

Potato Weed

Galinsoga parviflora

Weed management guide for
Australian vegetable production



INTEGRATED WEED
MANAGEMENT

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Identification

Potato weed (*Galinsoga parviflora*) is a warm-season erect annual herbaceous plant, native to Central America. It grows up to 0.6 metres in height, but is usually about 0.3 metres in height.

Leaves are opposite, symmetrical, between 1.0-11.0 cm in length and 0.5-7.0 cm in width, oval shaped, moderately hairy, with wavy margins. Cotyledon leaves are rounded with a slightly indented tip. Flowers are yellow with white to dull pink petals, 3.5-5.0 mm in length and 2.0-6.0 mm in height. There are two types of flowers: disc flowers, forming the central portion of the flower head; and ray flowers, giving the appearance of a single petal and forming a ring around the disc flower. Potato weed may also be known in parts of Australia as 'yellow weed'. It is named for its broad resemblance to potato plants.

Most vegetable farmers will be well aware of potato weed and how to identify it. It closely resembles 'hairy Galinsoga' (*Galinsoga quadriradiata*), though at the time of writing that species did not appear to be present in Australia. Depending on stage of growth and experience in identification, some other common annual heavy-seeding weeds of Australian vegetable production may be mis-identified as potato weed, including fat hen (*Chenopodium album*), amaranth (*Amaranthus* spp.), or blackberry nightshade (*Solanum nigrum*).

Figure 1 includes a series of photos of potato weed at different life stages in order to facilitate correct identification on-farm, from a young seedling through to a mature flowering plant.



Figure 1 Life stages, from emergence to flowering

Characteristics

Key characteristics

Table 1 Key characteristics of potato weed

Time of germination	Spring (peaking late spring and early summer) through to autumn/onset of frost.
Time of flowering and seed set	Late spring through to early autumn (28-66 days after emergence).
Reproduction	Primarily by seed; some vegetative reproduction possible.
Seed productivity	5,000-10,000 seeds per plant (up to 400,000 per plant considered possible).
Seed viability	Up to 20 years, though commonly less than one year.
Optimum germination soil depth	Soil surface to 5 mm.
Soil type/s	Favours moist sandy soils.
Competitive advantages	Responds well to soil disturbance; early emergence; rapid growth; several generations of plants possible in one season; long-term seed viability.

Seasonality

Seed begins to germinate in spring, generally stimulated by cultivation. Germination peaks in late spring and early summer, and may continue through to early autumn, or until the onset of frost in cooler climate zones. Optimal temperature for germination is approximately 16-17 degrees Celsius, but may occur in a range of 10-35 degrees Celsius. Many previous studies have found that seed germination is unlikely to occur in darkness.

Plants generally flower between 24 and 60 days after emergence, and viable seed may be dispersed from the plant 4-6 days after flowering. The average life cycle of a single plant is 40 days. The relatively short life-cycle of potato weed, and minimal seed dormancy, means that several generations of plant can be produced in a single growing season. This has led to the name 'quickweed' in some parts of the world.

Growth is favoured by higher light intensity and longer daylight periods, meaning that open or minimally shaded ground is preferred. However, even when potato weed is shaded by other plants, it is still capable of flowering and producing viable seed.

Reproductive characteristics

Potato weed reproduces primarily by seed, though vegetative reproduction is possible from cut stems or uprooted plants. Potato weed maintains itself over winter via seed on or just beneath the soil surface. Seed demonstrate little or no dormancy, meaning that they are immediately capable of germinating once coming into contact with warm, moist soil.

It is common to find 5,000 to 10,000 seeds per plant, though some research suggests that up to 400,000 seed per plant is possible on large plants.

Potato weed is capable of self-pollination as well as cross-pollination.

Seed viability

Viability of fresh potato weed seed appears to be relatively high, at greater than 90%. Longer-term viability of seed buried in the soil has been reported at anywhere between 2 and 20 years, however one study reported that most seed lost their viability within 10 months of burial in the soil.

Given the preference of potato weed seed for light to germinate, germination percentages are highest on the soil surface. Only 1% of seed germinate from a depth of 5 mm. Maximum burial depth for germination has been found to be 30 mm.

Soil preference

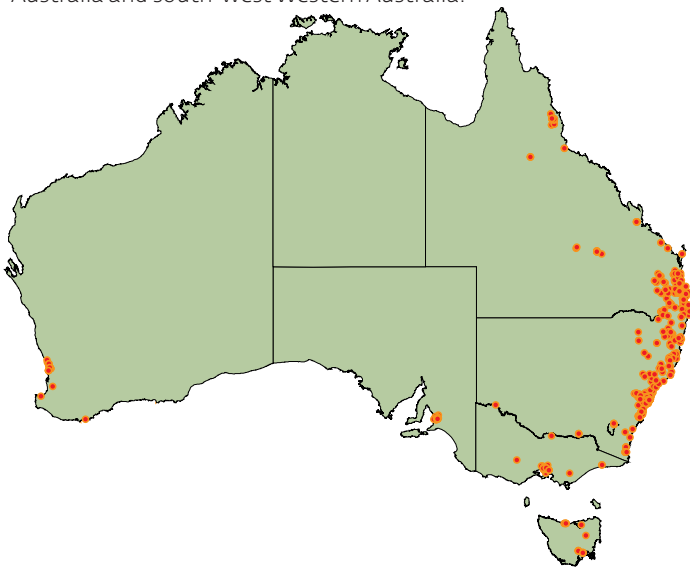
Potato weed shows a preference for moist sandy soils, with germination percentages found to be higher than on clay soils.

Methods of spread

Human activity (including agricultural activity) is the primary means of potato weed spread across longer distances. At a local scale, spread may be accomplished by soil disturbance, wind dispersal of seed, or attachment to animal fur or human clothing.

Distribution

Potato weed is a common weed of summer horticultural and agricultural crops, particularly in temperate and sub-tropical regions. It has been found in all states and territories except for the Northern Territory. It tends to be a less significant problem in drier climates (unless irrigation is used to produce crops). It is also susceptible to colder weather, being one of the first weed species to succumb to frost. Map 1 suggests that it is more likely to be found in key vegetable production zones of south-east Queensland, New South Wales, Victoria, Tasmania, South Australia and south-west Western Australia.



Map 1 Australian distribution of potato weed
(source: Atlas of Living Australia)

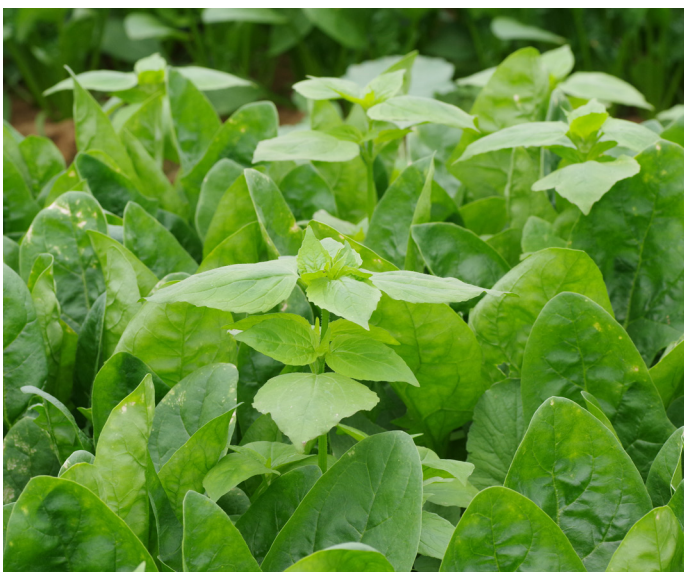


Figure 2 Potato weed is capable of establishing quickly and competing for resources (light, nutrients and moisture) in a variety of vegetable crops.

Impacts

Several key characteristics of potato weed enhance its potential to establish and cause problems within vegetable crops:

- Preference for frequently cultivated, moist soils which are generally characteristic of vegetable production.
- Spring-early summer germination, at a time when vegetable crops may be establishing.
- Capacity to produce seed even when growing in heavy shade.
- Short life-cycle and time from germination to seed production, allowing several generations of the weed to grow in a single warm season.
- Plants are able to flower for a large proportion of their life-cycle.
- Plants are self-pollinating as well as cross-pollinating - a single plant will quickly lead to an established population if not controlled before seed is produced.

Crop competition and contamination

Early emergence and rapid growth rate gives potato weed a competitive advantage over crop plants. Its competitiveness will depend in part on the characteristics of each crop. For example, it is more likely to be highly competitive in row crops that do not shade the soil surface, such as beans, carrots, onion or cabbage. Crops that produce a good canopy, such as corn or potatoes, are more likely to cope with competition from this weed. Large populations of potato weed can interfere with harvest operations, and increase processing time to address contamination.

A host of pests and diseases

Overseas research suggests that potato weed can act as a host of a number of viruses and nematodes harmful to vegetable crops including cucurbits and tomatoes.

Management

Management methods

Table 2 Potato weed management methods

Activity	Suitability	Notes
Tillage	✓ ✓ ✓	Most effective when plants are very young (cotyledon to four true leaf stage). Stale seed bed prior to crop planting likely to be highly beneficial.
Cover crops and crop residues	✓ ✓	Feasibility of cover crops dependent on cash crop produced and viability of non-crop period in annual rotation. Good establishment is critical.
Planting density	✓ ✓	Plant crop at highest practical density without impacting on crop yield.
Farm hygiene	✓ ✓	Best suited to farms with no current potato weed infestation, or an infestation restricted to one part of the farm.
Hand weeding	✓	As follow-up to early-stage herbicide and tillage. Hand weeding is expensive and not suitable for wide-scale use. Better suited to lighter infestations or to follow up on survivors.
Crop rotation	✓ ✓	Increase competition with the weed or make selective herbicides available.
Herbicides	✓ ✓ ✓	Pre-plant, per-emergence, or post-emergence in some crops. Be aware of potential for resistance.
Thermal control	✓	Good control of recently germinated weeds achieved by steam or flame.
Biological control	N/A	Not currently available in Australia.
Integrated weed management	✓ ✓ ✓	Precise combination of techniques will vary from farm to farm. Early control with herbicides or tillage is critical, while the plants are vulnerable and before further weed seed production.

Tillage ✓ ✓ ✓

Research suggests that tillage will be at its most effective when potato weed is at the cotyledon to four true leaf stage, regardless of choice of tillage equipment. However, because potato weed is capable of re-establishing from cut stem sections or uprooted plants, single or infrequent tillage passes may only be partially helpful in managing growing plants - particularly if mature plants are already present in the paddock at the time of tillage. A single tillage pass will also bring greater numbers of viable seed close to the soil surface, from where they will readily germinate.

Repeated shallow tillage during the fallow period is considered more effective by keeping the field free of mature potato weed during their growing season, and preventing seed production. This control option is commonly known as the stale seed bed technique, and may be useful in encouraging potato weed emergence prior to crop sowing to deplete the weed seed bank.

In an overseas experiment involving the closely related 'hairy Galinsoga' (*Galinsoga quadriradiata*), repeated shallow tillage passes were found to be more effective than repeated surface-level flaming in reducing germination. This suggests that several carefully timed tillage passes may reduce the viable weed seed bank near the surface, by bringing weed seed to the surface for germination and control.

Providing the crop beds have been prepared in advance and are largely undisturbed during planting, potato weed emergence can be significantly reduced within the subsequent crop.

Within growing crops, shallow inter-row tillage may be used to control many recently germinate potato weed and other weeds.



Figure 3 A shallow 'tickle' till within the crop row and between the plants early in their life cycle may help to manage recently germinated potato weed and other important broadleaf weeds.

Cover crops and crop residues



Cover crops grown in the period between vegetable cash crops offer growers an opportunity to reduce the impact of potato weed on their farm. When cover crops are well established and maintained, they can be expected to reduce potato weed emergence, flowering and seed set through competition for resources (soil nutrients, water and light), and potentially as a result of their biofumigant effects.

Research indicates that spring-early summer is likely to be the best time to suppress potato weed germination and growth by planting a cover crop, as this coincides with the period of greatest potato weed germination. For many vegetable growers though, this may be a time when a cash crop would normally be grown.

Selection of cover crop variety will need to take several factors into account, such as cost of and ability to grow the cover crop, its expected soil health benefits, relevance for breaking disease cycles within the cash crop, and overall contribution to cash crop productivity.

Good establishment is critical for achieving effective weed management using cover crops. This is particularly relevant to potato weed, which can germinate and grow very rapidly. A cover crop variety that rapidly shades the paddock and has the greatest chance of out-competing potato weed should therefore be chosen.

Overseas research has shown that a poorly establishing cover crop is unlikely to suppress potato weed with much effect, and

may even make the problem worse where many weeds are able to grow above the cover crop canopy and produce seed.

Instituting a stale seed bed (see 'Tillage') before the cover crop is sown has been shown to improve cover crop competition with potato weed, though this will require an even longer period out of production for the paddocks in question.

Where infestations have been particularly heavy, farmers in the US have taken their land out of production for three years, and established a dense sod or forage crop. After this period of time, they experienced little problem with potato weed.



Figure 4 Rapid-establishing cover crop varieties such as buckwheat (*Fagopyrum esculentum*) appear to be effective in suppressing broadleaf weeds such as potato weed.

Planting density



Agronomic practices, such as increased crop density, that contribute towards the rapid development of a thick canopy cover will lead to less return of potato weed seed to the soil. Increased crop density will result in fewer and shorter potato weed plants, fewer flowers, and reduced seed production. This principle is similar to selecting a competitive cover crop variety, as discussed above. It is worth bearing in mind, however, the capacity of potato weed to continue to produce seed even in low light conditions.

Competitive crop variety selection may result in more rapid establishment of crop canopy. Crops that have a relatively open canopy have been found to be much more prone to potato weed infestation, and may not be an appropriate selection if the potato weed infestation is particularly heavy.

Where it is appropriate to the crop, higher plant density and variety selection (including shading of wheel tracks where this is possible) may contribute to reduced potato weed impact in the longer term.

Crop competitiveness can be further maximised by implementing pre-plant, selective and inter-row weed management practices, as well as providing the crop with sufficient resources to maximise its rate of growth.

Higher planting density may have some adverse effects, such as increased competition among crop plants (lowering yield) and greater risk of soil and plant diseases.



Figure 5 Ensuring appropriate planting density to allow good coverage of the crop beds can be useful along with other techniques (such as stale seed beds, inter-row tillage and pre-plant/pre-emergent herbicide application where available) to suppress potato weed and other weeds effectively within the crop beds.

Farm hygiene ✓✓

Implementing appropriate farm hygiene practices helps limit the spread of potato weed seeds across and between properties, and onto crop beds from other parts of a property where the weed is present. Common practices include permanent or set vehicle tracks, equipment wash-down, and restricting movement onto the property.

While potato weed may be well managed within the crop beds, it may still be observed in wheel tracks, headlands and nearby non-crop areas, to the extent that plants are going to seed and replenishing the seed bank in the fields. Effectively managing off-bed potato weed plants may therefore reduce the burden of this weed within crop beds in the longer term. Regular monitoring will be required, given the relatively short life-cycle of potato weed from germination through to seed production.

Farm hygiene may be less relevant for managing potato weed where it has already spread across the whole farm. Other difficulties associated with this approach include the time required to wash equipment down thoroughly, and the potential for uncontrolled spread in flood prone areas.



Figure 6 Establishing a fixed equipment wash-down bay can help restrict the spread of potato weed on the farm, particularly where it is not present at all or only present on part of the farm.

Hand weeding ✓

Hand weeding is effective for removal of potato weed and other important weeds on vegetable farms, particularly those that are flowering and setting seed, and/or plants missed when other management operations have been implemented. Options include digging or hoeing plants out, or potentially pulling larger plants out by hand. Hand weeding may be necessary to remove potato weed plants growing close to crop plants, in crop plant holes in a plastic mulch system, or more generally within the crop bed where selective herbicide options are not available, and where other attempts to manage the weed have been less successful.

Potato weed plants that are flowering or close to flowering should be removed from the crop area rather than left on the ground, to ensure that viable seed are not added to the soil weed seed bank for future seasons.

Farmers are generally hesitant to implement wide-scale hand weeding due to its high cost. However, selective hand weeding can be a very effective follow-up to tillage and herbicide control in particular, implemented earlier in the crop life cycle. Removing a few remaining potato weed plants by hand and taking any flowering plants away from the paddock may have significant benefits in reducing the weed seed bank in future crop seasons. It may also help prevent herbicide resistance from developing.

Combining hand weeding with pre-plant bed preparation (tillage, stale seed beds and pre-plant/pre-emergence herbicide), and inter-row tillage where it is feasible, will be very useful in managing surviving plants. The longevity of potato weed seed (up to 20 years) suggests that several seasons of diligent application will be required to obtain desired results.



Figure 7 Diligent hand weeding over several seasons, utilised in combination with other weed management tactics, can result in almost complete eradication of weeds from the crop. In this paddock in Western Australia, farm staff were encouraged to remove all weeds by hand before seed set. They had succeeded in transforming a previously weedy paddock into one almost entirely free of weeds.

Crop rotation



Several crop rotation strategies may be considered by vegetable growers to reduce the burden of potato weed, and open up possibilities for more effective control:

- Rotating to crops that out-compete potato weed with greater effect (for example, corn or potatoes) can reduce the burden of this weed, relative to its impact on crops with a more open plant structure, such as carrots or onions.

• Vegetable growers may consider introducing crops into the annual rotation where some selective herbicide control of potato weed is possible.

- Rotating to shorter-season crops may also reduce the risk of surviving plants maturing and setting seed before the crop is harvested.

Herbicides



Herbicide management of potato weed is most likely to be achievable during fallow periods within the crop rotation, or by applying a pre-plant or post-emergence herbicide immediately before crop establishment.

Table 3 lists the range of selective and non-selective herbicides registered to control potato weed, across a variety of vegetable crops. It is notable that there are relatively few post-emergence

options available to vegetable growers, and those that are available may only be used in a small range of crops.

Growers should consult with their advisor or agronomist for specific product availability in their district, whether herbicide options are registered for the crop/s they grow, and the suitability of these products for their production system.

Table 3 Herbicides registered for management of potato weed in Australian vegetable production

Herbicide active ingredient*	Trading name/s	Group	Vegetable crop/s in which use is registered	Timing/crop growth stage
Atrazine	Gesaprim	C	Sweet corn, potatoes	Pre-plant, pre-emergence or post-emergence
Chloridazon	Pyramin	C	Red beet, silver beet, baby leaf spinach	Post-sowing pre-emergence
Clomazone	Command 480 EC; Director	F	Cucurbits, potatoes, beans	Post-plant pre-emergence
loxynil	Totril	C	Onions	Post-emergence
Methabenzthiazuron	Tribunil	C	Onions	Post-emergence (one or more true leaves in onion crop)
Metham	Metham Sodium; Tamafume (fumigants)	N/A	All crops	Pre-plant
Metolachlor	Metolachlor	K	Brassicas, beans, corn	Pre-emergence or immediately after transplanting depending on crop
Phenmedipham	Betanal Flow 160 SE	C	Beetroot, silver beet	Post-emergence selective
Prometryn	Gesagard; Prometryn 900DF	C	Carrots, celery, potatoes	Pre-emergence, or early post-emergence in carrots
Propachlor	Ramrod	K	Onions, transplanted brassicas, beetroot	Pre-emergence, pre-transplant or at-transplant, depending on crop
S-Metolachlor	Dual Gold	K	Brassicas, beans, sweet potatoes	Immediately after transplanting
Simazine	Gesatop; Simagranz	C	Asparagus	Pre-emergence

* Details correct at time of writing; please consult the relevant herbicide label/s, contact your reseller for current registration details, or contact the Australian Pesticides and Veterinary Medicines Authority. This table does not include minor use permits, or non-selective options such as glyphosate or diquat. If using crop rotations, the APVMA [Public Chemical Registration Information System](#) may be useful in identifying a range of herbicides suited to alternative cropping situations.

Herbicide resistance

Vegetable growers should remain aware of the potential for herbicide resistance to develop in potato weed and other key weeds, particularly if their crop rotation involves heavy reliance on a limited range of registered herbicides. Integrated weed management is of particular importance in reducing the risk of herbicide resistance developing.

Herbicide resistant populations of potato weed have not yet been reported in Australia. The only reported instance of herbicide resistance in potato weed populations overseas at the time of writing involved the herbicide metamitron, and this herbicide was only registered in Australia for fruit thinning in apple orchards.



Figure 8 Pre-plant or pre-emergent herbicides are often one of the key techniques for management of potato weed in broadleaf vegetable crops, such as this lettuce crop near Gatton, Qld.

Thermal control

Thermal weed management approaches (surface-level steaming, soil steaming and flaming) offer alternatives to herbicide application or chemical fumigation, and as a result are more likely to be used in organic production systems. They also offer an alternative to tillage.

Overseas research indicates that surface-level steam weeding of potato weed at the 2-4 true leaf stage achieved 100% control. Similar research involving the related weed 'hairy Galinsoga' achieved high rates of control of recently germinated seedlings using a flame weeder. In this study, flaming also appeared to be effective in reducing subsequent weed seedling emergence by sterilising much of the surface or near-surface soil weed seed bank. Cost, and the specialised nature of the equipment, can limit suitability.

Biological control

Overseas research has explored the potential of the antibiotic Vulgamycin, which is produced from a strain of the bacteria *Streptomyces* sp., as a biological control agent for potato weed. Post-emergence application showed good control of several weed species including potato weed, though some damage was also recorded in cotton, barley, maize and sunflower crops. Because of the likelihood of crop damage, this biological agent appears unlikely to be released for commercial use.

In general terms, biological control agents will only suppress growth and/or flowering of weeds, and will not achieve sufficient control alone.

Biological control is no silver bullet for success and therefore need to be integrated with other methods to achieve effective weed control. In Australia biological control has largely only been introduced for some perennial non-grass weeds in aquatic, pasture, and rangeland habitats. The short-term cropping season common in vegetable production makes it difficult for biological control agents to become established at effective levels. Therefore, vegetable farmers are unlikely to have the benefit of their use in the near future.

Bringing the control methods together

The three dimensions to success, most likely to provide effective control of major weeds such as potato weed include 'Deliberation', 'Diversity', and 'Dedication'.



In applying this '3D' approach, a variety of options is available as described on the next page. This is commonly known as 'integrated weed management', and is likely to bring you the greatest chance of longer-term success in restricting the impact of potato weed on your farm.



Figure 9 Dedicated application of a well planned integrated weed management strategy can result in little weed impact by the time of harvest, such as in this Brussels sprout crop in South Australia.

Integrated management of potato weed

Integrating all available and feasible weed control techniques in a timely and diligent way has been shown to be very effective in bringing heavy infestations of broadleaf weed species such as potato weed under control on Australian vegetable farms.

This section has been adapted from the chapter 'Vegetable Weed Management Systems', written by Craig Henderson, and published in the book *Australian Weed Management Systems* (edited by Brian Sindel, University of New England).

Some practices may be implemented for reasons other than weed management, but still have weed management benefits.

Depending on the farmer's circumstances and resources and the extent of the potato weed infestation, whole-of-farm integrated weed management strategies may include the following:

- Shifting most cash crop production to the parts of the farm where the potato weed infestation is lower.
- *Repeated cultivations* and *herbicides* may be used together to reduce the population of potato weed and other weeds before each crop planting. These approaches may include implementing a stale seed bed, and controlling recently emerged plants either by light tillage or herbicide application. Encouraging seeds to germinate and then controlling the plants before seed set can reduce the soil weed seed bank in the longer term.
- Including a cash crop or cover crop during the traditional non-cash crop period in the rotation may allow use of *selective herbicide options* that have been registered for potato weed control, although relatively few options are available for this weed. Fewer weeds may be expected to appear in the paddock when an out of season cover crop is grown. Including a fallow period in the crop rotation may also allow *non-selective herbicide* application to reduce the potato weed seed bank.
- Where a weed infestation is particularly heavy, it may be necessary to produce only short-season crops (if feasible) during the warmest months of the year, with the goal that crop seeding or transplanting through to harvest will take less time than the life-cycle of potato weed. A short crop production period may be beneficial in minimising contributions to the weed soil seed bank. Once the crop is harvested, the residue can be quickly ploughed in to prepare the land for the next cropping sequence, also helping to prevent seed set by escapee plants.
- Implementing and rigorously adhering to a *farm hygiene* program, for example: undertaking thorough vehicle washdown in between farm sites (especially infested and non-infested areas); laying concrete or gravel tracks along major farm laneways to reduce the amount of soil being spread by vehicles; and planting a competitive grass species (e.g. Kikuyu) along laneways and drainage lines, and mowing these areas to minimise the chance of undesirable weed establishment. Farm hygiene reduces the potential for potato weed seeds outside the vegetable beds to act as sources for recolonisation, and is particularly relevant when parts of the farm are infested while others remain free of the weed.

- Use of a *drip irrigation system* can mean that the non-irrigated inter-rows remain dry (unless rain falls) throughout most of the growing period, with consequent reductions in potato weed and other weed populations. Such an irrigation system may be integrated with a *plastic mulch* in some high-value vegetable crops such as cucurbits. This will result in little potato weed emergence within the mulched crop beds, though farmers need to remain aware of the potential for weed seeds to germinate in the crop holes, as well as where the mulch has been punctured during laying or during crop management activities.
- *Close plant spacings*, *rapid crop growth* and *canopy closure* may result in low survival of potato weed in the vegetable crop, and potentially reduced deposits into the soil weed seed bank. A similar approach is applicable to cover crop rotations.
- *Hand weeding* also has a role to play in an integrated approach. Farm staff should be encouraged where possible to physically remove and destroy older weeds (particularly those flowering) that they come across in the course of their work, especially at harvest time when large numbers of workers are likely to be systematically moving through each field. However, the relatively short life-cycle of this weed species will require repeated monitoring of the crop and removal of survivors, given its potential to grow to maturity quickly and for up to several generations of potato weed to grow in a single longer-season spring-summer cash crop.

Because annual broadleaf weeds such as potato weed rely on a rapid turnover of large numbers in the weed seed bank to maintain high populations, an integrated management system of this nature can be expected to result in a relatively sharp decline in weed numbers over time. Nonetheless, farmers need to remain aware of the potential for potato weed seed to remain dormant for up to 20 years, and therefore for germination flushes to occur at any stage given suitable conditions.

However, integrated management of potato weed is likely to be effective in reducing its impact at relatively little extra cost to the farmer, given that most of the operations described above would still have been implemented for other reasons and have other farm and crop benefits.

The key to integrated management of potato weed is a planned strategy to link the key management components in a sensible sequence, and the persistence to ensure that each step is diligently carried out. In the longer term, integrated weed management may contribute to improved enterprise flexibility, where cash crops may eventually be grown at any stage of the viable production period without concern that this will result in a vast increase in weed numbers, or that the weed burden will impact too significantly on the cash crop.

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Disclaimer

Descriptions of herbicide use in this guide are not to be taken as recommendations. Herbicides must only be used in accordance with the recommendations provided on herbicide labels. Readers are reminded that off-label use of herbicides may be restricted or not permitted under relevant legislation. Landholders are therefore advised to determine current registrations and legal requirements for herbicides they may be considering, and to consult with their State or Territory government departments regarding the legal requirements they are obligated to adhere to relating to herbicide use and weed control.

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