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GRDC
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GRAINS RESEARCH
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CORPORATION

CANOLA

SECTION 6

WEED CONTROL

KEY POINTS | WEED DENSITY | WEED SPECTRUM AND HERBICIDE RESISTANCE | WEED MANAGEMENT IN DIFFERING SCENARIOS | CLETHODIM DAMAGE

December 2015

SECTION 6

FAQ

Weed control

Canola is highly susceptible to weed competition during the early stages of growth, making early weed control essential.

Although the competitive ability of canola improves markedly once the crop canopy has closed, serious yield losses can occur beforehand.

Weeds present at harvest can cause excessive weed-seed contamination, reducing grain quality. As well as yield and quality considerations, uncontrolled weeds (i.e. weeds still growing in the crop after all treatments have been used) will add seeds to the soil seedbank, creating an ongoing weed problem.

Weed control in canola requires use of the range of available herbicide and non-herbicide options, that is, integrated weed management (IWM). [1]

6.1 Key points:

- Choose paddocks relatively free of broadleaf weeds, especially charlock, wild turnip, wild radish and other weeds of the Brassicaceae family, because in-crop herbicide options are limited. Grass weeds can be controlled in canola by using trifluralin and/or post-emergent herbicides; however, Group A resistant grasses are still of concern.
- Herbicide resistant varietal systems such as triazine-tolerant (TT), Clearfield® and Roundup Ready® (RR) can be of use in managing weeds in canola, particularly broadleaf weeds. However, careful management is needed to avoid the buildup of resistant weed populations.
- When choosing paddocks for canola, take care with those treated with residual herbicides, especially Group B and triazine herbicides (for conventional varieties); their residues can affect canola. Check labels for re-cropping intervals, some of which are up to 36 months.
- Ensure that all spray equipment is thoroughly decontaminated before using to spray canola. Apply chlorine if the spraying equipment has previously been used to spray sulfonylureas, ammonia for hormone herbicides (salt and amine formulations) such as 2,4-D amine and MCPA, and liquid alkali detergent for Broadstrike™ (flumetsulam) and Eclipse® (metosulam) decontamination. Where possible, use separate spraying equipment for residual herbicides such as the sulfonylureas.
- Imidazolinone-tolerant varieties are marketed as Clearfield® canola. These varieties allow the use of the Group B herbicide Intervix® (imazamox and imazapyr). Clearfield® varieties do not suffer from the yield and oil penalty that the TT varieties exhibit. The use of Clearfield® varieties and other herbicide tolerant systems allow for the rotation of herbicide groups and broaden the spectrum of weeds controlled. [2]

[1] A Storrie, S Sutherland (2009) Weed management. Ch. 8. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, https://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[2] L Serafin, J Holland, R Bambach, D McCaffery (2005) Canola: northern NSW planting guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/148300/canola-northern-NSW-planting-guide.pdf

More information

NSW DPI: Weed control in winter crops 2015

GRDC: Integrated weed management manual

GRDC: Soil behaviour of pre-emergent herbicides in Australian farming systems

Monsanto: What is Roundup Ready® canola?

BASF: Clearfield Production System. Best management practice 2015

GRDC: Herbicide tolerant canola in farming systems: a guide for growers

More information

WeedSmart - Options for crop topping canola

Weed management is strongly influenced by crop rotation sequence. Careful planning of a 5-year rotation will enable targeted weed control through both cultural and chemical methods, as well as the ability to plan herbicide rotations. The widespread occurrence of herbicide resistance in Australian weeds puts further emphasis on the need for careful planning and resistance-management strategies such as monitoring, herbicide mode-of-action (MOA) rotation and cultural management techniques including harvest weed seed control.

The area sown to herbicide-tolerant varieties of canola has increased dramatically in recent years; however, widespread use of these varieties without integrated weed-management techniques is likely to accelerate the development of resistance to the herbicides.

The resistance to several of these herbicides that already occurs in Australian weeds shows that these herbicide-tolerant varieties are not a panacea for herbicide-resistance management, but they will add significantly to the options available to farmers for resistance management.

6.2 Weed density

If weeds are very dense, they represent a greater threat to yield, especially if herbicide control is poor. Table 1 shows the impact of initial weed density and herbicide control percentage on final weed density. The greater the initial weed density, the higher the final number of weeds, especially if herbicide effectiveness is reduced. In addition, if large numbers of weeds are sprayed, the likelihood of herbicide-resistant biotypes being selected increases.

Constant spraying of large numbers of weeds, especially with the same MOA herbicide group, will accelerate the evolution of herbicide-resistance in weed populations. The choice of weed-management strategies will depend on the species present and their resistance status. [3]

Weedmaster DST has now been registered for pre-harvest use in canola to manage late season ryegrass and is a very effective IWM tool that has been rapidly adopted by growers.

Table 1: Impact of initial weed density on final weed numbers

	Final weed density (plants/m²)	
Initial density (plants/m²)	95% control	75% control
10,000	500	2500
1000	50	250
100	5	25

6.3 Weed spectrum and herbicide resistance

Many weed species affect canola production; those that feature consistently in Australia are listed in Table 2. Prior to the introduction of herbicide-resistant canola varieties, control of key broadleaf weeds was the most important constraint to production of canola throughout Australia.

The degree to which such weeds have restricted the canola area is reflected in the rapid adoption of the TT varieties across Australia. [4]

[3] A Storrie, S Sutherland (2009) Weed management. Ch. 8. In Canola best practice management guide for south-eastern Australia. (Eds D McCaffrey, T Potter, S Marcroft, F Pritchard) GRDC, https://www.grdc.com.au/uploads/documents/GRDC_Canola_Guide_All_1308091.pdf

[4] S Sutherland. Canola weed management. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

Table 2: Common weeds of Australian canola crops

**Weeds species that have been particularly important in restricting canola production prior to the introduction of triazine-tolerant varieties*

Weed (common name)	Scientific name
Wild radish* (Figure 1)	*Raphanus raphanistrum*
Indian hedge mustard*	*Sisymbrium orientale*
Annual ryegrass	*Lolium rigidum*
Shepherds purse*	*Capsella bursa-pastoris*
Wild turnip*	*Brassica tournefortii*
Charlock*	*Sinapsis arvensis*
Paterson's curse*	*Echium plantagineum*
Vulpia*	*Vulpia spp.*
Wireweed	*Polygonum aviculare*
Toad rush	*Juncus bufonius*
Wild oats	*Avena spp.*
Spiny emex	*Emex australis*
Turnip weed*	*Rapistrum rugosum*
Fumitory	*Fumaria spp.*
Buchan weed	*Hirschfeldia incana*
Cape weed	*Arctotheca calendula*
Volunteer cereals	

Figure 1: Wild radish is a common weed in canola crops.

6.3.1 Herbicide resistance in Australian weeds

Australian farmers have moved away from aggressive tillage practices because of the extreme risk of soil erosion. Few farmers use inversion tillage as is practiced in Europe; the majority use reduced-tillage methods. Significant proportions of the crops are seeded using no-till. Therefore, crop sequences and seeding techniques are dependent on herbicides.

Repeated use of herbicides has selected for herbicide-resistant weed biotypes. Herbicide resistance now affects many species of weeds in Australia, foremost among them annual ryegrass. Where canola production was restricted by weeds such as wild radish prior to the introduction of TT varieties, it is likely that herbicide-resistant weeds will re-impose restrictions if not carefully managed. This could be the case with multiple resistance and/or cross-resistance in single species, as well as mixed populations of resistant weed species.

Canola growers in Australia use a range of herbicides from many herbicide groups on canola crops, and the number of groups will increase with the commercial production of additional herbicide-resistant varieties in the next few years (Table 3).

Table 3: Common herbicides in use in canola crops in Australia

Herbicide Groups	Herbicides
A	Fluazifop, haloxyfop, sethoxydim, quizalofop, clethodim, butroxydim
B	Intervix (Clearfield® varieties)
C	Simazine, Atrazine, Terbuthylazine (TT varieties),
D	Trifluralin, Pendimethalin, Oryzalin, Propyzamide
I	Clopyralid
K	Metolachlor,
M	Glyphosate (RR varieties)

More information

Australian Pesticides and Veterinary Medicines Authority

There are confirmed cases where annual ryegrass biotypes are resistant to all selective herbicides currently available. For each paddock, monitoring and resistance testing are imperative to understand the control options open to the grower.

The major herbicide resistance problems in weeds in Australia are with Groups A and B herbicides; however, resistance to Groups C, D, F, L and M herbicides has also been discovered. [5]

Wild radish has now developed resistance to Group B, Group C and Group F herbicides. Combined with the resistance in ryegrass, this has serious implications for farmers in general but particularly to those wishing to use the IT and TT varieties.

While the majority of farmers are fully aware of the resistance problem, most still react to the development of resistance to a particular herbicide by changing to another herbicide. This is exemplified by the widespread change to trifluralin by southern Australian farmers in response to the failure of the Group A and Group B herbicides over the last two to three seasons. This will have the inevitable consequence that trifluralin resistance will increase.

The introduction of herbicide resistant crops will immediately increase the frequency of use of the specific herbicides on weeds. It is probable that this increased exposure to the herbicides will lead to more resistance problems, particularly in the case of the TT and IT varieties.

Farmers across Australia are being encouraged to adopt IWM in order to address the resistance problem. There are two essential components to IWM, namely the rotation of herbicide groups to avoid repetitious use of the same or similar herbicides, and the avoidance of treating large numbers of weeds with a single herbicide. To achieve the second component, farmers must move away from a high dependence on herbicides for weed control. [6]

For more information on integrated weed management, see the GRDC Integrated Weed Manual at http://www.grdc.com.au/IWMM.

[5] S Sutherland. Canola weed management. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

[6] http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

6.4 Weed management in differing scenarios

6.4.1 Canola following pasture

The pasture ley system of farming was developed in Australia to allow crops to make use of nitrogen provided by legume pastures. A cropping phase of a single year to several years follows a period of pasture production. Growing canola in the first year after pasture has been the preferred practice. The system provides fertile, low-weed-density conditions for the crop. A significant bonus is that cereal root diseases are controlled for the following wheat crop, provided grasses are controlled in the pasture. The ley-pasture phase provides farmers with one or more growing seasons in which weed numbers can be reduced by using non-selective techniques such as grazing, winter cleaning (pasture manipulation), topping, hay-making and silage production. In the spring prior to sowing, the pasture and weeds are killed with glyphosate. In a well-managed ley system, weed numbers are significantly reduced prior to planting the canola.

A common practice is to keep the canola crop as clean as possible of weeds, using the techniques outlined. This often allows the following wheat crop to be produced without selective herbicides.

The ley-pasture cropping system has a great deal of merit in terms of IWM. The system is excellent for reducing pressure on herbicides, as well as managing weeds that are already resistant to herbicides. Crop and pasture phases are usually of similar length (1–5 years). Management of herbicide resistance is straightforward in these systems. [7]

6.4.2 Canola in a continuous cropping sequence

Weed control in preceding crops consists of manipulating sowing time, exploiting crop competitive effects and relying heavily on selective herbicides.

Selection pressure for herbicide resistance is often high, especially to the Group A and Group B herbicides, because of the need to use these herbicides in the preceding crops.

This increases the risk of resistant biotypes being present in the crops when the herbicides are applied. Because of herbicide resistance, continuous crop programs may include a forage–fodder or green manure crop so that non-selective weed control can be achieved. Growers are now using non-selective options such as crop topping, crop competition and harvest weed seed control.

In both the ley system and the continuous cropping system, a significant component of weed management may be achieved through crop competition, although the effectiveness will vary between environments. [8] Weed management is also being achieved through crop-topping and harvest weed seed control including narrow windrow burning, chaff decks and chaff carts.

6.4.3 Triazine-tolerant canola

In 1999, TT canola accounted for almost 50% of the Australian crop. In most cases, TT canola is chosen because the weeds present cannot be controlled in the conventional varieties. In some situations, TT canola may be chosen as part of a strategy to control annual ryegrass resistant to Group A and Group B herbicides, in order to avoid repeated use of trifluralin. In addition, the TT varieties were initially grown without an associated best management package, although this has now been rectified. All future herbicide-resistant crops will be introduced with a best management guide. [9]

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7 S Sutherland. Canola weed management. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

8 S Sutherland. Canola weed management. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

9 S Sutherland. Canola weed management. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

6.4.4 Imidazolinone-tolerant canola

The IT (Clearfield)® canola varieties offer some significant benefits, but there are important limitations. These varieties are marketed along with an imidazolinone herbicide mix, originally On Duty®, but this has been replaced with Intervix®. This has a wide spectrum of activity and does not suffer from extended plant-back periods on acid soils. The introduction of IT varieties has reduced the area of TT canola, which will have herbicide-resistance management and environmental benefits. [10]

6.4.5 Roundup Ready® canola

More information

Roundup Ready® canola Crop Management Plan (CMP)

Pacific Seeds Hyola RT Technology

PIONEER® Brand OPTIMUM® GLY Canola

Roundup Ready® canola (Figure 2) is now available to Australian producers. Roundup® has a wide spectrum of activity on weeds, has no soil residual problems (in the great majority of situations), and belongs to a low-risk group in terms of herbicide resistance.

A problem that the industry has to deal with is the increasing number of documented cases of glyphosate resistance in annual ryegrass. If glyphosate is the only herbicide used in RR canola, these biotypes will survive unless some other intervention is used, such as alternative knockdown herbicides prior to sowing, cultivation at or prior to planting, and/or in-crop herbicides. Best management packages include recommendations for minimising the risk of increased selection for the glyphosate-resistant biotypes. [11]

Figure 2: Herbicide-tolerant canola, including Roundup Ready® varieties. (Source: GRDC)

6.5 Clethodim damage

More information

Canola Damage from Clethodim

Hart: Control of clethodim resistant annual ryegrass in break crops

Hart Trial Results Book

The application of clethodim at the maximum rate of product as defined for some states (i.e. 500 mL/ha of Select®, which contains 240 g clethodim/L; 330 mL/ha of Select Xtra®, which contains 360 g clethodim/L) has been reported to cause the following symptoms on canola:

- delayed flowering
- distorted flower buds
- possible yield suppression

[10] S Sutherland. Canola weed management. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

[11] S Sutherland. Canola weed management. Australian Oilseeds Federation, http://www.australianoilseeds.com/__data/assets/pdf_file/0012/2712/Chapter_12_-_Canola_Weed_Management.pdf

There may be varietal differences in crop damage, although little is known in this regard. However, farmers can control the timing and rate of herbicide application. Spraying earlier may avoid moisture stress, particularly in seasons when rainfall is light. Spraying early means that late-emerging grass weeds will not be controlled with in-crop sprays but these plants are likely to be suppressed by a rapidly closing canola canopy. Seed production from these weeds could still be managed with non-chemical options such a windrow burning. [12]

We have seen significant crop damage in canola with later applied clethodim. The Sumitomo Tech Sheet for Status and label state that it should not be applied after the rosette stage for rates over 250mL/ha.

Agronomist's view

Clethodim resistance in annual ryegrass is increasing. In the past, this was managed by increasing the rate of clethodim. However, populations of annual ryegrass now exist that are resistant to clethodim at 500 mL/ha, and some will survive when treated with 2 L/ha.

No new post-emergent grass herbicides for canola are in the pipeline, so pre-emergent herbicides will have a greater role in managing annual ryegrass post-emergence. The ability of some currently registered and potential products for controlling annual ryegrass in canola was assessed in 2012 at Roseworthy, South Australia (Table 4). None of the pre-emergent herbicides was particularly efficacious against clethodim-resistant annual ryegrass and none was better than using clethodim.[13]

Table 4: Control of clethodim-resistant annual ryegrass in canola at Roseworthy in 2012.

IBS, Incorporated by sowing; POST, herbicides were applied 8 weeks after sowing; CT, crop-topped. Within a column, means followed by the same letter are not significantly different at P = 0.05

Herbicide program	Annual ryegrass plants 8 weeks after sowing (no. per m^2)	Annual ryegrass spikes at harvest (no. per m^2)	Crop yield (t/ha)
1.5 kg/ha of atrazine IBS + 500 mL/ha of Select® POST	387ab	149cd	1.34a
1.5 kg/ha of atrazine IBS + 250 mL/ha of Select® POST	262b	306c	1.13a
1.5 kg/ha of atrazine IBS + 500 mL/ha of Select® + 80 g/ha of Factor® POST	333b	92d	1.37a
Group K IBS	498a	1105a	0.46d
Group K + 2.0 L/ha of Avadex® Xtra IBS	298b	775b	0.76c
Group K + 2.0 L/ha of Avadex® Xtra IBS	235b	260cd	0.88bc
Group K + 250 mL/ha of Dual Gold® IBS	350ab	802b	0.50cd
Group D IBS	108c	149cd	1.11ab

For more information on weed management in winter crops, see the *GrowNotes* Wheat. Section 6. Weed control.

More information

GRDC Update Papers: Maintaining the best options with herbicides

GRDC Update Papers: Options for using more residual herbicides in northern no-till systems

GRDC Update Papers: Herbicides and weeds regional issues trials and developments

GRDC Ground Cover: Revisiting canola management can lift returns

[12] T Cook, G Brooke, M Widderick, M Street (2014) Herbicides and weeds regional issues trials and developments. GRDC Update Papers, 6 March 2014, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/03/Herbicides-and-weeds-regional-issues-trials-and-developments

[13] C Preston, P Boutsalis, S Kleeman, RK Saini, G Gill (2013) Maintaining the best options with herbicides. GRDC Update Papers, 28 August 2013, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/08/Maintaining-the-best-options-with-herbicides