

# INTEGRATED WEED MANAGEMENT FOR SILVERLEAF NIGHTSHADE

## What is Integrated Weed Management?

Weed management has evolved and improved over thousands of years of agriculture around the world. Trial and error, and astute observations, identified many techniques that reduced the effects of weeds, and returned increased food and fibre yields. Soil cultivation, crop rotations, grazing, slashing, crop competition, sowing rate, fertiliser use, irrigation, hand-weeding, mechanical weeding, and biological control were used in combinations tailored to specific conditions. This is called Integrated Weed Management. Following World War 2 a string of herbicides was developed that dramatically changed weed control within a few decades. However, a range of problems associated with herbicide use has now led agricultural production back towards Integrated Weed Management, which is more robust and sustainable than reliance on herbicides alone.

Silverleaf nightshade is a long-lived perennial with a very resilient root system, and its management must be planned over at least a five to ten-year time frame. Uncoordinated and erratic control efforts are likely to result in futile expenditure with little gain over the long-term. The management suggestions below are based on research, observations, experience and practical knowledge, and are under-pinned by the information summarised in Section 2 above. If land is leased out, it may be prudent to include silverleaf nightshade management as part of the leasing agreement to protect the long-term productivity of the land. Cooperation and communication amongst local property managers within affected areas is a valuable way to share knowledge and help to reduce spread to unaffected properties and regions.

This section discusses many facets of silverleaf nightshade management. The reader is encouraged to consider their own particular situation and to construct an Integrated Weed Management Plan, based on a range of tactics that takes into account their local resources and constraints.

## Developing an Integrated Weed Management Plan

Silverleaf nightshade infests a wide range of land types over diverse regions, and it is unlikely that one plan will be equally applicable to all of these situations. Suggested strategies and tactics for a range of scenarios and enterprises are discussed under separate headings. It is likely that land managers will address several of these scenarios as they tailor their own particular Integrated Weed Management Plan.

Some managers may not have silverleaf nightshade, and so their focus will be on surveillance and hygiene to ensure that it is kept out. Others may have just a few scattered patches in a few paddocks. There are also properties with extensive and dense infestations in most paddocks. All three of these scenarios might apply to different areas of the same property. The invasion curve presented in (Fig. 2; Section 1) illustrates the increase in effort, cost and complexity as properties move from uninfested to heavily infested.

### THE BIG QUESTIONS...

Whatever the situation, managers are encouraged to ask three questions:

- 1) What is the current situation?
- 2) What would I like the situation to be – what does “success” look like, and by when?
- 3) What is a feasible Integrated Weed Management Plan to achieve success?



**FIGURE 39.** The area to right of the fence line has a dense infestation, and a solitary plant to the left of the fence suggests the beginning of the invasion process in that paddock. These early invaders should be a priority for control.

## Where do we start?

Designing a management plan for silverleaf nightshade can be a daunting task at first. But careful and logical thought will produce a plan that directs time and money to where it is most needed over the long journey. Large, dense, established infestations attract immediate attention, but careful consideration of the situation may identify higher priorities. The two highest priorities should be to stop seed and fragment movement to clean areas, and to control isolated outlier patches of silverleaf nightshade. Large dense infestations will still need to be managed, but the potential damage that can result from ignoring newly-established colonies (Fig. 39) dictates that they should take priority. The plan is analogous to fighting a bushfire – the main fire needs to be controlled and extinguished, but finding and extinguishing new spot fires is essential to prevent development of a second or third main fire. Table 2 may help to decide on strategies for each paddock.



**TABLE 2.** Prioritising silverleaf nightshade management (NSW DPI).

AREA	DENSITY		
	Light ( $<1$ stem/m <sup>2</sup> ) <10% ground cover	Medium (1-5 stems/m <sup>2</sup> ) 10-50% ground cover	Heavy ( $>5$ stems/m <sup>2</sup> ) 50% ground cover
Localised ( $< 0.25$ ha) small patch	Eradicate	Eradicate	Eradicate
Small (0.25-1 ha) part of paddock	Eradicate	Control	Control
Medium (1-10 ha) small paddock	Control	Control	Contain
Large ( $>10$ ha) large paddock(s)	Control	Contain	Contain

## Preventing spread to clean areas

Protecting a clean area requires minimising introduction of silverleaf nightshade seeds and fragments, by identifying and blocking invasion pathways, backed up by regular surveillance to find any escapes. Practical experience from diligent farmers across Australia has demonstrated that clean properties and paddocks can be defended against colonisation for decades, despite annual influx of seeds.

### Creeping lateral root growth

Silverleaf nightshade can spread 1 to 2 m per year via creeping horizontal lateral roots. This is usually of minor importance, except where colonies grow under fence lines and allow livestock in adjoining clean paddocks to access and spread the berries. If infested paddocks adjoin clean paddocks, consideration may be given to maintaining a “firebreak” buffer area (c. 5 to 10m) around the infested paddock, using herbicides, cultivation or slashing. This will minimise the chance of mature berries or lateral roots crossing the fence line. This spread should also be considered where silverleaf nightshade grows from a roadside towards a paddock fence, and around shearing sheds and livestock yards. Creeping lateral root growth also increases the area and density of infestations within paddocks, but is probably less important than seed or fragment movement to different parts of the paddock.

### Vegetative spread via fragments

Root and stem fragments produced by soil cultivation can be dragged within a paddock, or to nearby paddocks. This is most likely to occur with tined cultivators and deep seeding points. Long-distance spread is possible if contaminated machinery is transported to other areas and then used within a few weeks. Fragments are most likely to establish when conditions are warm and moist for several weeks after cultivation, but anecdotal evidence suggests that fragments may also survive in cool moist soils after sowing, to grow and re-establish during spring. Machinery should be cleaned before leaving an infested paddock – remove fragments caught on tynes, and knock off as much soil as is practical to dislodge any mature berries or seeds. Some growers also stop after traversing isolated patches and clean fragments from the tynes or points before proceeding into uninfested parts of the paddock. The probability of totally clean properties becoming infested via root or shoot fragments is relatively low in Mediterranean climates, unless contaminated machinery comes directly from working on another property that is infested. The risk is higher in central and northern NSW, where humidity and summer rainfall are higher.



### Spread by seeds

Establishment of new silverleaf nightshade infestations on clean land overwhelmingly originate from seeds ingested by livestock. There are other invasion pathways but sheep, in particular, are the main vector for seeds. The best defence for managers is to ask specific questions about properties that sheep are sourced from. If an assurance that silverleaf nightshade does not grow on the source property cannot be given, then the receiving property should take precautions. Late autumn and early winter is a particularly risky period because hungry stock are most likely to eat mature silverleaf nightshade berries on mature shoots, or from the soil surface (Fig. 40). Conversely, stock moved during spring are much less likely to be contaminated, but a visual check for mature berries stuck to wool may be prudent before release.



**FIGURE 40. Mature silverleaf nightshade berries can be sought out and eaten by hungry sheep during autumn, when pasture reserves are low.**



**FIGURE 41. Sheep can eat silverleaf nightshade berries during late summer and autumn – moving them to a clean paddock or farm can start a new infestation.**

If investigations suggest that livestock may have been grazing in paddocks infested with silverleaf nightshade (Fig. 41) within the last three weeks, during the mid-January to July period, then a quarantine period should be considered. The ideal situation would be that the livestock are contained on a fenced clean area on the source property, and then feed clean fodder for four weeks prior to transport. This is rarely a practical option, so managers need to balance risk with practicality. Alternatively, livestock could be restricted to a secure small holding paddock on the receiving property that is easy to inspect regularly for silverleaf nightshade. Whatever the quarantine period is, the receiving paddock should be one that is traversed frequently, to maximise the likelihood of finding any new infestations.

Silverleaf nightshade seed excretion peaks about 24 hours after ingestion, and then there is a steady decline over seven days to a low level. For the next seven days the output remains at a low level. In experiments single seeds were excreted 17 and 31 days after ingestion. There is no specific safe or risky quarantine period, because risk declines gradually with quarantine time. As a guide four days would be a minimum, but this might still have a significant risk. Seven days would be preferable, and after this the extra reduction of risk may not warrant the opportunity cost of continued quarantine. After four weeks the risk will be negligible, but this length of quarantine may be impractical for most. It should be noted that these suggestions do not reduce the risk to zero. It is always possible that a sheep may eat the odd mature berry at an unexpected time, but the relatively low number of seeds means that the probability of starting a new infestation is low.

Seed can also be introduced onto a clean property in contaminated seed for sowing, or hay. Again, it is prudent to ask suppliers about any weeds of concern that may be present in the produce. Suspect seed or hay could be refused, or fed out in a small quarantine paddock as described above. Machinery coming from known infested areas should be cleaned as well as is practical to minimise the chance of seeds dropping in mud, and construction soil should not be imported from pits infested with silverleaf nightshade. The risk of incursion due to wind or wildlife is low, but floodwater that has flowed through land or waterways infested with silverleaf nightshade is a high risk that warrants intensive surveillance once the waters recede.

## Surveillance

Surveillance over many years is a critical component of any plan to exclude or eradicate silverleaf nightshade from an area. Unfortunately, there is no substitute for thorough and regular searches at carefully selected times of the year. Timing of searches is determined by land use and management. Pasture paddocks, fence lines and roadsides are best inspected when shoots are green and fresh, and in flower. This is usually in December, except when pastures have been heavily grazed. In this case it may take two to four weeks after stock removal for shoots to recover and flower. Shoot emergence is usually delayed in cropped paddocks, and it may take four to six weeks after harvest for plants to be easily seen.

Silverleaf nightshade shoots in crop stubbles, especially canola, may also be smaller because of extraction of subsoil moisture by the crop. A second search in mid-autumn may be warranted, especially if there has been heavy rain during summer. Paddocks should ideally be searched on regular parallel transects, and GPS guidance units used for seeding and harvesting can be utilised to achieve this. A GPS or physical marking system should be used to mark or record any plants found, for follow-up herbicide treatment. Any unfamiliar plant with a purple, white, or blue flower should be investigated and identified. In addition, some areas should be checked regularly – gates, trough areas, shade trees, stock yards

and shearing shed yards, dam banks, flood-ways, creek-lines and sand hill “blow-outs”. It should be noted that individual shoots or small patches often may not be detected for several years, resulting in an established soil seed bank. As an example, a newly-acquired 1,000 ha property in WA was initially searched by one person using a ute to map the baseline silverleaf nightshade infestation. This took the equivalent of about four weeks to complete. Searching in early morning light may allow flowering plants to be seen more easily than when the sun is overhead.

**EFFECTIVE CONTROL TAKES AT LEAST 4-5 YEARS – DILIGENCE AND PERSISTENCE ARE ESSENTIAL.**

### BREAKOUT 4

#### HOLDING THE LINE IS POSSIBLE ....

Tim Dowdell bought an additional property in WA that was already infested with silverleaf nightshade. They still take sheep back to the nearby home property (clean of silverleaf nightshade, run by his father) to shear. They are careful to restrict sheep movements to the same tracks and areas. They frequently get new infestations (especially in wet summers) from sheep carrying seed to the home farm, but have managed to keep the home property clean through vigilance and spot-spraying – after 25 years of seed attack, the home farm is still clean! See Case Study 3 for more details.

Tim Dowdell and his father have prevented this situation from occurring on their clean home farm by vigilant surveillance and careful spot-spraying.



## Eradicating isolated plants and patches

As clean paddocks are invaded by silverleaf nightshade, isolated individual plants and small clonal patches develop throughout the paddock. At this stage the aim should be to eradicate them from that paddock. Isolated plants around gates, trough areas, shade trees, stock yards and shearing shed yards, dam banks, flood-ways, creek-lines and sand hill “blow-outs” also warrant repeated eradication. Eradication plans must be made for at least 5 to 10 years, due to the soil seed bank and regrowth from perennial root systems. Successful plans will include excellent surveillance and record keeping, and effective herbicides. A GPS is very helpful for revisiting treatment sites and annual photo point pictures help to track progress. Unfortunately, for many farmers, surveillance and spot-spraying may coincide with plans for holidays.

It is very difficult and labour-intensive to eradicate established plants without herbicides. An exception may be smothering a small number of plants with black plastic over several years. Digging, cultivation, grazing, and mowing are usually ineffective. There are a number of herbicides suitable for spot-treatment of silverleaf nightshade – please refer to the Herbicides section below.

Silverleaf nightshade frequently produces new shoots after initial herbicide treatment, and monitoring and re-treatment should be expected and planned for. Silverleaf nightshade shoots may take several years to re-appear following initial treatment. When using picloram, a residual soil active herbicide, it is very important to spray the shoot, and the soil for a 2m radius around the shoot. This is to allow picloram to move through the soil profile and be absorbed by the horizontal lateral roots.

Treatment of just the shoot often results in the emergence of a ring of daughter shoots from surviving lateral roots. High volume jets assist in soaking the silverleaf nightshade shoot and surrounding soil. Glyphosate is only absorbed through active shoots, so soil treatment is ineffective. Spot-spraying is best done early in the morning while plants are fresh, and flowering plants are easier to see. It is important to find and treat new plants as quickly as possible, because younger plants have a smaller root reserve and are more easily killed by herbicides. Soil residual herbicides may leave a bare patch of soil for several years (Fig. 42).

**FIGURE 42. Residues of soil active herbicides (e.g. picloram) often create bare patches that can persist for many years after application.**



## Managing established infestations

When silverleaf nightshade density increases to the point when spot-treatment is no longer practical, different tactics are needed. The aim now is to contain and weaken the infestation, and to protect crop and pasture yield.

The first two goals are relatively easy to achieve, however exhausting the root system takes years of persistent effort to reap the rewards. It may take three to five years of persistent spraying to notice a reduction in shoot density.

### THE BIG GOALS...

There are three major goals when managing dense, established infestations:

- 1) Prevent seed production.
- 2) Kill shoots during summer/autumn to protect following crop and pasture yield.
- 3) Reduce the size and vigour of the root system over time.



## “Dual Action” approach – the foundation of silverleaf nightshade management

Experience and research suggests that a “Dual Action” approach is most suited to long-term control of silverleaf nightshade. Action One, in early summer, is aimed at stopping seeding, and Action Two is aimed at weakening the root system in late summer or autumn. Tables 3 and 4 outline Dual-Action approaches for both crops and pastures.

**TABLE 3. Suggested Dual-Action approaches for cropping (NSW DPI).**

### ‘DUAL ACTION’ STRATEGIES FOR CROPPING

**EARLY:** An early action aims to achieve 100% seeding (seedbank) control in November or December when there are only a few stems distributed across the paddock which have just flowered. Options include knockdown herbicides, slashing, grazing, spray/graze or burning. The choice of products will be influenced by other weed species present and which crop types are to be planted in the future. Careful attention should be paid to plant-back periods listed on product labels to avoid damage to following crops. Control at this stage may help to synchronise the growth stages of subsequent shoot emergence.

**LATE:** A late summer or autumn herbicide treatment is applied when plants start to shut down naturally as the temperature declines. This coincides with the translocation of carbohydrates (energy) from the growing points down into the perennial roots. The aim of the treatment is to utilise the carbohydrate transfer to carry herbicides into the roots, maximising the potential for injury to them. The choice of product will be influenced by the plant-back requirement for following crops, and the levels of infestation.

**TABLE 4. Suggested Dual-Action approaches for pastures (NSW DPI).**

### ‘DUAL ACTION’ STRATEGIES FOR GRAZING

Dense infestations are often found in degraded pastures. Paddock renovation may begin with cropping prior to re-sowing a grass-based pasture, which allows the use of selective herbicides during the season. Depending on the silverleaf nightshade density, fluroxypyr, 2,4-D or even picloram products can be used in autumn to maximise root-bank control.

For scattered infestations the 1<sup>st</sup> action uses grazing (or spray/graze), hay-cut or silage, followed by the 2<sup>nd</sup> action in autumn by spot-spraying picloram products to target the root-bank.