

Weed management – getting the timing right

Introduction

Herbicide based weed management is facing increasing challenges. Herbicide resistance in New Zealand is more prevalent than previously thought and is likely to continue to increase. Existing herbicides are being lost due to regulations and market demands. Almost no new modes of action are coming to market internationally and due to the small market size and difficulty of registration these may not be available in Aotearoa-New Zealand. Globally, integrated weed management (IWM) is seen as the only future for weed management. It is based on a whole-of-farm / system level approach [3]. This changes the focus of weed management from just controlling in-crop weeds, principally with herbicides, to managing weeds throughout the whole rotation and at all points in a crop's life.

Timing, timing, timing

In IWM correct timing is often critical and that timing can be viewed from several angles.

- Crop rotation.
- The crop production cycle - from pre-planting to post harvest.
- The weed's life cycle, from dormant seed in the seedbank, to the weed plant, and back to seed again.

Viewing IWM from these different angles can make it seem less daunting, and assist with decision making.

Crop rotations

Increasing diversity, whether of crops, crop management tools or thought, is fundamentally important for arable production now and in the future. More diverse rotations reduce the potential for any particular weed (or pest or pathogen) to build up to problematic levels. Many pests, pathogens and weeds thrive in only one, or a small number of crops. Removing that crop species for a time, will also remove its pests and pathogens. In the case of weeds, their lifecycles (e.g. germination time) and morphology (e.g. climbing weeds) can make them particularly problematic in some crops, but, unproblematic in others. For some crop-weed combinations, e.g., grasses in cereal crops, herbicide options are more limited, especially if herbicide resistant grass weeds are present. Grass weed herbicide choices are wider and more effective in broadleaf crops.

Crop production cycle

The crop production cycle allows a diversity of weed management tactics to be implemented, starting with crop establishment.

Crop establishment

In tillage systems crop establishment is a key weed management time. Tillage pushes every germination button weed seeds have. Managing the resulting weed flush with false and stale seedbeds (see Arable Extra 136) can be the difference between good weed control through the rest of the crop's life or a real battle. Planting arrangements, such as narrower rows, or planting in a checker board pattern to decrease the time it takes to achieve canopy closure, can also significantly reduce weeds. In the UK and Australia there is an increasing move to using residual / pre-emergence herbicides in cereals, as herbicide resistant weeds are rendering post-emergence / selective herbicides less and less effective.

Moving sowing dates (both earlier and later) is a good option for a number of arable crops with particular problem weeds. Swapping between autumn and spring sown crops has likewise shown large reductions in problem weeds. Changes, however, are specific to the particular crop-weed combinations.

Key points

- Herbicide resistance, reducing herbicide options and market demands are driving a move towards understanding non-chemical weed management options and developing integrated weed management (IWM) systems.
- Unlike of herbicide control of in-crop weeds, IWM requires a whole-of-farm and multi-year approach.
- IWM targets weeds all year round and across the rotation using multiple tactics.

Delaying, banding and sub-surface application of fertilisers can also have weed management benefits. Crop demand for nutrients is generally small in the first month or two, so fertilisers applied at establishment are not used by the crop – rather they get taken up by the weeds, making them grow faster and be more competitive. Likewise, for surface application, most arable crops have larger seeds so are planted deeper, while most weeds have small seeds and only emerge from the top two to three centimetres of the soil. Consequently, the weeds' root systems are shallower than the crop's so they get first access to the nutrients as they filter down through the soil.

Crop growth

Killing in-crop weeds with herbicides has been the principal global weed management strategy for the last 70 years. From the perspective of a whole-of-farm and whole-of-year approach to weed management, the in-crop stage is a relatively narrow window. But, despite the broader perspective of IWM, in-crop weed management is critical to getting the harvest in and good yields, so it's still a critical time in weed management.

Healthy crops with good nutrition will be more competitive against weeds; thus fertiliser timing and placement that delivers the most nutrients to the crop and the least to the weeds can tip the competitive balance in the crop's favour.

Mechanical weeders can be a direct replacement for some, most, or even all, in-crop herbicide applications. Suitable weeders include the spring tine harrow, spoon weeder, Einböck Aerostar-Rotation and Combcut. The first three are used at establishment (e.g., for a false seedbed, and blind harrowing) as well as during the first weeks to couple of months of the crop's growth. Combcut is used to cut off thick stemmed broadleaf weeds in thin stemmed crops (e.g., cereals and linseed) later in the crop's life. See Arable Extra 134 for more information.

Harvest time

Harvest time offers a significant opportunity for weed management. For weeds that overtop the crop, cutting / mulching flower heads or cutting and removing seed heads is an increasingly important tool in Europe to manage herbicide resistant weeds. In New Zealand, taller herbicide resistant weeds such as wild oat, prairie grass and canary grass should be targeted for pre-harvest management. Likewise harvest weed seed control (HWSC), where weed seed passing through the header is killed or collected, is now a maturing technology in Australia and being trialed in Europe and North America. FAR will be undertaking HWSC research in the 2023/24 season. See FAR Arable Extra 135 for more information on harvest time weed seed management.

Cleaning down headers and other harvest equipment is also increasingly important for minimising the spread of herbicide resistant weeds among paddocks and especially farms.

Post-harvest

Immediately after harvest is a critical time to scout fields for surviving weeds, especially herbicide resistant weeds. This is the time in a crop's production cycle when the Herbicide Resistance Management project scouted fields to find herbicide resistant weeds. Signs of herbicide resistance are patches of a single weed species, or a single species being dotted around a paddock - which most likely would have been spread around by the header. You are looking for weed escapes that don't look like a failed herbicide application i.e. blocked nozzles (which leave a strip of mixed weed species), booms not turning on or off at the right time (leaving a boom width strip of mixed weed species), or overall poor weed control, caused by a tank issue (wrong rate, lacking adjuvants, dirty water, etc). If you think you have herbicide resistance, get advice from FAR, and take immediate action. Do whatever it takes to kill the resistant weeds, e.g., different herbicides, tillage, etc., and keep a record of the location in the paddock and monitor and manage it more intensively in future.

False seedbeds and other light tillage can be used to encourage shed crop seeds to germinate as well as weeds that don't have primary dormancy (see Arable Extra 136). Mowing and grazing are other post-harvest options for keeping surviving plants in check and preventing them from seeding.

If there is going to be a gap between harvest and sowing the next cash crop, even of just a few weeks, put in a cover crop, especially during summer. Cover crops can help suppress weeds and also provide benefits such as improved soil quality and reduced nitrogen leaching.

Weed life cycle

Annual and biennial weeds have a simple life strategy: be a seed. The weed plant is a temporary stage in its life cycle whose only job is to make lots more seed. The weed seed bank is the permanent life stage of these weeds and is, therefore, the basis of the weed challenge in arable / annual cropping systems.

Riemens *et al.* [3], in their new framework for IWM, defined weed management tactics by the point time during a weed's lifecycle that they are used. The three stages are:

- Prevent the establishment of weeds,
- Reducing the impact of weeds on the crop,
- Reducing seed return (seed rain) 1.

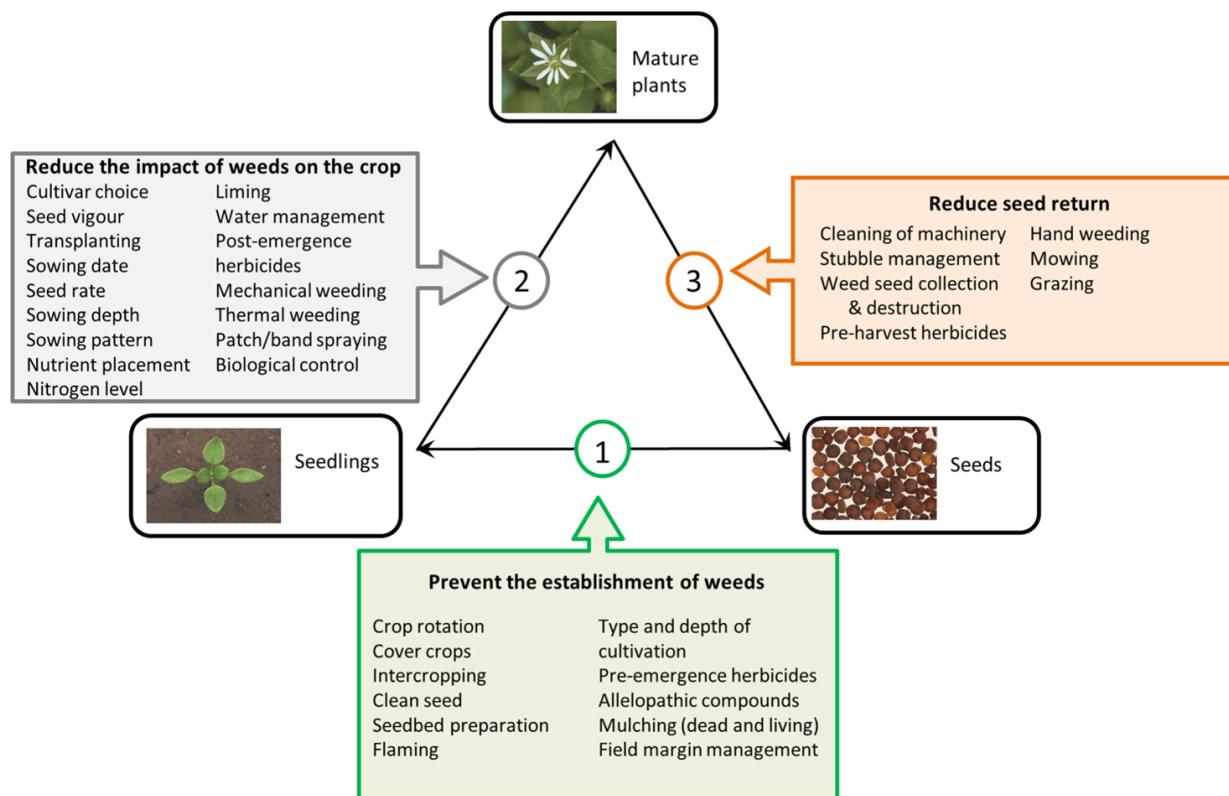


Figure 1. Weed control tactics are mentioned where they are expected to have maximum effect on weed survival. Weed control tactics affecting weed survival at different stages of their life cycle. From [13] under the CC BY license creativecommons.org/licenses/by/4.0/.

Figure 1 shows the many tactics that can be used at the different times of a weed's life cycle.

Conclusions

While implementing IWM can feel daunting, viewing it through the angles of rotations, crop production and weed life cycles breaks what can appear really complex, into clear points in time when specific weed management tactics can be implemented. Individually, many non-chemical weed management tools are not as effective as herbicides, but using multiple, diverse tactics provides cumulative weed control. This also builds redundancy into the system over time, in that if one tactic fails to have the desired effect, others can compensate later on.

References

1. Ghanizadeh, H. and Harrington, K.C., Herbicide resistant weeds in New Zealand: state of knowledge. *New Zealand Journal of Agricultural Research*, 2021. 64(4): p. 471-482. <https://www.tandfonline.com/doi/full/10.1080/00288233.2019.1705863> DOI:10.1080/00288233.2019.1705863
2. Liebman, M. and Gallandt, E.R., Many little hammers: ecological management of crop-weed interactions, in *Ecology in Agriculture*, Jackson, L.E., Editor. 1997, Academic Press: San Diego, CA. ISBN 978-0123782601. <https://www.sciencedirect.com/science/article/pii/B9780123782601500105>
3. Riemens, M., Sønderskov, M., Moonen, A.-C., Storkey, J., and Kudsk, P., An integrated weed management framework: A pan-European perspective. *European Journal of Agronomy*, 2022. 133: p. 126443. <https://www.sciencedirect.com/science/article/pii/S1161030121002148> DOI:10.1016/j.eja.2021.126443

© This publication is copyright to the Foundation for Arable Research ("FAR") and may not be reproduced or copied in any form whatsoever without FAR's written permission. This publication is intended to provide accurate and adequate information relating to the subject matters contained in it and is based on information current at the time of publication. Information contained in this publication is general in nature and not intended as a substitute for specific professional advice on any matter and should not be relied upon for that purpose. No endorsement of named products is intended nor is any criticism of other alternative, but unnamed products. It has been prepared and made available to all persons and entities strictly on the basis that FAR, its researchers and authors are fully excluded from any liability for damages arising out of any reliance in part or in full upon any of the information for any purpose."

ADDING VALUE TO THE BUSINESS OF CROPPING

PO Box 23133, Hornby, Christchurch 8441, New Zealand
 Phone: +64 3 345 5783 • Fax: +64 3 341 7061 • Email: far@far.org.nz • www.far.org.nz