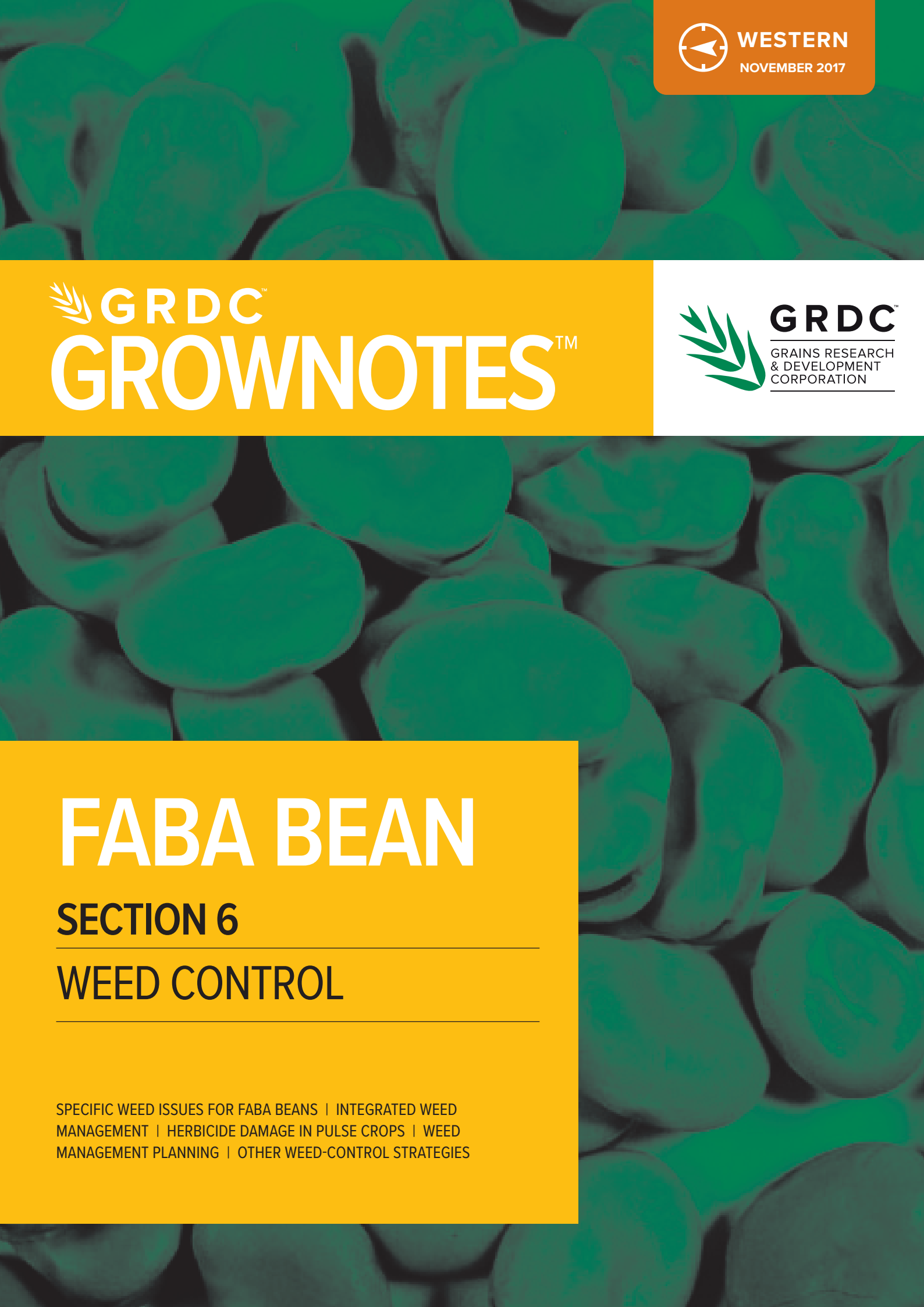

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FABA BEAN

SECTION 6

WEED CONTROL

SPECIFIC WEED ISSUES FOR FABA BEANS | INTEGRATED WEED MANAGEMENT | HERBICIDE DAMAGE IN PULSE CROPS | WEED MANAGEMENT PLANNING | OTHER WEED-CONTROL STRATEGIES

Weed control

Key messages

- Competition from weeds reduces grain yield and quality, and costs Australian agriculture more than $2.5 billion a year.
- Good management of crop rotations can substantially reduce the cost of controlling weeds with chemicals.
- Timely cultivation is a valuable method for killing weeds and preparing seedbeds.
- Herbicide resistance is one of the biggest agronomic threats to the sustainability of our cropping systems.
- Choose paddocks that are relatively free, or carry a low burden, of grass and broadleaf weeds.
- Substantially reduce the weed seedbank in the soil before the crop emerges, as there are limited weed-control options post-emergence.

Weed control is important, because weeds can:

- rob the soil of valuable stored moisture
- rob the soil of nutrients
- cause problems at sowing time, restricting access for planting rigs (especially vine-type weeds such as melons, tarvine or bindweed, which wrap around tines)
- cause problems at harvest
- increase moisture levels of the grain sample (green weeds)
- contaminate the sample
- prevent some crops being grown where in-crop herbicide options are limited, i.e. in broadleaf crops
- be toxic to stock
- carry disease
- host insects

6.1 Specific weed issues for faba beans

Problem weeds or issues in faba beans that require special attention or are difficult to fully control include:

- Faba beans are reasonably poor competitors against weeds initially, because of their slow germination, low plant populations and the extended period before ground is covered by the canopy closing.
- Annual ryegrass that is resistant to Group A products ('dims' and 'fops'), particularly where high rates of clethodim are required.
- Annual ryegrass that is resistant to trifluralin.
- Wild radish—there are no safe post-emergent treatments available.
- Crop-topping cannot always be conducted in a timely manner so as to be safe for the beans and at the optimum stage for preventing ryegrass seedset. Late germination of weeds (e.g. ryegrass, brome grass) can safely be prevented from setting seed by crop-topping in many earlier-maturing pulses.
- Snails
- Hoary cress, soursob, medics and tares. [1]

MORE INFORMATION

R Bowman (2013) Harvest weed seed key to overcoming resistance, GRDC Media Centre. Includes video.

AHRI (2013) Harvest Weed Seed Control

GRDC (2010) Managing the weed seedbank. Fact sheet.

GRDC and CropLife Australia (2008) Herbicide resistance: mode of action groups.

1 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

6.2 Integrated weed management

Good weed-control management is vital to successful and profitable crop production. Yield losses caused by weeds can vary enormously from almost negligible to a complete loss. Before sowing crops, thoroughly investigate which weed species are likely to germinate in a paddock and determine the availability of suitable herbicide options.

Weeds lower crop yields by competing for soil moisture, nutrients, space and light. They can also carry diseases and viruses that can infect crops. This competition reduces grain yield and quality, and can impede harvesting. Some weeds can restrict cropping options because herbicides for controlling them are sometimes limited.

Weed control is a numbers game, and growers should aim to reduce weed numbers and keep them low with an ongoing management program. A weed-management program should make the most of rotations and the opportunity to use selective herbicides from a different herbicide group in each crop in the rotation in order to reduce weed presence in the following crop. Care should be taken in planning a cropping rotation to avoid herbicide resistance, or in growing a crop that may become a 'weed' itself or lead to weeds that cannot be controlled with selective herbicides in the subsequent crop.

An IWM system that combines all available methods is the key to the successful control of weeds (Table 1). [2]

6.2.1 In-crop weed control

There are pre-emergent and early post-emergent herbicides available for grass-weed control in faba beans. However, with broadleaf weeds, post-emergent options are very limited. Weeds should be removed from crops early, and certainly no later than 6 weeks after sowing if yield losses are to be minimised. Yield responses will depend on weed species, weed and crop density and seasonal conditions. The stage of growth of the weed and of the crop are vital factors to consider when planning the use of post-emergent herbicides.

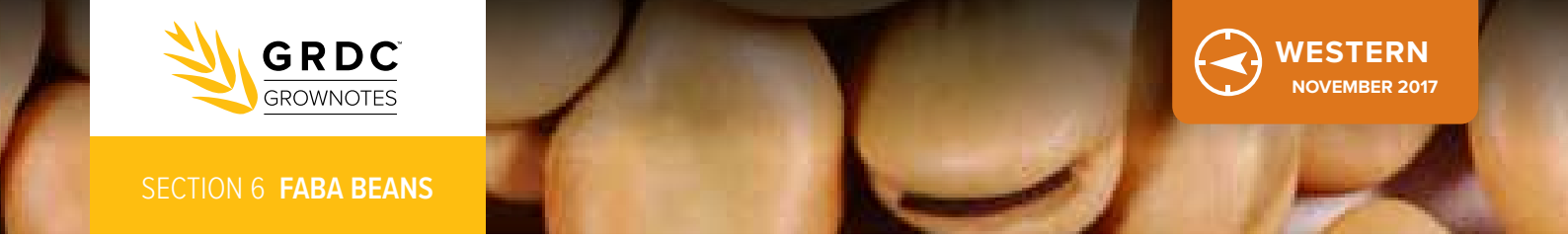
Read herbicide labels carefully for details on the best conditions for spraying.

Herbicide resistance

Herbicide resistance continues to develop and become more widespread. It is now one of the biggest agronomic threats to the sustainability of our cropping systems. However, this problem can be managed through good crop rotations, rotating herbicide groups, and by combining both chemical and non-chemical methods of weed control. [3]

2 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

3 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.



MORE INFORMATION

Australian Glyphosate Sustainability Working Group.

Weed Smart.

GRDC. Integrated weed management. YouTube videos.

Download the GRDC Herbicide Injury app from your app store or visit http://uteguides.net.au/

Table 1: *Weed control options for integrated weed management.*

	Herbicidal	Non-herbicidal
Crop phase	• Crop-top in pulse/legume crops • Use knockdown herbicides, e.g. double-knock strategy, before sowing • Use selective herbicides before and/or after sowing, ensuring escapes do not set seed • Utilise moderate-resistance-risk herbicides • Delay sowing (as late as spring in some cases) with weeds controlled in the interim • Brown-manure crops	• Rotate crops • Rotate varieties • Grow a dense competitive crop • Cultivate • Green-manure crops • Delay sowing • Cut crops for hay or silage • Burn stubble or windrows • Collect weed seeds at harvest and remove or burn • Destroy weed seeds harvested (use Harrington seed destructor)
Pasture phase	• Use spray topping • Use winter cleaning • Use selective herbicides, ensuring escapes do not set seed	• Use good pasture competition • Make hay or silage • Cultivate fallow • Graze

6.3 Herbicide damage in pulse crops

The risk of crop damage from herbicide application should be balanced against the potential yield loss from weed competition. In heavy weed infestations, some herbicide crop damage can be tolerated, because removing competing weeds means that yields will compensate for crop damage.

If herbicide is applied to dry soils, the risk of movement and crop damage is increased greatly after rainfall, particularly if the soil is left ridged and the herbicide washes into the seed row. Incorporation by sowing (IBS) may be more appropriate in dry conditions; or use a split application to minimise risk. Post-sowing pre-emergent (PSPE) herbicides should be applied to moist soil regardless of the sowing time.

Herbicides move more readily in soils with low organic matter, and with more sand, silt or gravel. Herbicide movement is much less in soils with higher organic matter and higher clay contents. Damage from leaching is also greater where herbicides are applied to dry, cloddy soils than to soils that have been rolled and are moist on top from recent rain.

The relative leaching potentials presented in Table 2 show that metribuzin leaches at almost three times the rate of simazine, and seven times the rate of diuron.

Table 2: *Relative leaching of some soil-active herbicides.*

Chemical	Example of product	Leaching index
Pendimethalin	Stomp®	1
Trifluralin	Treflan®	1
Diuron	Diuron 900DF	2
Prometryn	Prometryn 900DF	3–4
Simazine	Simazine 900 WDG	5
Metolachlor	Dual®	6
Metribuzin	Sencor®	14

1 is the least leaching

The relative tolerance of the crop type and variety will also affect the degree of crop damage from these herbicides. For example, lupins are more tolerant of simazine than are the other pulses. For more specific details on soil-active herbicides and the risk of crop damage in the cropping situation, seek advice from an experienced agronomist. [4]

Some soil-active herbicides (e.g. Terbyne® or simazine) can damage faba beans where wetter conditions favour greater activity and leaching.

Traces of sulfonylurea herbicides (such as chlorsulfuron, metsulfuron or triasulfuron) and carfentrazone (Affinity Force®) in spray equipment can cause severe damage to faba beans. [5]

6.3.1 Spray drift

When applying pesticides, the aim is to maximise the amount reaching the target and to minimise the amount reaching off-target areas. This results in:

- maximum pesticide effectiveness
- reduced damage and/or contamination of off-target crops and areas

In areas where various agricultural enterprises co-exist, conflicts can arise, particularly from the use of pesticides.

Pulse crops can be severely damaged by some hormone herbicide sprays, such as 2,4-D ester, drifting into the crop. This can happen when these sprays are applied nearby in very windy or still conditions, especially where there is an inversion layer of air on a cool morning.

When using these herbicides, spray when there is some wind to mix the spray with the crop. Do not use excessively high spray pressure, as this will produce very fine droplets that are more likely to drift onto a neighbouring pulse crop.

All pesticides are capable of drift. There is a moral and legal responsibility to prevent pesticides from drifting and contaminating or damaging neighbours' crops and sensitive areas (Photo 1). [6]

4 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

5 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

6 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

MORE INFORMATION

Pulse Australia (2015) Residual herbicides and weed control.

GRDC (2002) Field crop herbicide injury: The Ute Guide

Photo 1: *Glyphosate spray drift from the road verge on the left. Note the barrier effect of the tall weeds on the fence line.*

Photo: G. Bardell, Nufarm

Damage to faba beans from various herbicides is depicted in Photos 2–13.

Photo 2: *Crops grown on lighter soils are more prone to damage from simazine (Group C).*

Photo: A. Mayfield, Grain Legume Handbook, 2008

Photo 3: *High rates of simazine can damage faba beans, causing the lower leaves turn black and die back from the edge.*

Photo: A. Mayfield, Grain Legume Handbook, 2008

Photo 4: *Faba beans are susceptible to Tordon® or Lontrel® residue in soil. Note the stem distortion and severe leaf curl.*

Photo: A. Mayfield, Grain Legume Handbook, 2008

Photo 5: *Trifluralin (Group D) injury causing stunted growth (left). This herbicide can also cause multiple growing points to develop.*

Photo: C. Preston, University of Adelaide

Photo 6: *Damage (left) from Dual Gold® (metachlor, Group K).*

Photo: C. Preston, University of Adelaide

Photo 7: *Chemical leaf spotting from oils in a Group A herbicide applied after emergence. Note that spots are numerous, small, irregular in shape, and differ on top and bottom sides of leaf. It can be confused with chocolate spot and Aschocyta blight.*

Photo: R. Kimber, SARDI

Photo 8: *Leaf spotting caused by an MCPB herbicide (Group I) can be confused with Ascochyta and chocolate spot infections in beans.*

Photo: A. Mayfield, Grain Legume Handbook, 2008

Photo 9: *Symptoms of Brodal® (diflufenican, Group F) damage: white–pale yellow leaves with yellow blotches.*

Photo: A. Mayfield, Grain Legume Handbook, 2008

Photo 10: *Spray drift from 2,4-D (Group I) caused narrow leaves with crinkled edges.*

Photo: A. Mayfield, Grain Legume Handbook, 2008

Photo 11: *Damage from drift of Lontrel® (Group I).*

Photo: T. Bray, formerly Pulse Australia

Photo 12: *Leaf spotting from spray droplets of Affinity® (carfentrazone, Group G).*

Photo: C. Preston, University of Adelaide

Photo 13: *Leaf spotting from spray droplets of paraquat (Group L).*

Photo: C Preston, University of Adelaide

6.3.2 Tolerance of faba bean varieties to herbicides

Faba bean varieties do differ in their herbicide tolerance, depending on season, soil type and rate of application.

PBA Rana(ɒ) performs similarly to current varieties of faba beans at label-recommended rates of registered herbicides. This is based on visual observations from National Variety Trials (NVT) and Pulse Breeding Australia (PBA) breeding trials conducted on a range of soil types.

Herbicide-tolerance trials in South Australia (on alkaline sandy loams) showed Nura(ɒ exhibited greater sensitivity to imazethapyr (e.g. Spinnaker®). However, all varieties exhibit some yield loss to imazethapyr (Table 3).

Raptor® (imazamox) has a narrow safety margin in all faba bean varieties. It can be applied only under APVMA permit No. 14726. Field experience shows damage is more severe under moisture stress and conditions of slow growth. It should be considered a salvage option rather than a routine application.

Diuron has been safe in Farah(ɒ and Nura(ɒ over seven or eight trials, and is registered for use in faba beans, IBS or PSPE. [7]

Table 3: *Herbicide effect on yields of varieties, from variety trials.*

Variety	Years	Diuron® (diuron)	Simazine		(metribuzin)	Spinnaker® (imazathapyr)	Raptor®A (imazamox)	Terbyne® (terbuthylazine)
		2000–10	2000–10	2001–08	2003–10	2000–10	2003–10	2009–10
Farah(ɒ	2002–08	Safe (7)	Narrow (1/7)	6–18% (3/7)	Safe (6)	28–39% (2/3)	Narrow (3/6)	–
Fiesta	2000–07	Narrow (1/8)	18% (1/8)	21% (1/7)	S (5)	11–32% (2/8)	Narrow (4/5)	–
Fiord(ɒ	2000–02	Narrow (1/3)	Narrow (2/3)	Narrow (1/2)	–	18–30% (2/3)	–	–
Nura(ɒ	2003–10	Safe (8)	Narrow (1/8)	Narrow (1/6)	Safe (8)	10–53% (4/8)	Narrow (8/8)	Safe (2)
Rate		1.0 L/ha	1.5 L/ha	1.5 L/ha	280 g/ha	85 g/ha	45 g/ha	1.0 kg/ha
Application		PSPE	PSPE	6 weeks	PSPE	PSPE	3–4 leaf	PSPE

Safe: no significant yield reductions at recommended rates or higher in 2+ trials (no. of trials in parentheses).

Narrow: narrow margin, significant yield reductions at higher than recommended rate in 1+ trials (X of Y trials in parentheses), but not at recommended rate.

X%: percentage yield reduction (warning), significant yield reduction at recommended rate in 1 trial only.

X–Y%: percentage range yield reductions (warning), significant yield reductions at recommended rate in 2+ trials.

A Denotes use under APVMA permit. This use is not endorsed by this data and no responsibility will be taken for its interpretation.

6.3.3 APVMA

The national body in charge of administering these processes is the Australian Pesticides and Veterinary Medicines Authority (APVMA), and it is based in Canberra.

Details of product registrations and permits are available via the APVMA's website.

6.3.4 Always read the label

Apart from questions about the legality of such an action, the use of products for purposes or in manners not on the label involves potential risks. These risks include reduced efficacy, exceeded MRLs and litigation.

Be aware that herbicide-use guidelines on the label are there to protect product quality and Australian trade by keeping residues below specified MRLs. Residue limits in any crop are at risk of being exceeded or breached where herbicides:

- are applied at rates higher than the maximum specified;
- are applied more frequently than the maximum number of times specified per crop;
- are applied within the specified withholding period (i.e. within the shortest time before harvest that a product can be applied); or
- are not registered for the crop in question [8]

MORE INFORMATION

NSWDPI. Broadleaf weed trial in faba beans.

Pulse Australia variety management packages (VMPs).

National Variety Trials.

7 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

8 Pulse Breeders Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

FAQ

6.4 Weed management planning

Faba beans can be relatively slow to emerge but have rapid early growth even during the colder winter months. Consequently, they are initially poor competitors with weeds. Even moderate weed infestations can cause large yield losses and harvest problems.

Faba beans are reasonable competitors against ryegrass and other weeds early on, but because faba beans are sown at a relatively low plant population, weeds can grow without necessarily inhibiting early development of the beans. If weeds are present in the crop later in the season, they can affect yield and become a nuisance by setting seed, often necessitating desiccation to enable harvest.

Yield loss caused by weeds has not been recorded in faba bean research trials. The impact of weed seed-set and carryover to subsequent years may be more significant than yield loss, especially where weeds such as ryegrass or late broadleaved weeds are present and not controlled.

Faba beans can mature too late in some extended seasons, so crop-topping may have to be delayed or done before physiological maturity, risking yield and quality losses.

The weed-control strategy for growing a successful faba bean crop depends on substantially reducing the viable weed seedbank in the soil before the crop emerges, because there are limited weed-control options post-emergence.

Selecting paddocks that are relatively free, or carry a low burden, of grass and broadleaf weeds is very important.

Broadleaf weeds need to be heavily targeted in the preceding crop and/or fallow and paddocks with a severe broadleaf or grass weed problem should be avoided.

Pre-emergent herbicide options

The absence of cost-effective and safe post-emergent herbicides effectively limits broadleaf weed control options in faba beans to a small number of pre-emergent herbicides. The efficacy of most of these chemicals is very dependent on rainfall soon after application; inconsistent or partial weed control can result under drier conditions. [9]

The pre-emergent herbicides will not adequately control large weed populations by themselves, and so they need to be used in conjunction with paddock selection, crop rotation and pre-seeding weed control. [10]

Outlook® (dimethenamid) has been registered to control herbicide-resistant ryegrass in some pulses. But it is *not registered* for use in faba beans because it is deemed too damaging.

Trifluralin (i.e. TriflurX®), pendimethalin (i.e. Stomp®), triallate (i.e. Avadex®), cyanazine (i.e. Bladex®), simazine, terbuthylazine (i.e. Terbyne®) and some diuron brands (e.g. Diurex ®) are registered for use on faba beans.

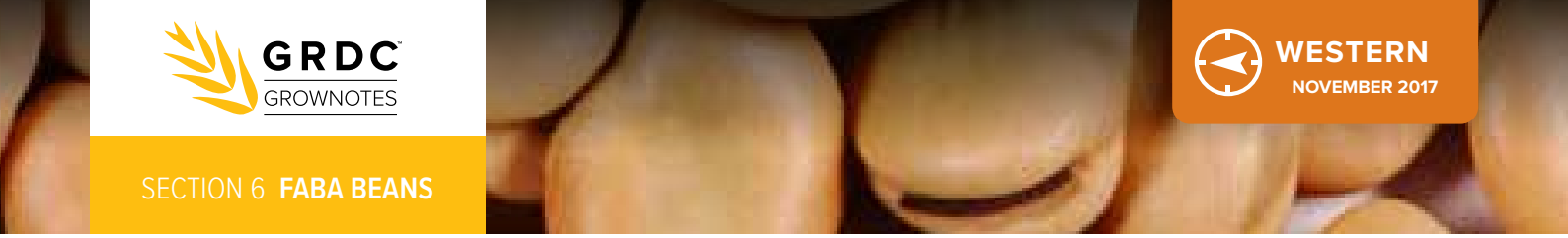
Trifluralin is used to control barley grass and for suppression of wild oats and brome grass. Pendimethalin is used for suppression of wild oats.

Stubble can tie up these two products. Best results have been achieved when stubble is at ≤50% ground cover, preferably left standing, and when higher water volumes (>80 L/ha) and coarse droplets are used.

Triallate provides control of wild oats and assists in the control of resistant ryegrass when used in a mixture. It can be applied immediately prior to or up 3 weeks before sowing. In a mixture, it does help to control ryegrass that has some resistance to trifluralin.

9 GRDC (2015) Pre-emergent herbicides. Fact sheet, https://grdc.com.au/GRDC-FS-PreEmergentHerbicide

10 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.



MORE INFORMATION

GRDC (2015) Pre-emergent herbicides. Fact sheet.

Specific guidelines for Group A herbicides. CropLife Australia.

Cyanazine may be applied from 14 days before sowing to the time of sowing and is often recommended in combination with trifluralin or pendimethalin.

Simazine is often mixed with trifluralin or other products to provide a broader spectrum of control of both broadleaf and grass-weed, including annual ryegrass, capeweed, fumitory, mustards, and geranium and suppression of wild oats.

Typically, a follow-up, post-emergent grass-weed herbicide is still required to provide the level of grass-weed control. [11]

Simazine

Simazine is the most widely used herbicide for broadleaf weed control, and can provide relatively cheap control of cruciferous weeds. Efficacy is highly dependent on receiving 20–30 mm rainfall within two to three weeks of application, and consequently weed-control efficacy varies under drier conditions.

Simazine has an adequate level of crop safety provided the following guidelines are adhered to.

- Simazine needs to be applied to moist soil as close to planting as possible.
- Weed control will be more reliable if the seedbed is level and free of clods. When clods break down after rainfall they expose untreated soil and disrupt the herbicide 'blanket'. Heavily ridged seedbeds often exhibit 'striping' and poor weed control on the 'hills'.
- Stubble does not present major problems, other than in heavy header trails or when it becomes heavily 'bunched' from tillage operations.
- Avoid shallow planting if simazine is to be used, because crop tolerance is based on the physical separation of the chemical from the faba bean roots. A planting depth of 7 cm is normally adequate on clay soils.
- Crop damage is often evident in compacted wheel tracks as a result of shallower planting depth and/or the concentration of chemically treated soil in the wheel-track depressions after rain.
- The planting furrow or trench needs to be closed and levelled at planting to reduce damage to plants. This will minimise the risk of simazine-treated soil being washed in and concentrated near the seedling.
- Good subsoil moisture at planting will also help to minimise the risk of crop damage. Roots will grow down into moisture, rather than developing into a shallow root system in the topsoil, where simazine activity is greatest.
- If grass weeds are present at application, consider tank-mixing glyphosate or Spray.Seed® with simazine.
- Avoid using simazine on coarse-textured, sandy loam soils; even low rates can leach down to the roots and cause significant crop damage.
- When applying simazine, avoid overlapping and double spraying on headlands. [12]

6.4.1 Post-emergent herbicides

Only one broadleaf herbicide, imazamox (e.g. Raptor® WG), is currently registered for post-emergence use, and only to a very limited extent. It can be used after emergence for broadleaf weed control, but can cause transient yellowing, height reduction and delayed flowering, any of which can reduce yield. (These effects are stated on the product label.) It is effective on cruciferous and many other weeds, e.g. barley grass.

Imazamox can result in significant crop damage in our environment, particularly with dry conditions after application.

11 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

12 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

It is used mainly in salvage situations (i.e. as a last resort), and even then should be applied only under good growing conditions.

With the shift into row-crop faba beans, some growers are successfully using glyphosate and other products as a directed spray into the inter-row area. This keeps a large proportion of the herbicide off the faba bean foliage, and minimises problems associated with crop damage.

Control of grass weeds after emergence is often inconsistent, with variable levels of control gained depending on the rate used and the level of resistance to the fop or dim herbicide being used.

Group A herbicides can occasionally cause leaf spotting in faba beans. This is usually associated with either frost or high temperatures occurring soon after spray application. It is not the Group A itself but the oil it is mixed with that causes the damage. The oil acts as a magnifying glass on the leaf and burns the leaf surface (Photo 14).

Photo 14: *Herbicide-mix injury from a Group A grass selective herbicide.*

Photo: R. Kimber, SARDI

Traces of sulfonylurea herbicides in boom sprays can cause significant damage to faba bean crops. The risk of residue damage is greater in the presence of grass-selective herbicides.

See product labels for specific recommendations on decontamination. [13]

6.5 Other weed-control strategies

Directed sprays in the crop

With the shift to cropping faba beans on wide rows, there is greater scope for the use of 'directed sprays' of glyphosate and other chemicals, either alone or in tank mixes with simazine. This largely avoids the problem of crop damage, and improves weed control through the ability to safely add wetters or mineral oils to the spray mix.

Growers in cotton growing areas of Australia are having good results using glyphosate in shielded sprayers. Although faba beans do have a degree of tolerance

13 Pulse Breeding Australia (2013) Southern/Western Faba & Broad Bean—Best Management Practices Training Course. Module 5—Weed Management.

to glyphosate during the vegetative stage, caution is still required, as the branches arising from the base and main stem contribute a large proportion of the total faba bean yield. Issues that need to be considered include:

- the selection and operation of spray shields (speed, nozzle type, etc.)
- the height of the crop (small faba bean plants are more susceptible)

Crop-topping and desiccation

With correct timing, desiccation can improve overall weed control as well as increase profitability in pulse crops.

The major differences between crop-topping and desiccation are:

- Herbicides used for crop-topping and desiccation are not always the same.
- Timing is not the same: desiccation occurs after crop maturity, while crop-topping is done earlier, to reduce the seedset of weeds before the crop matures.
- Herbicides are registered for desiccation as 'harvest aids', and the rates used are higher than those used for crop-topping.
- Both desiccation and crop-topping will cause reduced grain quality and yield if applied at the wrong maturity stage of the crop.

For more information, see Section 11 Crop desiccation.