INTEGRATED MANAGEMENT OF SILVERLEAF NIGHTSHADE

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ABSTRACT

Silverleaf nightshade is a deep-rooted summer perennial weed of southern Australia. Chemical and physical control tactics used for the past half century have not always been successful due to the resilience of the root system. Multi-year experiments established near Culcairn, NSW and Leeton, NSW showed that herbicides can reduce annual stem regrowth by up to 90%, depending upon the herbicide used and the time of application. Herbicide treatments containing the active ingredient picloram were the most effective, particularly if applied annually in summer and autumn. Competition from the perennial sub-tropical pasture species finger grass and digit grass at a field site at Wellington, NSW provided 94% suppression of silverleaf nightshade after two seasons.

Keywords: herbicides, pastures, IWM, silverleaf nightshade.

INTRODUCTION

Summer perennial weeds are a major cost to animal production in SE Australian mixed farming systems. Predicted climate change towards warmer, moister summers is expected to increase the spread and impact of summer weeds on pasture systems. Silverleaf nightshade (*Solanum elaeagnifolium* Cav.) is a typical example of an intractable, deep-rooted, summer perennial weed which significantly impacts on livestock productivity and health.

Silverleaf nightshade infests 140,000 hectares in SE Australia, with the potential to infest 398 million hectares, with nearly 95% of the infested areas affecting pasture lands (Kwong, 2006).

Silverleaf nightshade is currently classified as a noxious weed state-wide in South Australia and Victoria, and in one third of the local control authority regions of New South Wales. The spread, persistence and intractable nature of silverleaf nightshade is attributable to the presence of both a seed bank and a root bank. The seed bank is estimated to last for at least six years, and the extensive root system is thought to persist for longer, resulting in a need for long term management to reduce or eliminate a population once established.

The economic impact of silverleaf nightshade comprises direct control costs, production loss (yield and hay value), reduced land

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value, and environmental degradation. A survey of 254 land managers in SE Australia estimated that average total farm impact of silverleaf nightshade was $1730 per year in direct control costs and $7786 in lost production (McLaren *et al.,* 2004). Silverleaf nightshade can cause cereal yield reduction of up to 70% (Heap and Carter 1999) due to the depletion of soil moisture and nutrients during the previous summer as well as in-crop competition.

Additionally, the presence of silverleaf nightshade can reduce land values of both infested and nearby properties, with the potential to reduce land value by 25%. The lack of cost effective control tactics makes silverleaf nightshade management extremely difficult, with management limited to a few unreliable and expensive residual herbicides (Kidston *et al.,* 2007; Ensbey, 2009). A survey of 229 growers across SE Australia (McLaren, unpublished), identified that 84% growers needed more information and a package of actions that can be used to develop successful management plans for effective silverleaf nightshade control. This study investigated several options for silverleaf nightshade control.

METHODS AND MATERIALS

Pasture Competition

A study was conducted to determine whether summer active pastures provide competition to reduce the growth of silverleaf nightshade under field conditions. A field site was established in 2008 near Wellington (S: 32 31 57.34, E: 148 48 23.75), New South Wales. A complete randomised design with three replicates was used for eight pastures; Lucerne (*Medicago sativa* cv. Aurora), finger grass (*Digitaria milanjiana* cv. Strickland), digit grass (*Digitaria eriantha* spp. *Eriantha*), Rhodes grass (*Chloris gayana* cv. Katambora), phalaris (*Phalaris aquatica* cv. Sirolan), chicory (*Chicorium intybus* cv. Puna) and bambatsi panic (*Panicum coloratum* var. *makarikariense*), and sub-clover (*Trifolium subterraneum*) as a control. Pasture biomass and composition data were collected quarterly.

Herbicides

Field experiments were established in December 2006 at Culcairn (S: 35° 35′ 36.51″, E: 147° 10′ 5.28″) and Leeton (S: 34° 25′ 0.61″, E: 146° 22′ 10.57″), New South Wales. Treatments based on current registered herbicides, current reported practice and research reports were examined at each site in a randomised complete design with three replicates (Table 1). Treatments were applied annually using a shielded 4 m boom fitted with Lechler IDK 120-015 low pressure air induction nozzles operated at 250 kPa to provide 100 L/ha spray volume. Uptake spray oil at 1% v/v was included as a standard adjuvant.

Data on stem density, physiological maturity and mortality were collected just prior to and 4-6 weeks after each herbicide application to determine within season effectiveness of the herbicide treatments. Emergence data were recorded at the start of each season to determine between season effectiveness of the herbicide treatments.

RESULTS

Pastures

After two seasons, Strickland finger grass and digit grass were the most competitive, producing 10.8 and 9.6 t/ha biomass, respectively. The chicory pasture did not establish well and did not provide silverleaf nightshade control (Table 2). Phalaris and Rhodes grass did not provide significantly higher levels of control compared to the annual pasture. All other pastures significantly reduced silverleaf nightshade stem densities over time ($P<0.05$).

Herbicides

Silverleaf nightshade densities in December 2008 at the Leeton site were significantly different ($P<0.01$) as a result of two seasons of herbicide experiments (Table 2). Silverleaf nightshade control at the Culcairn field site were less conclusive ($P=0.07$), although some similar trends were evident. Annual ground cover (estimated 2-3 t/ha across the site) accumulated at the Culcairn site prior to winter annual weed control in 2008 which may have contributed to the lower stem emergence observed, whereas the Leeton site had minimal ground cover between seasons.

Two applications of either Tordon 75-D or Grazon Extra provided the greatest decrease in silverleaf nightshade density. Starane 200 and Roundup PowerMax, used once or twice per season, also provided suppression of silverleaf nightshade emergence after two seasons.

Atrazine 500 provided contrasting results between the two sites. It is speculated that differences in soil type, rainfall and general ground cover contributed to the observed differences. Similar levels of control as observed at Culcairn have also been noted at a District Agronomist's demonstration site near Ungarie. However, as the level of control achievable is not consistent it would difficult to recommend this treatment.

DISCUSSION

Current management practices focus on limiting seed production through herbicide application during the early reproductive phases in mid-summer. These practices typify the conventional approaches that have been successfully applied to annual weeds that rely upon seed banks for population survival. However, successful management programs for perennial weeds need to also include practices that reduce the root bank.

Table-1. Long term herbicide control of silverleaf nightshade stem emergence.

Herbicide	Application Rate	Leeton		Culcairn	
		Dec 2008 Density (stems/m^2 ± s.e.)	Stem Reduction 2006-08 (%)	Dec 2008 Density (stems/m^2 ± s.e.)	Stem Reduction 2006-08 (%)
Untreated control		15.3 ± 1.7	53	6 ± 3.3	-38
Roundup Powermax ®	1080g a.i./ha glyphosate	7.5 ± 1.5	-32	2 ± 0.6	-62
Roundup Powermax fb Roundup Powermax #	1080g a.i./ha glyphosate	9.2 ± 3.2	-20	3 ± 0.3	-7
Amicide 625 ®	937.5g a.i./ha 2,4-D amine	13.5 ± 2.9	12	5.3 ± 1.8	-1
Roundup Powermax + Amicide 625	937.5g a.i./ha 2,4-D amine + 1080g a.i./ha glyphosate	5 ± 2	-61	7.3 ± 3.1	0
Starane 200 ®	200g a.i./ha fluroxypyr	7.5 ± 0.6	-18	1.7 ± 0.7	-61
Tordon 75-D ® fb Tordon 75-D #	900g a.i./ha 2,4-D + 225g a.i./ha picloram	4.8 ± 1.4	-34	0.8 ± 0.4	-90
Grazon Extra ® fb Grazon Extra #	900g a.i./ha triclopyr + 300g a.i./ha picloram + 24g a.i./ha aminopyralid	3.8 ± 1.5	-60	1.3 ± 0.2	-72
Atrazine 500 ®	2000g a.i./ha atrazine	8.5 ± 1.4	142	0.8 ± 0.3	-79
Tordon 75-D	900g a.i./ha 2,4-D + 225g a.i./ha picloram	7.8 ± 1.2	-39	1.2 ± 0.4	-62
l.s.d. (0.05)		*5.9*	*123.6*	*n.s.*	*n.s.*

fb - denotes the same treatment applied in summer and again in autumn.

The presence of an active pasture can reduce stem numbers present in mid to late summer. As well as a direct reduction in stem density, competitive pastures can also lead to a reduced seed production and root vigour. Additionally, if stem emergence can be manipulated using competition, the phenological maturity of the population may be more uniform and allow for more timely application of herbicides.

Table-2. Effective pastures for silverleaf nightshade control at Wellington, NSW.

Pasture	Silverleaf nightshade Density (stems/m^2)		Percentage reduction
	2008	2010	(%)
Annual pasture	13.9	5.3	56.0
Lucerne	9.3	1.8	81.7
Digit Grass	13.1	0.9	94.0
Rhodes Grass	10.1	2.7	74.3
Phalaris	20.5	3.7	76.3
Chicory	9.3	7.3	21.7
Bambatsi Panic	14.4	2.4	86.3
Finger Grass	12.0	0.8	94.0
LSD (0.05)	*9.9*	*3.8*	*25.0*

Management of the silverleaf nightshade root bank is critical for achieving long term control. However, the cost and time associated with multiple herbicide applications per season may inhibit adoption, particularly as it takes many years to effectively manage the root bank. The density of infestations can result in them being either time consuming to individually spot-spray or uneconomic to treat with a broadacre boom application.

While herbicides have been used for control in the past (Cuthbertson *et al.* 1976, Lemerle 1982), long term control or eradication has been difficult to achieve in the field. A range of herbicides are useful for controlling seed set with a single mid season application, while picloram based products were the most effective of the autumn applied treatments for root bank control. However, picloram based products are typically five times more expensive to use than traditional herbicide choices ($95-100 and $15-20, respectively), even at the rates examined in these field experiments, which may make this strategy uneconomical.

Integrated management packages need to be tailored to suit each infestation. The use of residual herbicides has the inherent risk of impacting upon other components of the system. The residual picloram herbicides that have proven effective for controlling the root bank will also reduce the capacity of producers to establish and maintain broadleaf pasture and crop species in the following winter and spring, therefore their use must be carefully planned to fit within the projected use patterns. Herbicides for seed set control need to be selected that will not impact of perennial pasture production over summer, while the choice of autumn applied herbicides for root bank control needs to be made with consideration given to the proposed winter pasture or cropping practices.

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