MANAGING WILD OATS FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

NATIONAL
JANUARY 2019

Control wild oats through crop rotations, smart herbicide use and minimising grain sample contamination

PHOTO: RICHARD HOLZKNECHT

Wild oats standing tall above a wheat crop.

The management of wild oats has been complicated by the widespread development of herbicide resistance to the major post-emergent herbicides used to control it. This means a range of tactics are needed to drive wild oat numbers down and keep them low. These include a combination of pre-emergent herbicides, crop rotation, crop competition, stopping weed seed-set and harvest weed seed control. All growers should be conducting herbicide resistance testing to know which herbicides are still effective in each of their paddocks.

Wild oats (*Avena* spp.) are among the world's most common and economically damaging weeds of annual cropping systems. There are two main species of wild oat in Australian crops: *Avena fatua* and *A. sterilis* ssp. *ludoviciana* (also referred to as *A. ludoviciana*). Wild oats are also known as 'black oats'.

Wild oat substantially reduces crop yield because it is a highly competitive weed, especially when it emerges before or with the crop. Wild oat plants are well-adapted to infesting crops because they:

- can be difficult to identify having a similar appearance to cereal crops and therefore are not managed effectively;
- have post-harvest seed dormancy producing a staggered germination the following season;
- can develop resistance to herbicides but are slower to develop compared with weeds such as annual ryegrass; and
- usually shed a large proportion of seeds before crop harvest, allowing the weed to persist long-term in cropping fields.

KEY POINTS

- If uncontrolled, wild oats can reduce wheat yield by up to 80 per cent.
- Using a combination of effective agronomic, non-chemical tactics and herbicides is essential to manage wild oats.
- Use combinations of pre-emergent and post-emergent herbicides and change the combination each year to use different modes of action.
- In-crop post-emergent herbicides for wild oat should only be used following testing for resistance. Resistance is widespread in Australian wild oat populations and testing is recommended to determine which herbicides are still effective; particularly with Group A (fops and dims), Group B (sulfonylurea) and Group Z (flamprop-m-methyl).
- Post-emergent herbicides in the Group B (imidazolinone) class are still effective against wild oats. These products must be used in combination with Clearfield® imidazolinone-tolerant varieties of wheat, barley, canola and pulse crops, with a clear understanding of the crop plant-backs associated with using this group of chemicals.
- Managing large wild oat populations with a winter fallow and rotating to a summer crop is highly effective in NSW and Queensland.
- Cutting crops for hay or brown manuring can be an effective way of weed seed control if completed prior to seed shedding.
- Wild oats tend to initially grow in patches meaning more targeted monitoring and management is possible.

P Level 4 | 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604
T +61 2 6166 4500 **F** +61 2 6166 4599 **E** grdc@grdc.com.au

HOW WIDESPREAD IS THE WILD OAT PROBLEM?

Wild oat is the third most important weed in Australian broadacre cropping systems after annual ryegrass and wild radish, infesting more than 2 million hectares and causing 114,600 tonnes of crop yield loss and $28 million in lost revenue. Contributing to the impact of wild oats is the management costs required and particularly the additional costs associated with controlling herbicide-resistant populations ($6.2 million nationally).

TABLE 1 Regional estimates on the affect of wild oats on all crops.

GRDC region	Area infested (ha)	Crop yield loss (t)	Total revenue loss
Northern	631,200	20,400	$4.5 million
Southern	1,252,300	87,855	$21.7 million
Western	131,000	6,345	$1.9 million

SOURCE: LLEWELLYN ET AL, 2016

Wild oat is the most competitive grass weed in cereal crops across the northern region and second most competitive grass weed in the southern region.

HERBICIDE RESISTANCE

Herbicide resistance is one of the greatest threats to the sustainability of Australia's current grain production systems.

A reliance on herbicides for weed control in Australian grain systems has led to the development of resistance among 49 weed species across 12 herbicide mode of action (MOA) groups.

In Australia there are populations of wild oats resistant to Group A, Group B (sulfonylurea) and Group Z herbicides, with some populations resistant to multiple groups or sub-groups. It has been estimated that one in three wild oats populations are resistant to both Group A and Z herbicides (multiple resistance). Often wild oats populations found to be resistant to some Group A herbicides are still susceptible to other Group A herbicides. This highlights the importance of testing for herbicide susceptibility. The potential development of resistance to glyphosate is a key threat in wild oats.

Managing wild oats: key tactics

Growers should use the WeedSmart 'Big 6' tactics to manage wild oats. While some tactics are more effective than others in managing wild oats, the more that can be implemented the more you can drive down weed numbers.

1. Rotate crops and pastures

To effectively manage wild oats there must be a stacking of a range of control tactics both within and between seasons. This will include using different herbicide MOAs within a season and crop/pasture, either sequentially or as a tank mix. Also use multiple non-herbicide tactics within and between seasons.

ROTATING CROP TYPES AND CULTIVARS

Growing a range of different crops and pastures in succession allows the use of an increased number of weed management tactics to keep weed numbers low. Growing a range of crops, pastures and including fallow not only increases the number of herbicide MOAs that can be used but also allows the introduction of tactics such as delayed sowing, crop-topping, brown or green manuring, haymaking and silage.

Growing herbicide-resistant crops and pulses also increases the number of herbicide options available for controlling wild oats. Triazine-tolerant canola allows the use of atrazine and simazine (Group C) while the range of imidazolinone-tolerant (Clearfield®) crops, including wheat, barley, canola and lentils, enable the use of Group B imidazolinone ('imi') herbicides to control wild oats. Triazine-tolerant and imi-tolerant crops also have a role in paddocks that may have triazine or imidazolinone residues from the previous crop. Glyphosate-resistant canola can also play a role in wild oat management.

Pulse crops allow the use of a range of pre-emergent and post-emergent herbicides not suitable for cereal crops. Wild oat populations that are resistant to cereal crop Group A herbicides can still be susceptible to less-selective Group A herbicides, such as fluazifop and haloxyfop.

Pulse crops such as lentils, field peas and chickpeas and short-season cereals can also be sown later than the main cereal crop creating the opportunity for additional pre-sowing control of wild oats with a knockdown herbicide or cultivation.

Growing crops to either green or brown manure, or cut for hay or silage, creates another opportunity to control wild oats while generating income from fattening stock or selling hay or silage. Any of these techniques will give extremely high levels of wild oat control if conducted prior to oat seed-set. Remember to follow these tactics with either heavy grazing or an effective knockdown herbicide to prevent any wild oat regrowth from setting viable seed.

MODE OF ACTION MATTERS

The main reason resistance has developed is due to the repeated and often uninterrupted use of herbicides with the same mode of action (MOA).

USING PASTURE AND GRAZING MANAGEMENT

Introducing a well-managed pasture into the rotation will compete with the wild oats while generating income from livestock, hay or silage making. A well-managed legume-based pasture gives the additional benefits of building soil nitrogen and will act as a crop disease break.

Effective pastures include a one to two-year high-density legume such as berseem clover, crimson clover and Persian clover in the southern region or French serradella in WA. A more traditional three to four-year subclover, serradella or medic-based pasture is also effective. Lucerne also gives a range of options from different herbicides not used in cereal crops to hay cutting and grazing.

The Group A herbicides such as fluazifop, haloxyfop, quizalofop and propaquizafop can potentially be used to remove annual grasses in legume-based pastures. Remember to test your wild oats for herbicide sensitivity before using these products.

Paraquat can be used for pasture topping in spring to reduce annual grass seed-set and, when combined with grazing, can be very effective.

The Group B imi herbicide imazamox

can also be used on legume-based pastures including lucerne when used as an early post-emergent herbicide. Remember the overuse of Group B imi herbicides will lead to the development of herbicide resistance.

Dual-purpose grazing–grain cereal crops can also be effective with good crop competition and intensive grazing.

While wild oats are readily grazed by livestock, high grazing pressure needs to be maintained when wild oats are heading. Maintaining adequate grazing pressure is difficult where paddocks are large. Short grazing duration with high stock density will see wild oats reshoot and rapidly set seed. Therefore, grazing will only be useful where sufficient grazing pressure can be maintained to prevent flowering and seed-set or is followed with another tactic to prevent seed-set of regrowth.

WINTER FALLOWS

Winter fallow is a very effective technique to control wild oats and a range of other weeds.

In the northern region winter fallow is often followed by a summer crop. In drier areas, where summer cropping is unreliable, a long winter fallow is also highly effective. Use non-selective herbicides, grazing and/or cultivation to control wild oats.

Multiple winter fallows will be required to get a large population under control. Two successive winter fallows are required to reduce seedbanks by 99 per cent. Therefore, summer cropping or long fallowing can be a highly effective strategy.

OTHER TACTICS TO CONSIDER

- Use weed-free seed. Buy clean seed or choose your 'cleanest' paddock to harvest seed for planting. Grade it to ensure you are not 'planting' wild oats in the next crop.
- Delaying sowing coupled with effective control of seedlings prior to sowing will drive down the weed seedbank.
- Strategic cultivation can be a useful tool to control a large flush emergence of wild oat seedlings. However, cultivation can extend seedbank life and/or stagger germination by burying seed. This contrasts with surface-germinating weeds such as fleabane or sowthistle, which will not emerge from deeper in the soil. Trials have shown the majority of wild oat seeds emerge from or remain viable in the top 7.5cm of the soil. This suggests plants arising from seeds in this layer are the most likely to compete with the crop as they will emerge around the same time as the crop. As the depth at which seeds are buried increases, the percentage of seedlings emerging decreases (Table 2). Extrapolating from this data for wild oat seeds in clay soils, it would be expected that total emergence from below 12.5cm would be low.

TABLE 2 Percentage of wild oats seeds emerging at 10-day intervals buried at varying depths of a light sandy clay loam, Western Australia.

	Percentage of seeds emerging from varying depths		
Sowing depth	10 days	20 days	30 days
0.5cm	60	65	65
2.5cm	68	75	75
12.5cm	32	75	80
15cm	10	62	65
17.5cm	3	45	47

SOURCE: PATERSON ET AL, 1976

DRIVE DOWN WEED NUMBERS

The general 'Big 6' WeedSmart tactics recommended to drive down weed numbers and reduce the impact of herbicide resistance are:

1 Rotate crops and pastures

2 Use the double-knock

3 Mix and rotate herbicides

4 Stop weed seed-set

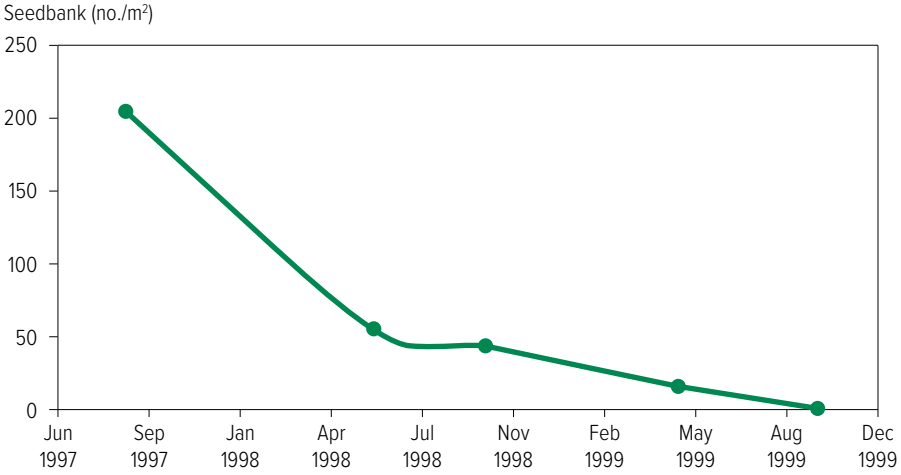
5 Increase crop competition

6 Implement harvest weed seed control.

Visit weedsmart.org.au

A well-managed pasture phase will reduce wild oat seed-set through a range of tactics such as competition, hay, spraytopping and grazing.

FIGURE 1 Persistence of wild oats with a small seedbank and no seed replenishment in northern NSW.



SOURCE: WALKER ET AL, 1999 UNPUBLISHED

2. Double-knock

Double-knock is the use of two tactics in close succession, where the second tactic controls any survivors of the first tactic. These tactics can be anything that controls the weeds and are not limited to herbicides, for example a knockdown herbicide followed by cultivation, grazing followed by herbicide or cultivation, or two herbicides with different MOAs.

Some growers extend the time between tactics to control additional weed germinations, however this often reduces the level of control of weeds that have survived the first tactic.

The most commonly used form of double-knock is the double knockdown herbicide where any application of glyphosate is followed by a high rate of paraquat or paraquat + diquat. This ensures any wild oats that may have glyphosate resistance are controlled by the second herbicide application.

Other useful double-knocks for the control of wild oats include:

- heavy grazing followed by a knockdown herbicide;
- pre-emergent herbicide followed by a selective post-emergent herbicide in-crop; and
- in-crop selective post-emergent herbicide followed by crop-topping.

3. Mix and rotate herbicides

PRE-EMERGENT OR RESIDUAL HERBICIDES

Pre-emergent or residual herbicides are applied prior to crop and weed emergence. They provide extended control of germinating or emerging weeds.

Pre-emergent herbicides can provide a 40 to 80 per cent reduction in wild oat numbers in zero-tillage farming systems with minimal incorporation. Therefore, pre-emergent herbicides must be followed with a selective post-emergent herbicide in-crop, or harvest weed seed control, or any combination of these.

The performance of pre-emergent herbicides will vary with herbicide, physical soil conditions, timing and amount of rainfall, and the position and depth of wild oat seeds germinating in the soil profile (GRDC Pre-emergent manual: https://grdc.com.au/SoilBehaviourPreEmergentHerbicides).

It is important to assess crop plant-back intervals when using pre-emergent herbicides. Using a herbicide with a long plant-back can limit future crop-pasture choices. The plant-back period is strongly affected by many factors such as the amount of rainfall or irrigation as well as the duration of moist soil, the pH, temperature and microbial activity following application of pre-emergent herbicides.

When pre-emergent herbicides were first introduced for weed control they had to be fully incorporated into the surface soil with cultivation. This practice had additional costs for incorporation, additional labour, loss of soil moisture and inconsistency of control.

Pre-emergent herbicides are generally registered to be incorporated by the planting operation and are known as 'incorporated by sowing' (IBS) or they can be applied after seeding and prior to crop emergence, known as 'post-sowing pre-emergent' (PSPE). These techniques are most effective with reduced-tillage systems as the majority of wild oat seeds are found near the soil surface. IBS and PSPE applications may require higher herbicide label rates compared with the full incorporation technique. There are several factors to consider when using this technique:

- Herbicides applied IBS often require a tyne or a disc planter with some soil throw/disturbance to ensure soil covers the herbicide-treated soil.
- Poor levels of weed control are often found immediately adjacent to the crop row because the herbicide-treated soil is removed during the planting operation. This is less of a problem with herbicides with higher water solubility compared with herbicides such as trifluralin and pendimethalin.
- Sowing travel speed is very important to ensure adequate soil throw to incorporate the herbicide, yet avoid herbicide-treated soil being thrown into the next planting row where crop damage may occur, particularly in cereals. The sowing speed rule of thumb is 1km/hour per 2.5cm spacing (that is, 22.5cm spacing should be 9km/hour maximum for a tyne seeder). This will vary with soil conditions and machine and must be checked. Dry soil will throw further than wet soil.

HERBICIDES CURRENTLY REGISTERED FOR CONTROL OR SUPPRESSION OF WILD OATS

Cereal options: Herbicides currently registered for control of wild oats using IBS or PSPE in a range of cereals include imazapic + imazapyr (B – imi); pendimethalin, oryzalin + trifluralin (D); prosulfocarb + s-metolachlor (J + K); pyroxasulfone (K); and triallate, prosulfocarb (J).

Canola options: Triazine-tolerant canola also has several IBS or PSPE Group C herbicides including terbuthylazine, simazine and atrazine. For all canola cultivars there are trifluralin, pendimethalin and propyzamide (D); triallate (J); and metazachlor (K).

Pulse crop options: Pulse crops also have IBS or PSPE herbicides registered for controlling wild oats:

- chickpeas – terbuthylazine, simazine (C); trifluralin, pendimethalin (D); triallate (J);
- field peas – imazethapyr (B); terbuthylazine, metribuzin (C); trifluralin, pendimethalin (D); triallate (J);
- lupin – terbuthylazine, simazine (C); trifluralin, pendimethalin (D); triallate (J);
- faba bean – imazethapyr (B); terbuthylazine, simazine (C); triallate (J); and
- lentil – terbuthylazine (C); trifluralin (D).

Weed control is often improved by using herbicide tank mixtures.

IN-CROP SELECTIVE HERBICIDES – GROUPS A, B AND Z

Since the early 1980s, post-emergent selective herbicides have protected crop yield from wild oat competition, but they have not prevented seed going back to the seedbank at the end of the season. Resistance to these herbicides is now widespread in the northern and southern regions, and less common in the western region.

Recent resistance surveys show the focus should not only be on Group A. For example, 2016 resistance surveys in central NSW found 69 per cent of samples showed resistance to the Group Z herbicide flamprop-m-methyl. This was up from 51 per cent of samples resistant in 2013. The Charles Sturt

University resistance testing service showed that in 2017 75 per cent of wild oat samples were resistant to 'fops', 9 per cent were resistant to 'dims', 17 per cent were resistant to 'dens', 11 per cent were resistant to Group B 'su' and 17 per cent were resistant to Group Z.

There is often cross-resistance between the herbicide groups, with one in three wild oat populations resistant to Group A fops also resistant to Group Z.

If planning to use in-crop selective herbicides it is critical to test for herbicide susceptibility as it may reveal the post-emergent herbicides that are still effective.

Testing has shown that while there is resistance to in-crop Group A fop herbicides such as diclofop, fenoxaprop and clodinafop, herbicides such as fluazifop, haloxyfop, quizalofop and propaquizafop will still be effective in pulse crops and canola.

Group B (imidazolinone) post-emergent herbicides are still effective against wild oats. These products must be used in combination with Clearfield® imidazolinone-tolerant varieties of wheat, barley and canola and pulse crops, with a clear understanding of the plant-back implications associated with this group of chemicals.

Crop-topping wild oats tends to be less effective than it is for annual ryegrass because in most seasons wild oats mature earlier than the crop. This creates a very narrow window of application for stopping seed-set while minimising damage to the crop.

ADDITIONAL HERBICIDE TIPS

Revisit paddocks two to three weeks after spraying herbicides to determine treatment effectiveness.

Group A dim chemistry: the addition of ammonium sulfate can improve efficacy, particularly in high bicarbonate water sources.

NOTE: Bicarbonate needs to be tested for specifically as it does not register on normal water hardness tests.

Always use herbicides as the label states and refer to the Australian Pesticides and Veterinary Medicines Authority for the latest updates and regulations (https://apvma.gov.au).

4. Stop wild oat seed-set

The focus on wild oats control must include seedbank management by stopping seed-set and keeping weed numbers low. Wild oats has a relatively short-lived seedbank (three to four years) and a seed half-life of about six months, so preventing seedbank replenishment will reduce weed numbers in a relatively short period of time.

SELECTIVE SPRAYTOPPING

Selective spraytopping is the use of a selective herbicide to prevent seedset of wild oats.

Two herbicides are registered for this use:

Flamprop-m-methyl (Group Z): in wheat and chickpea and Pinoxaden + cloquintocet-mexyl (Group A): in wheat and barley.

Both the growth stage of the wild oat and crop are important to maximise efficacy and crop safety. Refer to the product label for full details.

Herbicide susceptibility testing must be carried out before you plan to use this technique..

NOTE: If a wild oat plant is resistant to herbicides at the seedling stage it will be resistant at all growth stages.

For best results selective spraytopping should be used in combination with an earlier control such as pre-emergent herbicide.

CAUTION: Some Group A herbicides have very long harvest withholding periods.

MANURING, BALING AND SILAGE

The tactics of manuring, baling and silage are normally used to manage wild oats when there has been a massive control failure in crop. While the income from a grain harvest is forgone these techniques enable the control of a weed blowout within the current season. Failure to control a massive wild oat blowout means a large amount of seed is returned to the seedbank and it will take more than five years to bring the wild oat population down to manageable levels.

Taking a partial approach by patch spraying wild oats in crop with glyphosate (brown manuring) can be effective at reducing large numbers of seed returning to the seedbank. However, evidence shows most growers regret not treating the whole paddock as the wild oats are more widespread than initially thought.

CROP-TOPPING

Crop-topping involves using a non-selective knockdown herbicide such as glyphosate once the crop has reached a certain level of maturity (28 per cent moisture) where it will not be severely damaged by the herbicide. The aim is to reduce the amount of viable wild oats seed. This technique is more effective in a drier spring where the crop matures more closely to the wild oats. In wetter springs crops mature later than the wild oats, which mature and shed seed before herbicides can be applied.

HARVEST SALVAGE

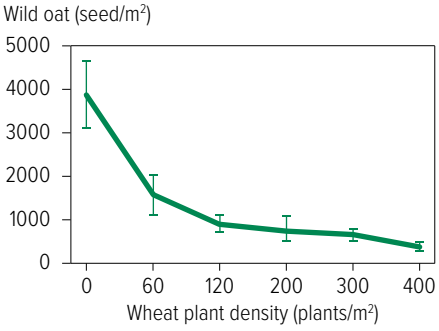
Harvest salvage is similar to crop-topping; however, the aim is to kill weeds and desiccate the crop for harvest. It is not strictly targeting weed seed production.

NOTE: If crop-topping or using harvest salvage, only use herbicides registered for that purpose at the correct timing for that crop.

5. Crop competition

Recent research has shown that using crop competition can be effective in managing wild oats in wheat crops. Sowing winter cereals at increased plant density, has been shown to reduce wild oat seed production (Figure 2, Table 3) and that barley is a significantly better competitor than wheat (Table 3).

FIGURE 2 Influence of increasing wheat plant density on wild oat seed production. There was a 40% reduction in wild oat seed production by increasing wheat plant density from 60 to 120 plants/m².



SOURCE: WALSH, 2017

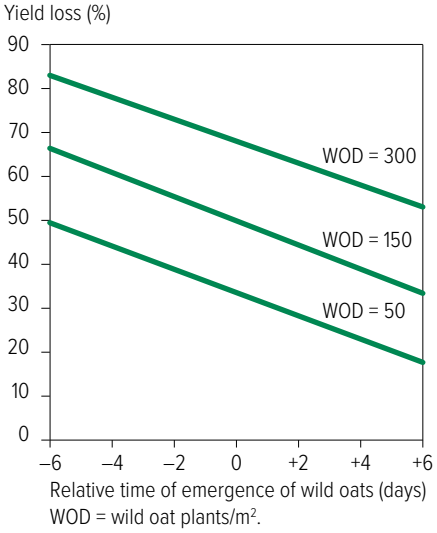
TABLE 3 Influence of crop density and herbicide rate on seed production of wild oats.

Treatment	Wild oat seeds produced per m²	
Target crop density	Wheat	Barley
50	550	21
100	230	7
150	200	5
LSD (P=0.05)	(ns)	(0.61)

SOURCE: ADAPTED FROM WALKER ET AL, 1998

The growth and development of wild oat plants are severely restricted when seedlings emerge later than the crop. Research by O'Donovan et al (1985) in Canada showed the effect of time of emergence and density of wild oats relative to wheat on wheat yield (Figure 3). The higher the wild oat density and earlier it emerges the greater the wheat yield loss. It is therefore important to ensure crops emerge quickly by sowing at the correct depth and using good-quality seed. This research also demonstrates why pre-emergent herbicides are very effective in reducing early crop competition.

FIGURE 3 Influence of wild oat emergence at various intervals before the crop (–), at the same time as the crop (0), and at intervals after the crop (+) on yield loss of wheat.



SOURCE: O'DONOVAN ET AL, 1985

6. Harvest weed seed control

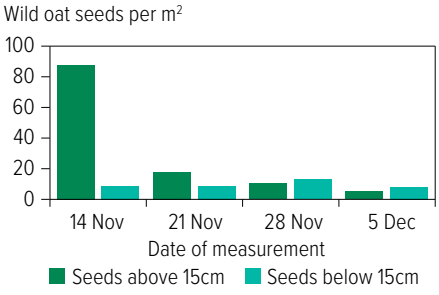
Harvest weed seed control (HWSC) in particular has been an effective weed control strategy in annual ryegrass and is widely adopted in WA and increasingly in SA, Victoria and southern NSW.

HWSC involves collecting or destroying weed seeds that are present at harvest. There are currently six HWSC tools being used by Australian grain growers: narrow windrow burning; chaff carts; chaff tramlining or chaff decks; bale direct systems; chaff lining; and seed impact mills.

While brassica weeds (for example, wild radish, some mustard species, wild turnip) and annual ryegrass often have characteristics well suited to HWSC, i.e. the mature seed is retained on the plant for an extended period, it is less effective on wild oats due to the shattering of seed before crop harvest. However, HWSC is more effective on wild oats that have germinated later in crop as their maturity is closer to that of the crop. The greatest amount of seed collected occurs when harvest is close to crop maturity. Any delay in harvest will see the percentage of wild oats seed collected by HWSC decline rapidly as seen in Figure 4.

Read more about HWSC at the WeedSmart website (https://weedsmart.org.au/the-big-6/harvest-weed-seed-control-holy-grail/).

FIGURE 4 Results from Hawker, South Australia, 2009, showing how quickly wild oat can shed mature seed.



SOURCE: PETER HOOPER, HOOPER CONSULTING

Effectiveness of wild oat control strategies

There are many strategies that can be used to manage wild oat and research is ongoing into the effectiveness of these. The following table outlines the impact of these strategies on weed control. By combining multiple strategies, we can drive down weed numbers. The list of tactics in Table 4 includes 19 different options. Many of these may not be applicable to your farm, but there are likely to be at least six to eight that should be incorporated in your farming system.

Herbicide resistance/ susceptibility testing services

Two commercial testing services are available in Australia to determine the level of herbicide resistance in your paddocks:

CHARLES STURT UNIVERSITY

- Herbicide resistance seed testing for wild oats (as well as annual ryegrass, barley grass, brome grass, and wild radish).
- The best time to collect suspected resistant weed seed is when it is close to maturity, which often occurs before the crop is to be harvested.
- Samples must be received before 1 April to be tested for the upcoming season.

More information: www.csu.edu.au/weedresearchgroup/herbicide-resistance

PETER BOUTSALIS, PLANT SCIENCE CONSULTING

- Two types of herbicide resistance/ susceptibility tests are offered: seed test and The Quick Test.
  - To test for pre-emergent herbicide resistance you must use the seed test. Seed tests take about 12 weeks.
  - The herbicide resistance/ susceptibility Quick Test is suitable for post-emergent herbicides such as glyphosate or in-crop selective herbicides. The Quick Test will work on grasses from seedlings to advanced tillering as long as the plants are green and healthy.

More information:
www.plantscienceconsulting.com.au

TABLE 4 List of tactics that could be used in combination as an integrated weed management approach to reduce the impact of wild oats and maintain the usefulness of effective herbicides.

Tactics to control wild oat	Likely control % (range)	Ease of incorporating into farming system
Double knockdown (double-knock)	99 (99—100)#	Easy to moderate
Silage and hay: crops and pastures	97 (95—99)	Moderate to hard
Renovation crops: green or brown manuring, mulching etc.	95 (85—99)#	Moderate
Crop choice and sequence	95 (30—99)	Ease to moderate
Herbicide-tolerant crops	90 (80—99)	Easy
Spraytopping with selective herbicides	90 (60—99)	Easy
Sow weed-free seed	85 (50—99)#	Moderate
Knockdown herbicides to fallow and pre-sowing control	80 (70—90)	Easy
Pre-emergent herbicides	80 (70—90)	Easy to moderate
Selective post-emergent herbicides	80 (70—90)	Easy
Pasture spraytopping	80 (70—90)	Moderate
Grazing to actively manage weeds in pastures	75 (60—80)	Moderate to hard
Improving crop competition	70 (20—99)	Ease to moderate
Inversion ploughing	50 (40—60)#	Moderate to hard
Autumn tickle	40 (30—60)	Easy to moderate
Harvest weed seed control	40 (20—80)	Moderate to hard
Burning crop residues	40 (0—80)#	Moderate to hard
Fallow and pre-sowing cultivation	40 (0—80)#	Easy to moderate
Crop topping with non-selective herbicides	30 (10—50)#	Easy

no reference in IWM manual, so estimate was made by Cook et al (2014).

SOURCE: COOK ET AL, 2014. ADAPTED FROM STORRIE, 2014

IDENTIFYING AND MONITORING WILD OATS

Wild oats can grow in discrete patches but can also be spread across the paddock. Wild oat densities are generally up to 50 plants/m^2 while high densities can reach 500 plants/m^2. This is lower than annual ryegrass, which ranges up to thousands of plants/m^2.

SEEDS

Wild oat seeds are large (15 to 25mm) and drop within 1 to 2m of the parent plant. They are usually dark in colour but can vary through to cream. Hairiness of seeds also varies. Wild oats can produce large numbers of seeds. In northern NSW maximum seed-set has been approximately 225 seeds/plant for low densities and less than 50 seeds/plant for densities above 50 plants/m^2.

Up to 20,000 seeds/m^2 can be produced by uncontrolled infestations.

PLANTS

The seedling leaves emerge rolled and are twisted in an anticlockwise direction, the opposite to wheat and barley. Wild oat plants have a large ligule with no auricles. The leaves tend to be slightly hairy with a slight bluish hue. Wild oats have a rolled sheath and the colour of the collar (where leaf blade joins leaf sheath) is similar to the leaf.

Wild oat plants between rows in a grain crop. PHOTO: EMMA LEONARD, AGRIKNOWHOW

GROWNOTES™

GrowNotes™ — your one-stop shop for regional trial results and best practice recommendations:

www.grdc.com.au/GrowNotes.

CAN BE CONFUSED WITH ...

In the seedling phase, wild oat can be confused with all brome grass species, which have tubular leaf sheaths, a prominent collar and long hairs on the edge of the leaf blade.

Often the seed remains attached to both wild oat and brome grass seedlings, so carefully dig up the seedlings to find the seed.

Brome grass. Note the prominent hairs on the leaf margins. PHOTO: ANDREW STORRIE, AGRONOMO

Wild oat (*Avena fatua*) seeds. PHOTO: GEOFF SAINTY

FREQUENTLY ASKED QUESTIONS

Why is it that I can often kill wild oats with grass herbicides but the ryegrass in the same paddock is resistant?

Ryegrass often occurs at higher densities than wild oats, which means there will be more resistant plants in that population even before many herbicides are applied. Ryegrass is also an obligate out-crosser so it must get pollen from another plant to produce fertile seed. This enables resistant genes to move between plants. Wild oats on the other hand is self-pollinated (88 to 100 per cent) so genes are not shared between plants. Recent research by Australian Herbicide Resistance Initiative (AHRI) found the genetics are also very different between these two weeds. Ryegrass is diploid and has two copies of each gene. Wild oats is more like wheat, and has six copies of every gene (hexaploid). In ryegrass, a single gene mutation causes it to be resistant to a grass herbicide. In comparison, a single gene mutation will cause nil to low-level resistance in wild oats as the resistance gene in wild oats is diluted by susceptible genes. Read more at the AHRI website (https://ahri.uwa.edu.au/why-do-wild-oats-develop-resistance-slowly/).

Is there any new technology/research that may assist with wild oat management?

No. However, GRDC is investing research into better surveillance of weeds either in fallows or crops. Images, gathered by ground-based vehicles, drones or satellites, may be analysed for spectral and shape signatures specific for wild oats. The idea is this technology can be used to apply herbicides more accurately to individual weeds. There is currently optical spray technology in place for fallow weeds, but there is a need for more accurate technology for weed recognition within crops.

Are there any pests or diseases associated with wild oats?

Wild oats are a main host for cereal cyst nematode (*Heterodera avenae*), stem nematode (*Ditylenchus dipsaci*), and the root lesion nematode (*Pratylenchus neglectus*). They also host the root diseases rhizoctonia (*Rhizoctonia solani*) and crown rot (*Fusarium graminearum*). Wild oats can host the foliar diseases oat leaf rust (*Puccinia coronata avenae*), oat stem rust (*Puccinia graminis avenae*) and barley yellow dwarf virus between cropping seasons.

RESOURCES

Congreve, M (2016) Advances in weed management webinar 'Ecology and management of wild oats'. GRDC video, **https://www.youtube.com/watch?v=V8Vgy1ROIA8.**

GRDC (2015) Controlling Black Oats. GRDC Radio, featuring Chris Preston, Southern Update, 29 October 2015, **https://grdc.com.au/news-and-media/podcasts/grdc-radio-southern/2015/10/103-south.**

GRDC (2018) Integrated Weed Management Hub. GRDC, **https://grdc.com.au/resources-and-publications/iwmhub.**

MORE INFORMATION

Michael Widderick
Queensland Department of Agriculture and Fisheries
michael.widderick@daf.qld.gov.au
07 4529 1325

Tony Cook
NSW Department of Primary Industries
tony.cook@dpi.nsw.gov.au
0447 651 607

Hanwen Wu
NSW Department of Primary Industries
hanwen.wu@dpi.nsw.gov.au
02 6938 1602

Catherine Borger
WA Department of Primary Industries and Regional Development
catherine.borger@dpird.wa.gov.au
0467 816 082

Richard Daniel
Northern Grower Alliance
richard.daniel@nga.org.au
07 4639 5344

Maurie Street
Grain Orana Alliance
maurie.street@grainorana.com.au
0400 066 201

Peter Newman
Australian Herbicide Resistance Initiative
petern@planfarm.com.au
08 9964 1170

REFERENCES

Llewellyn, R., Ronning, D., Clarke, M., Mayfield, A., Walker, S., and Ouzman, J. (2016). *Impact of weeds on Australian grain production: the cost of weeds to Australian grain growers and the adoption of weed management and tillage practices*. GRDC and CSIRO. www.grdc.com.au/ImpactOfWeeds

Price, L., and Daniel, R. (2017). *Practical strategies for problem weeds; glyphosate resistant barnyard, liverseed grass and sowthistle, Group A resistant wild oats and feathertop Rhodes grass*. GRDC Update Paper. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2017/07/practical-strategies-for-problem-weeds-glyphosate-resistant-barnyard,-liverseed-grass-and-sowthistle,-group-a-resistant-wild-oats-and-feathertop-rhodes-grass2

Storrie, A.M. (Ed.) (2014). *Integrated weed management in Australian cropping systems*. GRDC, ISBN 978-1-921779-61-9. www.grdc.com.au/IWMM

Street, M., and O'Brien, B. (2016). *Report on the 2014 GOA Herbicide Resistance Survey*. Grain Orana Alliance. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2016/02/goaherbicideresistancesurvey2014

Walsh, M. (2017). *The challenge of managing wild oats in northern region cropping.* GRDC Update Paper. https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2017/03/the-challenge-of-managing-wild-oats-in-northern-region-cropping

Wu, H., and Koetz, E. (2014). Long-term seed bank management of wild oats in southern New South Wales. *Plant Protection Quarterly*, 29(4).Ecology 13:841-847

Content prepared and edited by Andrew Storrie, AGRONOMO on behalf of GRDC.

DISCLAIMER
Any recommendations, suggestions or opinions contained in this publication do not necessarily represent the policy or views of the Grains Research and Development Corporation. No person should act on the basis of the contents of this publication without first obtaining specific, independent, professional advice. The Corporation and contributors to this Fact Sheet may identify products by proprietary or trade names to help readers identify particular types of products. We do not endorse or recommend the products of any manufacturer referred to. Other products may perform as well as or better than those specifically referred to. GRDC will not be liable for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information in this publication.

CAUTION: RESEARCH ON UNREGISTERED AGRICULTURAL CHEMICAL USE
Any research with unregistered agricultural chemicals or of unregistered products reported in this document does not constitute a recommendation for that particular use by the authors or the authors' organisations.
All agricultural chemical applications must accord with the currently registered label for that particular agricultural chemical, crop, pest and region.
Copyright © All material published in this Fact Sheet is copyright protected and may not be reproduced in any form without written permission from GRDC.

Produced by **www.coretext.com.au**