduction, but often these applications may be poor on large weeds. It can often be extremely difficult to time applications to control weed seeds before they mature, while also not affecting crop yield. Check product labels carefully and observe withholding periods. Never use a product that is not registered for late season application, as the trade implications for exceeding maximum residue limits (MRLs) are significant.

Manage weeds in fallow to prevent seed set

Multiple germinations are likely during the fallow period in response to individual rainfall events and the lack of crop competition in fallow results in higher weed pressure and faster growth rates.

The rapid escalation of glyphosate resistance in many crop areas is making fallow weed control more difficult. As resistance emerges, spray applicators should take steps to ensure maximum glyphosate performance:

- Apply maximum permissible application rates;
- Target small weeds, under good growing conditions;
- Use good quality, clean water. If water is hard, always pre-treat with ammonium sulfate;

Photo: Mark Congreve

Do not let weeds 'blow out' in the current crop as this will result in massive seedbank replenishment that will be increasingly difficult and expensive to manage.

Photo: Mark Congreve

A well-timed desiccation application may prevent weeds from setting seed; however, may not kill established weeds.

Photo: Mark Congreve

Weeds such as feathertop Rhodes grass can exploit bare ground such as untreated crop edges.

- Glyphosate takes at least 4-6 hours to fully enter the leaf. Rainfall or hot and low humidity conditions (e.g. Delta T above 8-10) during this period will reduce uptake.
- Use large droplets (Very Coarse spray quality) and keep water rates low (typically 50 to 60 litre per hectare, but increase to 80 to 90 L/ha if weeds are 2 leaf or smaller, and coverage could be an issue;
- Only add additional adjuvants if directed on the label. Adding the wrong surfactant may reduce control;
- Almost all tank mix partners added to glyphosate to improve broadleaf control will be somewhat antagonistic for grass weed control; and,
- Double knock – follow glyphosate with a contact herbicide such as paraquat applied approximately 5 to 7 days later.

Be sure to manage weeds in other non-crop areas (for example around sheds, silos, roadsides, fencelines). If unmanaged, these areas can be a source of ongoing weed seed production.

Understand and utilise pre-emergent herbicides

Pre-emergent (sometimes called residual) herbicides, by their nature will persist in the soil for some period of time and will control weeds as they germinate. Pre-emergent herbicides have a role in the fallow; at crop establishment; or as a directed/lay-by application within the inter-row to provide extended periods of weed control and therefore reduce the frequency of application of post-emergent herbicides.

While never 100 per cent effective, a well-executed pre-emergent herbicide application should be the foundation of most weed control programs and has several benefits:

- Substantially reduces the weed burden and takes the pressure off post-emergent applications – both in fallow and in crop;
- When applied at planting, allows the crop to establish without weed competition and therefore protects potential yield;
- Provides insurance in case subsequent weather conditions prevent timely post-emergent applications; and,
- Reduces the frequency of non-selective herbicide applications in long fallow – potentially saving costs and redirecting herbicide resistance pressure to less frequently used modes of action.

If applying a pre-emergent herbicide with a knockdown application where weeds are already present, or where pre-emergents are applied after crop establishment, then pre-emergent herbicide intercepted by green plant material will be taken up by the foliage and not reach the soil. High levels of weed interception can result in reduced length of residual control.

All pre-emergent herbicides require incorporation. Some herbicide labels may recommend mechanical incorporation, while several rely on rainfall. Follow label advice.

To be able to reach the soil in situations of high stubble/crop residue, a 'mobile' pre-emergent herbicide will be needed. Mobile herbicides are generally water soluble and do not bind strongly to organic matter. Best results will be achieved when applied with higher water volumes and sufficient rainfall occurs soon after application for incorporation. However, there is the potential for some of the herbicide to leach under heavy rainfall and especially on light soil types, which may result in reduced length of persistence. Additionally, should mobile herbicides move with soil moisture this increases the risk of crop injury, while also increasing the risk of waterway contamination in coastal environments.

The length of residual control is influenced by several factors. The interaction between these is unique to each herbicide. However, in coastal high rainfall environments, the major factors influencing length of persistence is the amount and frequency of rainfall and soil type.

Some pre-emergent herbicides can cause crop injury in certain situations. Typically this is more likely to occur where a high concentration of the herbicide comes in contact with the germinating crop.

Factors that increase the likelihood of crop injury are:

- The target weed is similar to the crop being grown. For example, residual grass weed herbicides used in a cereal crop, or broadleaf residual herbicides used in broadleaf crops are more likely to cause potential crop injury than a residual 'grass' herbicide used in a broadleaf crop;
- High rainfall between herbicide application and crop emergence and seedling development, especially if soils are water-logged;
- Cold soil temperatures resulting in slow crop emergence;
- Any other stress on the emerging crop (for example disease or insect damage);
- Lighter or gravel soil types;
- More than one residual herbicide applied, including situations where there are carryover residues from previous applications;
- When applied post-sowing, pre-emergent (PSPE), rainfall concentrating herbicide in the planting furrow – especially where the seed slot is not well closed; and,
- In some situations, application at the higher end of the registered application rate.

Photo: Mark Congreve

Residual herbicides with high mobility will be required in high crop residue systems. However, these herbicides also have the potential to leach and move off-site.

FARMING SYSTEMS INFLUENCE PERFORMANCE OF PRE-EMERGENT HERBICIDES

The mobility and level of binding on organic matter varies greatly between different residual herbicides.

Some residual (pre-emergent) herbicides have very low soil mobility (for example trifluralin, pendimethalin, flumioxazin). In paddocks that have been regularly cultivated, weed seeds will be distributed through the soil to the depth of cultivation. If a herbicide with low mobility is applied to the surface and not physically incorporated, poor control of weeds germinating from depth may be experienced.

Conversely, some herbicides are quite mobile (for example imazapic, imazethapyr, hexazinone, s-metolachlor, atrazine). More mobile herbicides can be moved down the soil profile with rainfall and be more likely to control weeds germinating from deeper in the soil profile than less mobile herbicides. Additionally, this mobility is an important requirement when used in sugarcane trash blanket systems to allow the herbicide to wash through the trash and into the soil.

As could be expected, herbicides with higher mobility have greater potential to leach or move off target and therefore need to be applied correctly in coastal farming systems to avoid environmental impact. Some herbicide labels may also restrict the conditions where they can be applied.

In-crop post-emergent herbicides for clean up

Post-emergent herbicides work best when used to clean up escapes from fallow and at-planting herbicide programs. With effective prior management, they will be targeting low weed numbers and should be timed when weeds are very small and actively growing.

Allowing high numbers of large weeds to establish in the crop (for example no pre-emergent program) and expecting to be able to control these with a single post-emergent application is bad practice. Crop yield will have already been severely impacted and post-emergent herbicide control is often poor due to poor coverage of weeds. Failure to kill all weeds and targeting large weed numbers increases selection for herbicide resistance. Inter-row cultivation or chipping following post-emergent herbicides used in 'salvage' situations helps both reduce weed seed levels for subsequent crops as well as reducing selection pressure for herbicide resistance.

In general there are limited, effective post-emergent herbicide options to remove grass weeds in grass crops (for example, brome/ryegrass/wild oats in winter cereals or barnyard grass/feathertop Rhodes in sorghum/maize) or broadleaf weeds in several broadleaf crops (for example bellvine/sesbania in pulses). Where herbicides are registered for these use patterns, they often require to be targeted to very small weeds under good growing conditions.

Application and spray quality

Some herbicides such as glyphosate and Group 4 herbicides (for example 2,4-D, fluroxypyr, dicamba) are well translocated within plants. These herbicides are generally best applied with large (Very Coarse; VC) droplets and typically lower water volumes (50 to 80 L/ha).

Using larger spray droplets also assists in reducing off-target spray drift. For all broadcast applications of 2,4-D, the sprayer must be set to deliver a minimum of VC spray quality, with buffer zones to sensitive areas also required. Only certain nozzles can meet this requirement of VC (or larger) spray quality. Spray quality output at various application pressures and travel

Photo: Mark Congreve

Post-emergent herbicides need to target small weeds for consistent results.

speeds for many common nozzles can be found in *Nozzle Selection Guide* by GRDC.

VC (or larger) nozzles are also ideal for application of pre-emergent herbicides. For pre-emergent applications, increase water rate as the level of stubble/crop residue increases.

Contact herbicides (for example, paraquat, Group 14), systemic herbicides that are poorly translocated (for example Group 1), as well as many fungicides and insecticides, require higher levels of coverage for best results. Generally a Medium (M) or Coarse (C) spray quality is preferred, with water rates increasing as stubble or canopy density increases.

As a rule, nozzles will perform best when operating at the mid to upper range of their rated operating pressure. Be particularly careful when operating air induction nozzles towards the bottom of their pressure range when using oil-based pesticides or adjuvants as the spray pattern can collapse.

Spray applicators should have a minimum of two sets of nozzles (one set to deliver medium (M) to coarse (C) and another set to deliver very coarse (VC) or larger spray quality) to optimise performance while remaining in compliance of legal label requirements.

When moving between different crops, fully decontaminate the sprayer to avoid chemical residues affecting the following crop. The GRDC fact sheet *Decontamination* provides detailed information on boomspray decontamination.

All nozzles wear out. The rate at which this occurs depends on the nozzle construction material, the products being applied and the frequency of use. Boomspray decontamination is a good time to check nozzle wear and replace worn nozzles.

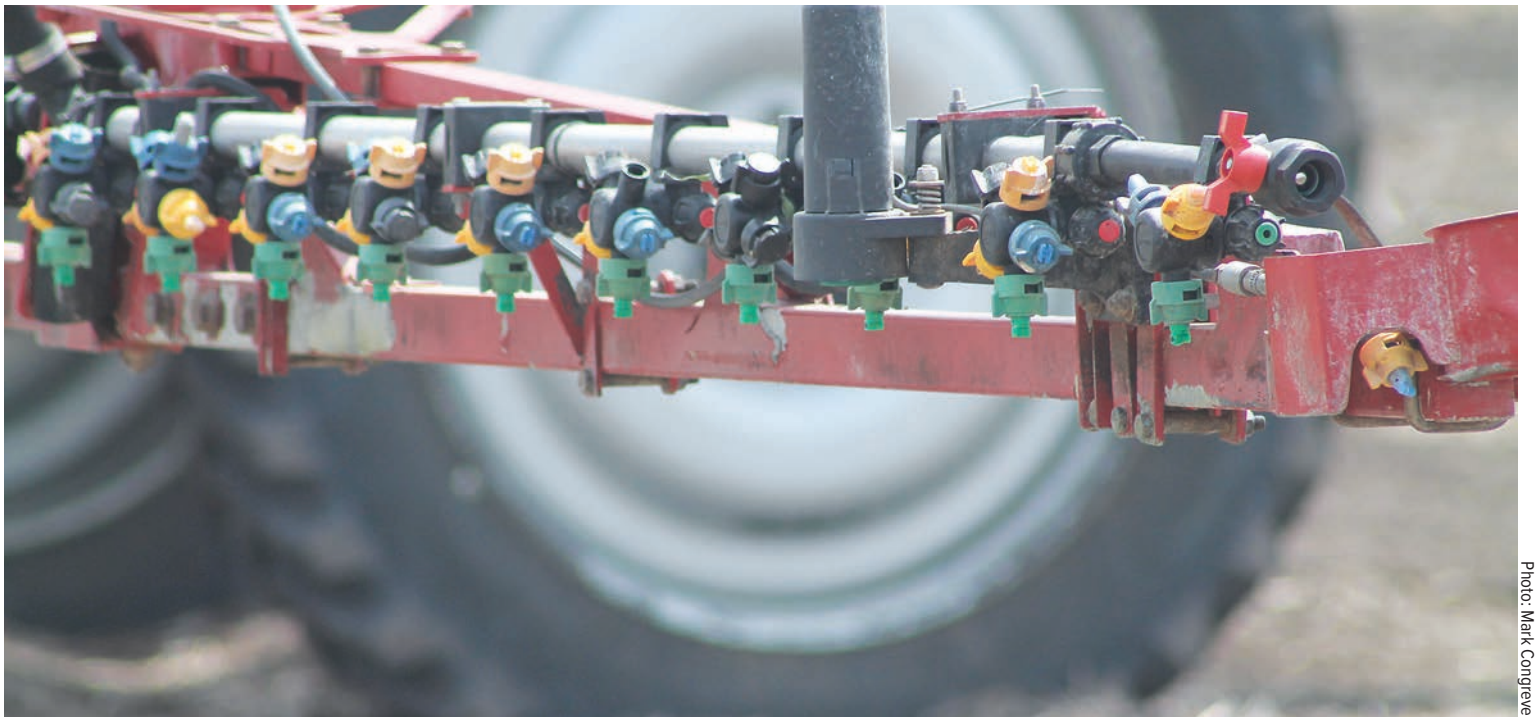


Photo: Mark Congreve

Ensure correct nozzles are available to suit the pesticide requirements, desired spray quality and water rates.

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MORE INFORMATION

Common weeds of grain cropping – The ute guide https://grdc.com.au/resources-and-publications/all-publications/common-weeds-of-grain-cropping-the-ute-guide

Herbicide behaviour e-resources https://grdc.com.au/resources-and-publications/resources/herbicide-behaviour

Soybean agronomy portal (including weed management and coastal weed identification) www.soyaustralia.com

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