

Weed management in vegetables



**Integrated
Crop Protection**
PROTECTING CROPS

Overview

Weeds increase the cost of growing vegetables, reduce crop yield and quality, and impact farm management decisions, such as timing of harvest and choice of herbicide options.

The growth of weeds in vegetable production systems is enhanced by soil disturbance, irrigation and the application of fertilisers. Weeds harbour many vegetable diseases, nematodes, mites and insects, especially aphids and thrips that transmit viruses. Weed pressure is generally higher when soil conditions are poor due to heavy cropping.

This fact sheet provides growers and advisors with an overview of:

- Important weed species in Australian vegetables and their impact on profitability
- Weed control methods and critical success factors
- Key features of an Integrated Weed Management approach.



Figure 1: Important weed species, nutgrass piercing plastic mulch in a cucurbit crop (above left) and fat hen (above right) (Source: Sindel et al. 2011; Kristiansen 2015)

Key messages

- Weeds increase the cost of growing vegetables, reduce crop yield and quality, and impact farm management and profitability
- Weed management is an important component of the integrated crop protection approach – combining chemical, cultural and biological methods to keep weeds, insect pests and disease pressure low enough to prevent significant economic loss
- Choose the appropriate methods by considering the available options
- Consider timing such as weather and crop life cycle
- Be diligent by removing weeds before they set seed or spread further
- Have good knowledge of your main weeds and their characteristics
- Develop a plan, and implement an Integrated Weed Management (IWM) strategy
- Watch out for herbicide resistant and prescribed weeds and report them if found

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Important weed species and their impact on profitability

Weed species

The top five most important weed species in Australian vegetable production tend to be annual or biennial heavy seeding broadleaf species, and include:

1. Fat hen (*Chenopodium album*) (Figure 1)
2. Stinging nettle (*Urtica urens*)
3. Mallow (*Malva parviflora*)
4. Nutgrass (*Cyperus rotundus*) (Figure 1)
5. Pigweed (*Portulaca oleracea*).

However, the most important weed may vary depending on the district, crop, soil type and time of season. Nutgrass (4) is problematic because of its persistent underground parts and is less easily controlled using selective herbicides unlike other grass and sedge weeds. It becomes a problem in no-till systems.

Increased cost of production

Weed management costs are estimated at \$479 per hectare on average in Australian vegetable crops, which is about 11% of total pre-harvest variable production costs (Table 1). The cost of weed management varies based on the crop type and other associated costs e.g. labour, cultivation and input products.

Reduced yield and crop quality

Weeds, when combined with diseases and pests, can reduce yield in vegetable crops by 10 to 70% by competing for water, soil nutrients, light and space that ultimately restricts the development of the plant. Yield impacts depend on crop type and stage, for example studies have shown reduction in yields of approximately 20% in broccoli, 25% in lettuce but up to 90% in carrots where no weed control activities are undertaken. Other factors that influence yield impacts include pest type, soil type, weather conditions, timing of infestation and crop management.

Weeds can host pests and diseases that reduce crop quality and yield, as well as increase the cost of pesticide use. Insect pests spread the majority of viruses within a crop, or from weeds to crops. Examples of pests and diseases that may be hosted by weeds include:

- Capsicum chlorosis virus in capsicums
- Powdery mildew (*Erysiphe heraclei*) in carrots and parsnips
- Black leg fungus (*Phoma lingam*) in brassicas
- Dry leaf spot (*Xanthomonas campestris* pv. *vitians*) in lettuces
- Fungal root rot (including *Pythium*, *Rhizoctonia* and *Fusarium*) in a variety of vegetables
- Aphids and thrips (several species) in a variety of vegetables
- Mites and nematodes (several species) in a variety of vegetables.

Table 1: Weed control cost estimates for a selection of different crops (Source: NSW DPI Gross Margin Budgets 2009 and 2013)

CROP	CONTROL METHOD	WEED CONTROL COST (\$/HA)	TOTAL PRE-HARVEST VARIABLE PRODUCTION COSTS (\$/HA)	WEED CONTROL COST (% TOTAL)
Cabbages	Pre-emergent herbicide, chipping and weeding, other unspecified activities	\$1,039	\$4,228	25%
Capsicum	Ground preparation, plastic mulch film laying	\$152	\$9,004	2%
Carrot	Cultivation and bed forming, pre- and post-emergent herbicide application	\$165	\$2,809	6%
Lettuce	Bed forming and labour costs - chipping & weeding	\$1,164	\$7,189	16%
Pumpkin	Ground and bed preparation, pre- and post-emergent herbicide application	\$121	\$1,715	7%
Beetroot (processing)	Ground preparation, pre- and post-emergent herbicide application	\$230	\$1,982	12%
Average		\$479	\$4,488	11%

Impact on farm management

Weeds can impact on farm management in a number of ways:

- Reduced effectiveness of insecticide and fungicide applications due to plant density
- Increased difficulty in harvesting crop through reduced access or blocking equipment
- Limited registered herbicides for controlling weeds within the crop rows, particularly for broadleaf weeds after crop emergence. This has led to an increase in the use of pre-emergent herbicides, plastic mulch, precision shallow cultivation and hand weeding where feasible
- Increased vulnerability of the crop before the crop canopy develops within the first few weeks after emergence, for example carrots, cabbage and beets. Some crops that don't form a canopy, such as onions and leeks, will remain at a competitive disadvantage with weeds and are more challenging to manage.

Weed control methods and critical success factors

There are a number of weed control methods available to Australian vegetable growers, which can be grouped into chemical control, mechanical weed control, mulches, cultural (or management), and innovative control methods. Their application will depend on the time of the season, production system and compatibility with each other, as they are rarely used in isolation. Each method's relative effectiveness of weed control and affordability to implement varies based on feedback from growers and advisors around the country (Table 2).

The critical success factors for weed control include:

- **Choose the appropriate methods** by considering the available herbicide options, preparing beds to reduce the weed seed bank, as well as the role of tillage, cover crops and crop rotation within your system
- **Consider timing** such as weather and access to paddocks, weed life stage, crop life cycle, and ground conditions, particularly moisture
- **Be diligent** about applying appropriate weed control methods, focusing on removing weeds before they set seed or spread further

Table 2: Weed control methods and relative effectiveness and affordability

CONTROL METHOD	EFFECTIVENESS	AFFORDABILITY
Chemical		
Pre-emergent herbicide application	High	High
Post-emergent herbicide application	Moderate	High
Fallow herbicide application	High	High
Shielded inter-row herbicide application	Moderate	High
Spot-spray herbicide application	Moderate	Low
Fumigation	Moderate	Moderate
Bioherbicides (mainly organic producers)	Moderate	Moderate
Minor use permits	-	-
Mechanical		
Chipping and hand weeding	High	Low
Tillage during fallow and before sowing or planting	High	High
Inter-row tillage	Moderate	High
Intra-row tillage	Moderate	Moderate
Mulches		
Plastic mulch	High	Low
Biodegradable mulch	High	Low
Organic mulch	Low	Low
Cultural (management)		
Crop rotation	Moderate	High
Increased plant density	Low	High
Farm hygiene	Moderate	High
Irrigation management	Moderate	Moderate
Grazing and slashing (mainly organic producers)	Moderate	Moderate
Innovative (Figure 2)		
Solarisation	Moderate	Low
Thermal weed control	Moderate	Moderate
Green manure crops	Moderate	Moderate
Biofumigation	Moderate	Moderate
Permanent beds and controlled traffic farming	Moderate	High
Precision agriculture	High	High
Weed sensor technology	High	Low
Stale and false seedbeds	High	High
Vertebrate pest control	Moderate	Moderate



Figure 2: Examples of innovative weed control methods, Calliente biofumigant cover crop (left) and 'Ladybird' robotic weed management machine (Source: AHR 2015; University of Sydney 2014)

- **Have good knowledge** of your main weeds and their characteristics e.g. trial herbicides on-farm. Always adhere to herbicide label recommendations, and get advice if you're not sure what to do. This might include asking about the best surfactants, nozzles, pressure and machinery speed to use
- **Develop a plan**, and implement an Integrated Weed Management (IWM) strategy that combines a number of control methods and looks after resistance management (covered in the next section).

Integrated Weed Management

Integrated Weed Management (IWM) is a sustainable management system that combines all appropriate weed control methods for a particular vegetable crop(s). The purpose of IWM is to:

- Reduce the possibility of weed control failure
- Reduce the impact of weed management activities on the environment
- Increase crop yield and quality, while assisting to manage insect pests, diseases and soil health
- Increase the possibility that the mix of methods used will continue to work, for example preventing herbicide resistance.

IWM is more than just relying on a few conventional practices, such as herbicides, tillage and hand weeding. An example of an IWM strategy for cucurbit production is:

- Apply pre-plant herbicide
- Use plastic mulch where appropriate
- Implement drip irrigation (subsurface if feasible)
- Control of weeds in the inter-row space before the crop vines had spread

- Chipping or hand weeding within the crop beds
- Use mechanical inter row management
- Consider crop rotation
- Use cover crops
- Ensure farm hygiene (Figure 3)
- Focus on soil health management.

IWM is also an important component of the integrated crop protection approach, which combines chemical, cultural and biological methods to keep weeds, insect pests and disease pressure low enough to prevent significant economic loss.

A number of growers involved in the Integrated Crop Protection project demonstration sites around the country have successfully implemented an IWM strategy. In particular, the introduction of cover crops into the production system has shown positive results.



Figure 3: Biosecurity sign promoting farm hygiene (Source: AUSVEG 2015)

“Caliente [cover crop] is not a silver bullet but another safe and effective means by which farmers can increase their soil fertility as well as a tool for combatting soil borne pathogens and weeds.” – David East, Bewray Produce, WA (lettuce and baby leaf)

“With cover crops more leeks have healthy, strong white roots and have leaves that peel back easily and neatly – a quality that is highly desirable as it makes trimming and cleaning much easier and faster with less harvested product going to waste.” – Adam Schreurs, Schreurs & Sons, VIC (celery, leeks and baby leaf)

Further information

To stay up to date or for more information:

- **Phone or email:** Anne-Maree Boland, RMCG on 0427 679 042 or anne-mareeb@rmcg.com.au or Gordon Rogers, AHR on 0418 517 777 or gordon@ahr.com.au
- **Online:** www.integratedcropprotection.com.au, or register your interest at https://www.surveymonkey.com/s/soilwealth_ICP_Eol
- **Social media:** follow us on Twitter @ProtectingCrops or our Community of Practice on Facebook at <https://www.facebook.com/protectingcrops>
- **In person:** at one of our many workshops, field days and events around the country, check the website above for details.



Figure 4: Adam Schreurs inspecting cover crop results on the ICP demonstration site with master class participants

Additional resources

- **Weed Management for the Vegetable Industry - Scoping Study (VG13079)**, University of New England, <http://ausveg.com.au/intranet/technical-insights/docs/VG13079.pdf>
- **Integrated weed management components for vegetables**, Department of Agriculture and Fisheries, Queensland, <https://www.daf.qld.gov.au/plants/fruit-and-vegetables/vegetables/weed-management-for-vegetables>
- **Herbicide Resistance Management Strategies**, CropLife Australia, <http://www.croplife.org.au/files/resistancemanagemen/herbicides/2010%20Herbicide%20Resistance%20Management%20Strategies.pdf>
- **Weed ID: The Ute Guide app for portable devices**, Grains Research and Development Corporation, <https://itunes.apple.com/au/app/weeds-the-ute-guide/id482862261?mt=8>
- **NSW WeedWise app for portable devices**, Department of Primary Industries, New South Wales, <http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/images/wid-documents/weed-wise-spotlight>
- **Woody Weed Specialists app for portable devices**, Dow AgroSciences Australia, <https://itunes.apple.com/us/app/woody-weed-specialists/id668582351?mt=8>
- **APVMA app for portable devices**, Australian Pesticides and Veterinary Medicines Authority, <https://itunes.apple.com/us/app/apvma/id564121943>
- **National surveillance system for weeds and plant pests**, Plant Health Australia, <http://www.planthealthaustralia.com.au/national-surveillance-system-for-weeds-and-plant-pests/>