10-2024

Control small weeds in crops

Department of Primary Industries and Regional Development, Western Australia

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DPIRD-37

In an integrated weed management program, control of weeds should occur in the fallow, pre-sowing, early post-emergent, and in-pasture phases. Weed control can be achieved through killing weeds (particularly seedlings) with cultivation, herbicides, targeted weed control in wide-row cropping, targeted control of small patches of weeds, and biological control tactics.

Cultivation - fallow and pre-sowing

Cultivation is useful as a one-off tactic in reduced tillage or no-tillage operations, to achieve effective weed control. Over-reliance on cultivation can reduce surface stubble cover, increase erosion risk, degrade soil structure, and reduce soil moisture retention. Poorly timed cultivation will result in a poor seedbed, leading to reduced crop emergence, herbicide damage, and reduced herbicide performance.

Benefits

- Well timed cultivation effectively kills weeds through:
  - plant burial
  - seed burial, thereby reducing the ability to germinate
  - root severing
  - plant desiccation, where plants are left on the soil surface to die
  - breaking seed dormancy
  - seed placed in a more favourable environment to encourage germination for subsequent control
- The impact of cultivation will depend on the weed species. Annual ryegrass seed more rapidly loses viability at deeper soil depths than when shallowly buried. By contrast, seed viability of other species, such as wild radish and common sowthistle, increase with depth of burial.
- In preparing a seedbed, cultivation provides a weed-free environment for the emerging crop.
- Cultivation can control weeds in situations where herbicides are ineffective or not an option. That is, when weeds are too stressed to respond to herbicides, especially over the summer fallow, weeds are resistant to herbicides, or herbicide sensitive crops are nearby.
- Pre-sowing cultivation or full disturbance cultivation at sowing reduces the reliance on knockdown herbicides and therefore, the likelihood of weed populations developing herbicide resistance.

- Cultivation for weed management can be obtained when incorporating soil ameliorants, such as lime or gypsum, or breaking up a plough pan.

Issues to consider

- Strategic cultivation must consider whole-farm practicalities. Avoid repeated cultivation – use it strategically in situations where no suitable alternatives are available. Cultivation can increase weed control costs through increased labour and machinery inputs.
- Maintain soil structure by cultivating at suitable soil moisture levels and appropriate implement ground speed. Travelling faster than the recommended speed for a particular implement type will greatly increase the damage to soil structure. Cultivating when the soil is too wet can cause ‘smearing’ and compaction and cultivation when the soil is too dry can destroy soil structure. Both will lead to reduced water infiltration and storage, and soil aeration.
- The tillage implement used will influence the level of soil disturbance and thereby, the effect on weeds present. A disc plough or mouldboard will invert soil and bury weed seed. For weeds species where burial prolongs the life of the seed bank, scarifiers and cultivators that cause little soil disturbance by operating at less than 10 cm depth can be used to kill weeds and may simulate weed seed germination, for effective control once the weeds have emerged.
- Choice of cultivation practice can influence weed density and spectrum. For example, species like skeleton weed, which reproduce vegetatively, will be encouraged by cultivation. Weeds like fleabane or silver grass will be effectively controlled by cultivation and are encouraged by the reduced tillage system.
- Cultivation is most successful when used against small weeds, before flowering commences. Root systems of large weeds may be extensive, making removal difficult. Weeds that are not fully dislodged by the cultivation may re-root if the surface soil remains moist.

Herbicides for different situations

Herbicide tolerant crops

Herbicide tolerant crops have a tolerance to herbicides that would normally cause severe damage, like Group 2 imidazolinone in Clearfield® canola. Herbicide tolerant crops provide additional crop choice, enabling alternate weed management tactics to target specific weeds while maintaining crop sequences.

Herbicide tolerance traits are introduced to crops by conventional breeding methods (and include triazine tolerant (TT) canola introduced in 1994, and imidazolinone tolerant (IT) wheat, introduced in 2001) or by genetic modification (GM), where genes are introduced from another organism. Genetically modified herbicide tolerant (HT) cotton has been commercially grown in Australia since 2000, while Roundup Ready® (RR) canola was first commercialised in some states in 2008.

Winter fallows

Winter fallows are becoming more popular in Western Australia, especially in the drier areas. They are usually incorporated in cropping programs as a one-year rotation to reduce weeds and retain moisture profiles. A fallow period on its own, or in sequence with numerous crops, can be highly effective in reducing the weed seedbank. An alternative is a 10-month fallow.

These suit enterprises that are 100% cropping or those with stock where there is value in grazing early feed. In this system, the first spray is not applied until there is stem elongation and some

woodiness. This achieves soil stabilisation and a mulch effect to reduce summer evaporation, provided the fallow is not grazed afterwards. Growing canola after the fallow can increase the reliability of the canola and broaden the opportunity for good weed control.

Both fallow systems give an opportunity to do deep-ripping or liming on those paddocks while they are out of cropping and, if weed numbers are kept low, crops can be dry sown the following season. To achieve this objective, it is important to have a zero seed set policy for fallows.

Controlled traffic or tramlining for optimal herbicide application

Controlled traffic or tramlining refers to a cropping system designed to limit soil damage by confining all wheel traffic to permanent lanes for all field operations, including seeding, harvesting, and spraying activities.

A traffic lane can increase the health of the crop due to improved soil characteristics, which in turn can improve the competitive ability of the crop. Traffic lanes can also provide guidance and a firmer pathway for more timely and accurate application of herbicide. This will help to improve weed control and reduce input costs.

Weed detector sprayers

Weed detector sprayers are for the control of scattered weeds in crop fallows. Weed detector-activated sprayers detect the presence of weeds using infra-red reflectance units linked to a single nozzle. When a weed is detected, a solenoid turns on an individual nozzle and the weed is sprayed. In action, light-emitting diodes (LEDs) point two different light sources, infrared and near infrared, towards the ground. Green weeds have a different reflective signature to stubble or soil. The system can operate at speeds of up to 20 kilometres per hour (km/h), requiring a stable boom to aid operational efficiency.

Weed detector sprayers have a lower risk of drift, as coarse droplets are used and only a low percentage of the paddock is sprayed.

Grower experience using this technology in most summer spraying and winter fallow situations, results in less than 10% of the entire paddock being sprayed. For greener paddocks, with more ground cover from weeds, it is often more economical to blanket spray the entire paddock, given the low glyphosate price.

Weed control in wide-row cropping

Widening the row spacings allows methods of weed control to be employed, such as selective chemicals in the on-row zone and non-selective chemical, physical, or mechanical methods in the inter-row zone.

Wide-row cropping in Western Australia

Wide-row cropping has been used in Western Australia as a strategy to overcome herbicide resistant wild radish and, to a lesser extent, annual ryegrass, particularly in pulse crops.

This tactic uses non-selective (knockdown) herbicides to control weeds in the inter-row space of the crop. In some circumstances, inter-row cultivation may be applicable. Band spraying over the crop row allows selective herbicides to control weeds that the shielded sprayer or inter-row cultivation techniques cannot reach. In addition, band spraying effectively reduces the total amount of herbicide used on a per hectare basis, which in turn reduces costs and minimises the potential for herbicide carryover.

Glossary

- Wide rows – crop rows that are 50 cm and wider
- Inter-row – the strip of soil between the crop rows
- Crop-row – the strip of soil taken up by the crop
- Shielded spraying – the practice in which shields are used to protect the crop-rows while weeds in the inter-row area are sprayed with a non-selective herbicide
- Band spraying – the practice in which a given area (band) of selective herbicide is applied to weeds in either the crop-row or inter-row, only
- Inter-row cultivation – the practice in which weeds in the inter-row space are controlled using tillage equipment. Note - where retained stubble is dense, it may not be physically possible to carry out inter-row cultivation. Also, inter-row cultivation can stimulate emergence of some weed species.

Inter-row shielded spraying and crop-row band spraying

The trend towards wide-row planting for a range of crops risks greater reliance on herbicide control to balance declining crop competition. This poses serious problems for the development and management of herbicide resistant weeds.

Issues to consider

- Shielded spraying allows inter-row application of non-selective herbicides, in-crop, which can increase crop yield.
- Band spraying reduces the risk of herbicide resistance development by limiting the application of higher risk selective herbicides over the crop row.
- Herbicide mode of action groups need to be rotated.
- Timing of shielded spraying is important.
- Care must be taken with the set-up and operation of shielded sprayer.

Inter-row cultivation

Issues to consider

- Inter-row cultivation gives the opportunity to control weeds without herbicides.
- Timing of inter-row cultivation is critical to ensure maximum levels of weed control. Best control is achieved when weeds are small.
- Weed control is reduced if the soil is too wet, as the weeds will transplant.
- Heavy stubble cover may preclude the use of inter-row cultivation.
- Inter-row cultivation does not control weeds in the crop row, so an additional tactic must be used for the crop-row weeds.
- This method cannot be used in conjunction with ground covering stubble mulch techniques, as cultivation reduces the opportunity to maintain the mulch.
- Inter-row cultivation can stimulate emergence of some weed species.

Image 1: Untreated weeds in lupins prior to inter row cultivation. Photo – Glen Riethmuller, Department of Primary Industries and Regional Development

Image 2: A lupin crop where simazine was sprayed over the row to target crop-row weeds, and cultivation was performed in winter to target inter-row.

Biological control of weeds

Biological control is the management of weeds using the weed's natural enemies, or biological control agents. The mode of action of a biological control agent is to feed on the weeds (insects) or cause disease in the weeds (pathogens). These in turn slow growth, reduce seed-set, and/or lead to the death of the weed.

For example, Patterson's curse is partially controlled by insects like crown weevil.

Types of biological control

The generally recognised types of biological control include classical, inundative, and conservation.

Classical control

Classical control is the most widely used approach and involves:

- exploration for natural enemies of the host weed in the plant's region of origin
- rigorous host testing of potential control agents
- importation and clearing through quarantine
- approval followed by release on the target weed.

Inundative control

The inundative approach involves mass production of biological control agents and mass release of them to produce an epidemic against the weed. The inundative approach is best illustrated by the development of bioherbicides, which have an advantage over chemical herbicides where they are ineffective due to herbicide resistance or inappropriate for use, such as near sensitive wetlands or organic agriculture systems. Bioherbicides have been researched in Australia, but they are not commercially used due to the constraints of production costs and limited markets.

Conservation biological control

Conservation biological control involves managing both the crop and the weed to favour the presence of naturally occurring biological control agents that attack the weed.

Benefits of biological control

- About 33% of biological control agents have resulted in substantial control of the target weeds. This success can range from complete (no other weed control required), to substantial (other weed control methods are needed but the effort required has been reduced) to negligible (control still depends on other control measures).
- When classical biological control is successful it is very cost-effective.
- The recognised potential of bioherbicides as an effective form of weed control stimulates future investigation.

Issues to consider

- Weed biology factors influence biological control efficacy. Not all weeds are suitable for biological control.
- Survival of the control agent relies on survival of the weed.
- The success of biological control depends on the existence of suitable agents and their degree of host specificity. It is difficult to find biological control agents for weeds that are closely related to crops (for example, wild oats).
- Bioherbicide technology is limited in terms of the cost of production. The Australian market is generally too small to warrant bioherbicide development.

Contact us

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More information

Integrated Weed Management Manual | Grains Research and Development Corporation (grdc.com.au)

Refer to the department website at dpird.wa.gov.au for more information on the following:

- Assessing weed population density
- Controlling small crop weeds
- Crop weed management at harvest
- Developing a controlled traffic (tramline) farming system
- Genetically modified crops and herbicide resistance
- Herbicide resistance
- Information on genetically modified (GM) crops
- Preventing crop weed seed introduction and spread
- Reducing crop weed seed numbers in the soil
- Stopping crop weed seed set

Last updated October 2024

dpird.wa.gov.au