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GRDC
GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SUNFLOWER

SECTION 6

WEED CONTROL

FALLOW WEED CONTROL | PRE-EMERGENT HERBICIDES | POST-EMERGENT HERBICIDES | INTER-ROW SPRAYING | CULTURAL CONTROL: INTER-ROW CULTIVATION | POTENTIAL HERBICIDE DAMAGE EFFECT | REFERENCES AND FURTHER READING

MORE INFORMATION

NSW DPI Management Guide. Weed control in winter crops 2016.

NSW DPI Management Guide. Weed control in summer crops 2012–13.

Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

Weed management studies in sunflower. V Osten, G Wright, M McCosker.

SC Peltzer, A Hashem, VA Osten, ML Gupta, AJ Diggle, GP Riethmuller, A Douglas, JM Moore, EA Koetz (2009) Weed management in wide-row cropping systems: a review of current practices and risks for Australian farming systems. Crop & Pasture Science 60, 395–406.

Weed control

Good weed control is essential for the production of high-yielding and profitable crops. Yield losses caused by weeds can vary greatly, from almost negligible to the complete loss of a crop. Weeds also cause harvest problems, reduce grain quality, contaminate grain, and re-infest paddocks. [1]

Weeds lower crop yields by competing for soil water, nutrients, space and light. In dryland crops where water is often limited, competition for water is the most important factor in reducing yields. For irrigated crops, competition for light and nutrients are more important. Cropping options can also be restricted by difficulty or inability to control weeds in some crops, for example burrs and thornapples in sunflowers.

The first 7 weeks after emergence is the most critical period for weed competition in sunflowers. Early sunflower growth can be reduced by as much as 39% without effective weed control. Additionally, weeds can harbour pests and diseases of the crop. [2]

It is important to rotate herbicide groups to reduce the risk of resistance to Group A herbicides.

The most common broadleaf weeds in sunflowers are bladder ketmia, fleabane (Figure 1), bindweed and milk thistle. The most common grass weeds in sunflowers are barnyard grass and volunteer sorghum.

Figure 1: *Fleabane is one of the most common broadleaf weeds in sunflower crops.*

1 J Fleming, T McNee, T Cook, B Manning (2013) Weed control in summer crops 2012–13. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/248471/Weed-control-in-summer-crops-2012–13.pdf

2 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

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A Storrie (2009) Collecting and preparing plant specimens for identification. NSW Industry & Investment, Primefact 919

DR Berglund (Ed.) (2007) Pest management—Weeds. In Sunflower production. Extension Publication A-1331. North Dakota Agricultural Experiment Station and North Dakota State University Extension Service

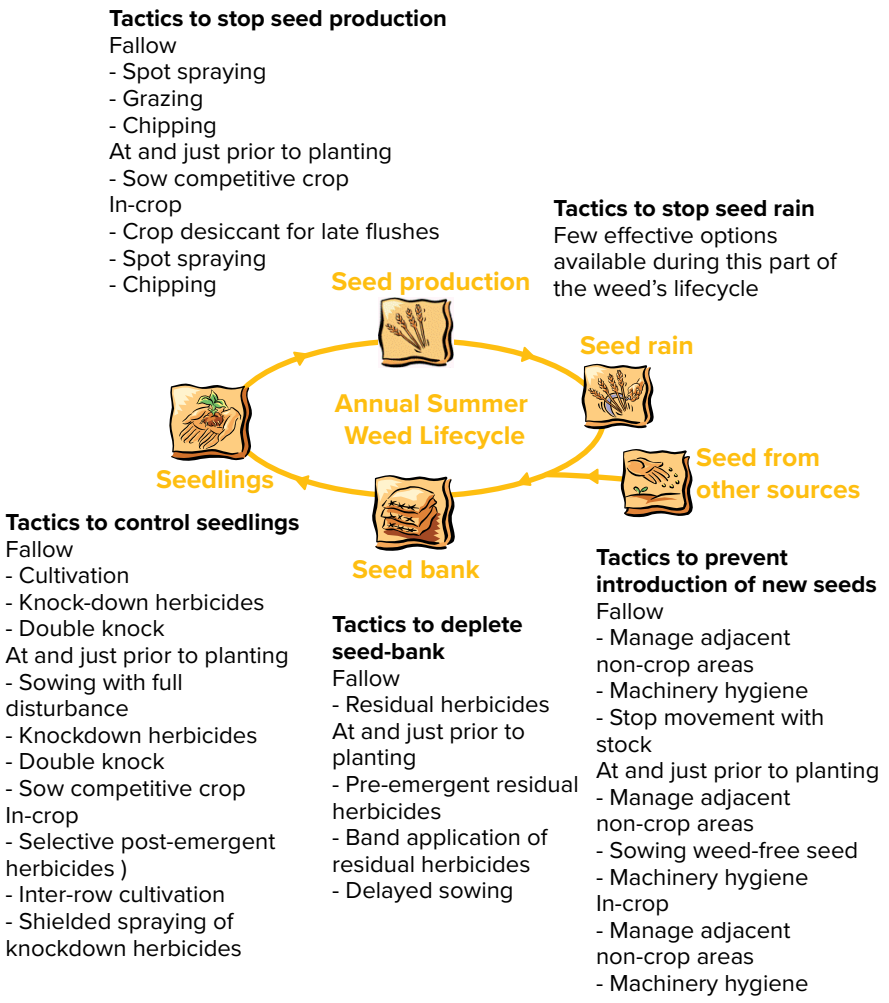

Figure 2: *Integrated weed management for sunflowers. (T McGillion and A Storrie, 2006; V Osten, 2010)* [3]

3 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

MORE INFORMATION

Maurie Street from Grain Orana Alliance discusses glyphosate resistance in ryegrass. GRDC Podcast: 080 Glyphosate resistance survey

Weed management in Queensland field crops

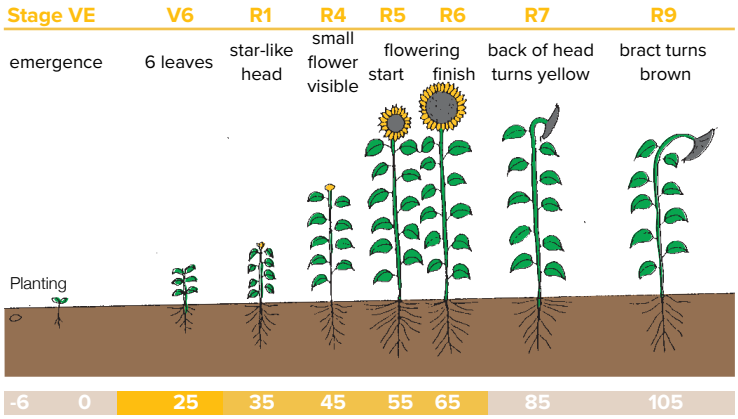

Figure 3: *Sunflower growth stages.* [4]

Table 1: *Herbicide application timing.* [5]

Pre-emergent	PSPE	Post-emergent	Pre-harvest desiccation
Incorporated (PSI)	metolachlor	butroxydim	diquat glyphosate
Incorporated by sowing (IBS)	pendimethalin	fluazifop-p	
metolachlor – PSI, IBS	prometryne	haloxyfop	
pendimethalin - PSI		propaquizafop	
trifluralin- PSI		quizalofop	
		sethoxydim	

In the 'Sunflowers in Northern NSW and Southern Qld—Tools for Success' benchmarking study, only 20% of paddocks in 2004–05 and 13% in 2003–04 and 2005–06 had no weeds detected. This indicates the need for better weed control in sunflowers. [6] The large number of weed species detected by the project and the prominence of broadleaf weeds is a reflection of the lack of herbicides available for post-emergence control of these weeds and limitations with paddock selection.

There are pre-emergence application options for sunflowers, and herbicides are registered and available for post-emergence control of grass weeds. With the increasing incidence of resistance to Group A herbicides, these options should be used as part of an integrated weed management strategy. The identification of glyphosate-resistant barnyard and liverseed grass in northern NSW is a further complication for weed management. Rotation of herbicide groups is difficult with many crops, including sunflower, so an integrated system that combines a number of tactics should be used for weed control. [7] Good herbicide-based weed control can be achieved in sunflowers when glyphosate-resistant barnyard grass and feathertop

4 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

5 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

6 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

7 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

Rhodes grass are present, through use of selective grass-weed control products such as haloxyfop (Verdict®).

Inter-row cultivation is an option to help control broadleaf weeds. Shielded spraying is used on a limited scale, because of the difficulty in application without damaging the sunflowers. [8]

Registered herbicide options for use in-crop are limited, so it is important to select paddocks with low weed populations, particularly broadleaf weeds.

Grass weed control options are available but are all Group A herbicides, and with increasing Group A herbicide resistance, post-emergence options are further reduced. Avoid paddocks that contain bladder ketmia, fleabane, bindweed, milk thistle, barnyard grass and volunteer sorghum, which were noted in the study to be particularly common.

The high incidence of barnyard grass is particularly important, with the recent identification of glyphosate resistance. Volunteer sorghum levels were of concern from a rotational point of view, illustrating the importance of effectively desiccating sorghum crops and fallow grass-weed control. [9]

For sporadic populations of weeds such as thornapples (*Datura* spp.), Noogoora burr and Johnson grass, the time-proven method of chipping or spot spraying is often the most effective and economical control and avoids expensive contaminations at harvest.

Important: You must use a product registered for the required purpose. Always check the label and follow the label instructions. State registration and label instructions should take precedence over all other recommendations. [10]

6.1 Fallow weed control

The increasing use of herbicides during the fallow period for fallow efficiencies and management of resistant weeds provides the same benefits to sunflower as to other summer crops. However, sunflowers are sensitive to some commonly used residual herbicides such as atrazine, chlorsulfuron (Glean®), picloram (Tordon®), imazethapyr (Spinnaker®), imazapic (Flame®), and metsulfuron-methyl (Ally®). These products should be avoided in areas that could be planted to sunflowers.

Some other chemicals used in fallow weed control have the potential to affect crop emergence if the crop is sown too soon after the chemical application. To reduce this risk, a plant-back period is recommended. Please check labels for guidance on plant-backs. Table 1 provides a guide to some commonly used chemicals. [11]

6.2 Pre-emergent herbicides

Paddocks with high broadleaf weed populations should be avoided as in-crop control options are limited and expensive. Pre-emergence application of Stomp® or Stomp Xtra® (pendimethalin) is an option for controlling several grass and broadleaf weeds in sunflower. [12]

Pre-emergent (soil-active/residual) herbicides need to be incorporated by cultivation (pre-emergent or incorporated-by-sowing) or rainfall (post-sowing pre-emergent) to be effective. The efficacy of these herbicides is often compromised by lack of incorporation in no-till systems, crop residues and highly variable rainfall. Even with

MORE INFORMATION

http://www.australianoilseeds.com/Technical_Info/apvma_minor_crop_permits#Sunflower

www.apvma.gov.au

PODCAST

Maurie Street from Grain Orana Alliance discusses harvest weed seed management. GRDC Podcast: 096 Which weeds can be controlled at harvest

MORE INFORMATION

http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/summer

Raising the bar with better sunflower agronomy

MORE INFORMATION

http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/summer

8 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

9 L Serafin, S Belfield (2008) Sunflower production guidelines for the northern grains region—northern NSW and southern Qld. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/249779/Sunflower-production-guidelines-for-the-northern-grains-region.pdf

10 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

11 Australian Sunflower Association (2004) Weed management. The New Big Black Sunflower Pack. Australian Oilseeds Federation

12 L Serafin, D McCaffery, S Thompson (2014) Sunflower. Summer crop production guide 2014. pp. 80–92. NSW DPI Management Guide. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/summer-crop-production-guide

MORE INFORMATION

GRDC Update Paper: Pre-emergent herbicides part of the solution but much still to learn

High plains sunflower production handbook MF2384 (1999) Kansas State University Agricultural Research Station and Cooperative Extension Service

incorporation, if no follow-up rain occurs for weeks or months, the herbicides can remain inactive in the topsoil. Weeds can germinate below the chemical band and emerge through the dry soil and establish. These herbicides are only effective on establishing seedlings and have little effect on established plants.

These herbicides are highly effective and reliable in irrigated sunflowers. [13]

Table 3: *Herbicides for grass weeds – pre-emergent application – and weeds controlled or suppressed.*

Active constituent	**metolachlor 720 g/L & s-metolachlor 960 g/L**	**pendimethalin 330, 440 & 455 g/L**	**trifluralin 480 g/L**
Trade names	Various & Dual® Gold	Various & Stomp® Xtra	Various
Incorporation / timing	PSI, IBS, PSPE,	PSI, PSPE	PSI
Grass weeds			
Annual phalaris			✓
Annual ryegrass			✓
Barnyard grass	✓	✓	✓
Button grass			
Crab grass			✓
Crowsfoot grass	✓	✓	
Early spring grass		✓	
Guinea grass			✓
Johnson grass seedlings			✓
Liverseed grass	✓	✓	✓
Mossman river grass		✓	✓
Native millet		✓	
Pale pigeon grass	✓	✓	
Paspalidium		✓	
Pepper grass		✓	
Qld bluegrass		✓	
Red flinders grass		✓	
Spiny burr grass			
Stink grass		✓	
Summer grass	✓		✓
Weeping lovegrass	✓	✓	✓
Wild oats			
Herbicide group	K	D	D

NOTE: PSI = pre-sowing incorporated; IBS = Incorporated by sowing; PSPE = post sowing pre-emergent
Adapted from: Manning et al. 2008; Infopest, Nov 2009

13 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

Table 4: *Herbicides for broadleaf weeds – pre-sowing application – and weeds controlled or suppressed.*

Active constituent	**metolachlor 720 g/L & s-metolachlor 960 g/L**	**pendimethalin 330, 435, 440 & 455 g/L**	**trifluralin 480 g/L**
Trade names	Various & Dual® Gold	Various & Stomp® Xtra	Various
Incorporation / timing	PSI, IBS	PSI	PSI
Broadleaf weeds			
Amaranthus		✓	✓
Blackberry nightshade	✓	✓	✓
Common heliotrope		✓	✓
Fat hen	✓	✓	
Mintweed		✓	
Pigweed	✓	✓	✓
Potato weed	✓		
Redshank			✓
Sowthistle	✓		
Stagger weed		✓	
Wandering jew	✓		
Wireweed		✓	✓
Yellow vine (caltrop)		✓	✓
Herbicide Group	K	D	D

Adapted from: Manning et al. 2008; Infopest, Nov 2009

Table 5: *Herbicides for broadleaf weeds – post sowing pre-emergent application – and weeds controlled or suppressed.*

Active constituent	metolachlor 720 g/L & s-metolachlor 960 g/L	pendimethalin 330, 435, 440 & 455 g/L	prometryne 900 g/kg
Trade names	Various & Dual® Gold	Various & Stomp® Xtra	Nufarm Prometryne 900
Incorporation / timing	PSPE	PSPE	PSPE
Broadleaf weeds			
Amaranthus		✓	✓
Blackberry nightshade	✓		
Bladder ketmia			✓
Common heliotrope		✓	
Fat hen	✓		
Mintweed		✓	
Morning glory			✓
Pigweed	✓	✓	✓
Potato weed	✓		
Sowthistle	✓	✓	
Stagger weed		✓	
Wandering jew	✓		
Wireweed		✓	
Yellow vine (caltrop)		✓	✓
Herbicide Group	K	D	D

Adapted from: Manning et al. 2008; Infopest, Nov 2009

6.3 Post-emergent herbicides

Post-emergent herbicides have the advantage that they are not applied until the weeds have emerged. There are a number of highly effective grass herbicides (Table 5) registered for use in sunflowers. However, there are no selective post-emergent herbicides registered for broadleaf weeds.

The major disadvantages for post-emergent herbicides are poor control due to poor application and unsuitable meteorological conditions during and after application and plant stress.

Herbicide resistance risk for the Group A mode of action selective grass herbicides is high. Therefore, over-use of these products without an integrated weed management plan in operation, will lead to the failure of these herbicides in as few as six applications.

MORE INFORMATION

J Fleming, T McNee, T Cook, B Manning (2012) Weed control in summer crops 2012–13. NSW Department of Primary Industries

Pest Genie

JT O'Donovan, EA de St. Remy, PA O'Sullivan, DA Dew, AK Sharma (1985) Influence of the relative time of emergence of wild oat (Avena fatua) on yield loss of barley (Hordeum vulgare) and wheat (Triticum aestivum). Weed Science 33, 498–503.

Table 6: *Post-emergent selective grass herbicides and weeds controlled or suppressed.*

Active constituent	butroxydim 250 g/kg	fluazifop-p 212 & 128 g/L	haloxyfop-r 520 g/L	propaquizafop 100 g/L	quizalafop-p- ethyl 99.5 g/L	sethoxydim 186 g/L
Trade names	Factor® WG	Various & Fusilade® Forte	Verdict® 520 & various	Correct® & various	Targa® & various	Sertin® 186 EC
Annual ryegrass					✓	✓
Barnyard grass	✓	✓	✓	✓	✓	✓
Crab grass	✓	✓				
Crowsfoot grass	✓	✓	✓	✓	✓	✓
Dinebra	✓				✓	
Early spring grass	✓					
Johnson grass seedlings	✓	✓	✓	✓	✓	✓
Liverseed grass	✓	✓	✓	✓	✓	✓
Millet	✓		✓		✓	
Mossman river grass		✓	✓			
Pale pigeon grass		✓			✓	
Rhodes grass	✓	✓			✓	
Spiny burr grass	✓					
Stink grass	✓				✓	✓
Summer grass	✓	✓	✓		✓	✓
Sweet summer grass						
Volunteer barley	✓		✓	✓	✓	
Volunteer maize	✓					
Volunteer sorghum	✓			✓		✓
Volunteer wheat	✓		✓	✓	✓	✓
Windmill grass	✓					
Wild oats		✓			✓	✓
Herbicide group	A	A	A	A	A	A

Adapted from: Manning et al. 2008; Infopest, Nov 2009

6.4 Inter-row spraying

Effective weed control to ensure maximum yields and a clean grain sample is best achieved by a combination of crop rotation, good fallow weed control, judicious use of the range of registered herbicides, inter-row cultivation and shielded spraying.

Sunflowers are poor competitors compared to many other crops such as winter cereals. Despite this, the best available agronomy should be implemented to optimise crop environment and growth. Parameters that can improve competitiveness, include crop variety choice, row spacing, sowing rate and sowing depth, optimal crop nutrition and control of diseases and pests.

The development and adoption of auto-steer systems has made inter-row control of weeds in crops more feasible due to reduced operator error during the weed control operation.

MORE INFORMATION

V Osten, H Wu, S Walker, G Wright, A Shields (2006) Weeds and summer crop row spacing studies in Queensland. In Proceedings of the 15th Australian Weeds Conference. Weed Management Society of South Australia

http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/publications/summer

Inter-row weed control allows the use of low herbicide resistance risk, non-selective herbicides to control a range of grass and broadleaf weed seedlings. In sunflowers, this can be particularly useful for the management of broadleaf weeds.

Directed (without shields) inter-row spraying can be effective if used when crop plants are small and conditions minimise the risk of herbicide contacting the crop.

Inter-row shielded spraying is an effective method of controlling small seedlings early in the crops growth with lower risks of crop damage compared with directed sprays.

Shielded sprayers must be correctly calibrated and operated. The bottom of the shields must be less than 5 cm from the ground, and coarse spray droplets used. This means keeping application volumes greater than 70 L/ha and ground speeds around 5 kph.

Dust produced by the shield skirts can also reduce the effectiveness of the herbicide, particularly glyphosate, paraquat and diquat.

The herbicides registered for use in sunflowers for inter-row application using a shield sprayer are paraquat, diquat and 2,2-DPA. [14]

For more information consult your agronomist.

6.5 Cultural control: inter-row cultivation

Inter-row cultivation gives the opportunity to control small annual weeds without herbicides, or in combination with over-row banded herbicides and can be used as a ´back up´ if herbicides fail. Moisture stressed or herbicide resistant weeds can also be controlled. Inter-row cultivation is more effective in drier seasons with higher levels of control and less stimulation of weed germination.

Studies in central Queensland have shown that inter-row cultivation can reduce the effects of a competitive weed like sweet summer grass that can reduce sunflower yield by 65%.

Inter-row cultivation in sunflowers is normally conducted when the crop is 5 to 6 leaf.

Like spraying, weed size is critical to high levels of weed control. Research in Canada found that, as weed size increased, level of control decreased. Table 11 shows the effect of timing of rotary hoeing on control of fat hen (*Chenopodium album*). With many weed species the highest levels of control occurs using cultivation after germination but before emergence. Therefore, highest levels of control will be achieved with two cultivations.

Inter-row cultivation is now more feasible with guidance technology like Robocrop® ‘floating’ tool bar systems and auto-steer. Operator fatigue has always been a problem with inter-row cultivation and spraying leading to crop damage and loss of sections of crop row. These systems allow closer cultivation to the crop row and reduce the number of weeds near the row which compete strongly with young sunflowers.

Timing of inter-row cultivation will also be determined by the developmental stage of the crop. Cultivating when the crop is too large can damage roots, reducing yield.

Use of inter-row cultivation will also be restricted if stubble cover is high. Cultivation in high trash cover can cause balling of the stubble with soil, which could bury crop plants and make further inter-row operation difficult. Loss of stubble cover from cultivation also poses significant moisture loss and erosion risks.

Inter-row operations are relatively slow with 40 ha treated per day being typical.

14 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

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MORE INFORMATION

Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

6.6 Potential herbicide damage effect

Sunflowers can be unintentionally damaged by herbicides via application of registered products, soil residues and herbicide drift. Sunflowers are particularly sensitive to atrazine (Group C), and sulfonylurea (Group B) herbicides such as metsulfuron, chlorsulfuron and triasulfuron

Research conducted in northern NSW in the 2007–08 season showed that registered products can cause crop yellowing and stunting, although sunflowers may be more tolerant to damage sustained early in the season. Vapour drift is confined to volatile herbicides such as 2,4-D ester. [15]

Vapours may arise directly from the spray or from evaporation of herbicide from sprayed surfaces. Use of 2,4-D ester in summer can lead to vapour drift damage of highly susceptible crops such as tomatoes, sunflowers, soybeans, cotton and grapes. This may occur hours after the herbicide has been applied.

Vapours and minute particles float in the may be carried for many kilometres in thermal updraughts before being deposited.

Sensitive crops may be up to 10,000 times more sensitive than the crop being sprayed. Even small quantities of drifting herbicide can cause severe damage to highly sensitive plants. [16]

6.7 References and further reading

DD Buhler, JD Doll, RT Proost, MR Visocky (1995) Integrating mechanical weeding with reduced herbicide use in conservation tillage corn production systems. Agronomy Journal 87, 507–512

DC Cloutier, ML Leblanc (2001) Mechanical weed control in agriculture. In Physical control methods in plant protection. (Eds C Vincent, B Panneton, F Fleurat-Lessard) Springer, pp. 191–203

JF Holland, DW McNamara (1982) Weed control and row spacing in dry-land grain sorghum in northern NSW. Australian Journal of Experimental Agriculture & Animal Husbandry 22, 310–316

T McGillion, A Storrie (Eds) (2006) Integrated weed management in Australian cropping systems—a training resource for farm advisors. CRC for Australian Weed Management

15 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Weed Management https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=4

16 J Fleming, T McNee, T Cook, B Manning (2013) Weed control in summer crops 2012–13. NSW DPI Management Guide. NSW Department of Agriculture, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/248471/Weed-control-in-summer-crops-2012–13.pdf