Social factors influencing landholder management of silverleaf nightshade

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Summary Silverleaf nightshade (*Solanum elaeagnifolium* Cav.) is recognised as one of the world's worst agricultural weeds. Yet, little is known about the broader social drivers or barriers that influence farmer adoption of particular control strategies. To better understand these drivers and barriers, individual semistructured interviews were conducted with 18 farmers involved in the management of silverleaf nightshade (SLN) across four Australian states. Findings from this research reveal that the most significant driver for landholders to control SLN is the potential implications for property value in the district if SLN is not properly controlled. Time and associated labour costs represent the main challenges in controlling SLN, but they do not act as a barrier to ongoing control due to the high importance placed by farmers on controlling SLN. Based upon these findings, the paper makes three key recommendations for future SLN extension.

Keywords Silverleaf nightshade, social drivers and barriers, best management adoption.

INTRODUCTION

Silverleaf nightshade is a deep-rooted, summer growing, perennial weed, estimated to infest over 350,000 hectares in Australia. It competes directly with spring, summer and autumn growing pastures and crops for moisture, sunlight and nutrients. To date, research has focused primarily on quantifying the farm-level impacts of SLN in terms of losses in production and control costs (e.g., McLaren *et al.* 2004, Wu *et al.* 2016). However, little is known about the social drivers and barriers for landholders to adopt particular SLN control strategies.

Social factors, ranging from farmers' personal goals, knowledge and networks, to the broader cultural, environmental and economic context in which they make decisions, have a significant impact on adoption of new practices or innovations (Vanclay 2004, Wilkinson 2011). Understanding these social factors can provide valuable insights into farmers' weed control strategies and decisions, and help in identifying opportunities to improve weed management practices (Van der Meulen *et al.* 2006). Drawing upon qualitative social research across four states, the aim of this paper is to investigate the social drivers and barriers for SLN control, and to reflect on the implications for adoption of SLN best management practices.

MATERIALS AND METHODS

The research reported in this paper forms part of a larger national project funded by Meat and Livestock Australia and Australian Wool Innovation aimed at improving awareness and adoption of best management practices for SLN control (Herbert *et al.* 2016, in these proceedings). With the aim of benefitting the largest number of growers possible, farm scale participatory on-farm validation sites of best management practice (BMP) were established in 57 locations across four states through active coordination with state and local agencies, private sector contractors and advisors and local grower groups. As part of this process, a small cross-section of 18 growers were selected, using purposive sampling, for case studies aimed at promoting the successful management of SLN to other farmers and to increase national adoption of the BMP strategies. These growers were selected based on their experiences in applying a range of successful approaches in managing SLN – including the 'Dual Action' approach, which is the current BMP recommended to control this weed.

Individual semi-structured interviews were conducted with these 18 farmers between October 2014 and September 2015. The farmers interviewed represent different states (Vic – 4 farmers, NSW – 7 farmers, SA – 3 farmers and WA – 4 farmers) and cover a range of soil and climatic conditions. The majority (15) run mixed farming operations. While the principal aim of the interviews was to construct

case studies of best practice SLN control, an equally important aim was to gain an understanding of the social factors that influence how and why landholders control SLN. All interviews were analysed using open and axial coding (Miles and Huberman 1994) as a way of firstly finding common descriptors and then the relationships between those descriptors. Finally, the data were analysed using a thematic analysis to derive key themes from across the data. For example, 'impacts of SLN on farm production' and 'potential impacts on property value' were identified as two common descriptors during the analysis process. These descriptors were also considered to be closely related in that farmers in the interviews discussed potential, or actual, impacts of SLN as a strong driver for adopting control strategies. As a consequence, both of these descriptors were grouped with other similar descriptors to form part of a broader theme – key drivers to control SLN.

In total, four key key themes emerged from analysis of the landholder interviews. In summary, these themes surround the following issues: priority given to controlling SLN; key drivers to control SLN; barriers to the control of SLN; and, current control strategies as drivers and barriers to BMP adoption. Each of these themes is discussed in more detail below.

RESULTS

Priority given to controlling SLN All of the farmers interviewed believed that SLN was a high priority, if not the highest priority, weed needing to be controlled on their farm. This was due largely to the persistence of the weed and the fact that it is extremely difficult to keep under control. For example:

> *[SLN is a priority] because I know if you don't [control it] it'll just take over.* (Landholder 4)

> *It would be number one [priority]… because everything else we can spray and you kill and it's gone. Whereas you go and spray this nightshade and you go back two weeks later and there'll be another one there. You just keep coming back and it's constant.* (Landholder 18)

Key drivers to control SLN The key driver for controlling SLN mentioned most frequently by farmers was its potential impacts on property value if not sufficiently managed each year to reduce infestations. While concerned about SLN infestations on their farm, of equal concern was the effect of infestations within neighbouring properties on property prices in the local district.

> *Last week when I was in South Australia there was a farmer that's been trying to sell a block there, part of his paddock, he reckons … it's probably wall-to-wall silverleaf because it's never been controlled. He said he can't sell it, nobody wants to buy it.* (Landholder 5)

> *There's one farm in a similar area, probably ten kilometres to the north of [property] that's not been sold and it's just riddled with silver leaf and deep sand…. Someone will buy it [eventually] … but it's been sitting there for probably ten years.* (Landholder 12)

The prospective or actual observed impacts of SLN on farm production and viability were considered important by many farmers. For example:

> *You've got to control it because it will have an impact on your crop yields and it uses moisture, it uses nutrients, it does well. In good summers it does very well.* (Landholder 12)

> *SLN has reduced the sheep carrying capacity of the property by out-competing pastures and reducing the amount of feed available for stock. It has also depleted the soil moisture available to the cropping phase of rotations. By controlling SLN, the potential impact of the weed on the farm's carrying capacity and crop yields has been reduced*. (Landholder 16)

However, the impacts of SLN on farm production, including reports of production losses, were discussed less frequently and in far less depth than impact on property value.

Barriers to the control of SLN Time and cost were the predominant challenges for farmers in controlling SLN. In many cases the time invested by farmers to control the weed, particularly during summer, was significant ranging from two weeks up to three months full-time work (for spot spraying over widespread areas).

> *Most of my summer is spent [spraying SLN], a third of the year. Eight hour days. Seven days a week virtually.* (Landholder 5)

> *The chemicals are not expensive. It's the time involved. If the chemicals were five times more expensive than what I'm using I'd still use the five times more expensive because chemicals are not expensive. I might use two drums of Roundup,*

$200/$300 a year for chemicals. And here I am three months driving up and down the bloody paddock on a motorbike, out in the sun cooking. So you know the [main] expense is the time. (Landholder 17)

Clearly this is costly labour time that could otherwise be devoted to other farming work. The cost of chemical controls was mentioned less frequently by farmers, perhaps because spending money on chemicals to control SLN is considered a normal part of weed management. Rather than chemical costs, farmers emphasised the labour costs involved in controlling SLN.

It's certainly cost us a lot in labour…. I'm not the only who's been attending to it but it certainly costs in labour, big time. (Landholder 5)

Sometimes expenditure has been over $25,000 per annum as controlling SLN is a full-time job for a farmhand for about six weeks in January and February. (Landholder 3)

Nonetheless, chemical expenditure for controlling SLN was frequently higher than $10,000 per annum and in a few cases over $40,000. For two farmers interviewed, the relatively high expenditure meant that the price of chemicals was a major factor in determining which chemical options to use.

Glyphosate is used to control SLN because it is cheaper in comparison to other chemical options, easier to apply, and there is always some in the shed. (Landholder 4)

The price of chemicals dictates which option to use. We have increased rates of Roundup in the last ten years as the cost of this chemical has dropped. (Landholder 12)

Current control strategies as drivers and barriers to BMP adoption All of the farmers interviewed used a control program focusing predominantly on the use of chemicals. Indeed, a mix of chemicals was by far the most widely used SLN control strategy reported by farmers.

[I use] mostly just Roundup. When I spot spray with Roundup, if I've just got a hand sprayer, I'll probably wet the leaves, so it could be 10 litres to the hectare or something like that it's going on. (Landholder 4)

I was spraying to burn the top off it. Next year I would try and stop it from seeding but it used to damn well seed, you couldn't get round it all. And next year you go back, it was there, still there. You were back, back, back, effort, effort. And it was seeding and getting bigger but since we've been using a better wetter, I think the wetter's definitely the answer. We used 2,4-D for start off, we used Tordon, that was 15 years ago. And then we used Starane and then we used Roundup. But now Roundup and a good wetter, and I use a bit of, sometimes a bit of Ally…. The only thing that's keeping it under control is my spraying. And that's the only way we're going to head this. (Landholder 17)

Chemical use was, however, often combined with one or more of the recommended practices detailed in the SLN BMP guide – mostly competitive crops and pasture or mechanical control. Significantly, each of these control strategies was tailored by farmers to suit their farming system and personal values and goals.

Chemicals and competition [through vigorous groundcover] are used to keep SLN under control. We have recently adopted a dual action approach but it is too early to assess the results. (Landholder 7)

Cultivation is the main source of spread for SLN. Therefore, control strategies need to be focused primarily on machinery hygiene. In addition to this, sheep brought onto the property or from other paddocks are quarantined for two days to ensure that weed fragments are not spread. (Landholder 10)

Minimum till has meant a change from specific spraying for SLN to general summer spraying programs. One third of the farm is leased and is continually cropped. A substantial reduction in SLN infestation in these areas has been observed. With no-till, SLN is now no worse than other weeds. (Landholder 16)

Almost all the farmers interviewed recognised that SLN is one of the most persistent weeds to kill and they understood the economic consequences on the farming operation if controls were not applied early to stop the seed set and run the root reserves. Livestock producers stressed that getting the herbicides and timing right to prevent seed set was critical for success. Farmers interviewed who had cropping production systems,

consistently applied controls every year in summer and autumn, over a number of years, to reduce infestations.

DISCUSSION

Control of SLN is a high priority for farmers because it is readily spread by seed and is very difficult to control. While the prospective and actual impacts of SLN on production are important drivers for controlling the weed, of greatest concern to farmers are the potential implications for property values in the district if SLN is not properly controlled. The interviews highlight a strong collective concern, and even a sense of social responsibility, among farmers to control SLN so that it does not adversely affect local property values. This shows that farmers' socio-cultural values and goals relating to the broader viability of farming in the district may be more significant drivers to control SLN than short-term economic impacts on production.

The time involved in controlling SLN, and associated labour costs, represent the most significant challenges for farmers in controlling SLN. These constraints are recognised in the adoption literature (e.g., Pannell *et al.* 2006). However, our research shows that because SLN is considered by farmers as a priority weed, such challenges do not act as a barrier to ongoing control of SLN. This applies also to the cost of chemicals. For most of the farmers interviewed, cost does not appear to be a barrier to the use of chemical controls. This is perhaps because chemicals are considered by these farmers as a normal part of effective weed management, and the chemicals that are used to control SLN can be applied also to control a range of other weeds.

Farmers tailor the use of different SLN control strategies to suit local conditions, personal goals, and existing farming practices. While multiple chemical controls are the predominant approach used in managing SLN, these are typically used in combination with one or more non-chemical controls such as the use of competitive crops and pastures, farm and machinery hygiene practices, and minimum/no-till cropping. The social and environmental context underpinning farmers' practices is crucial to take into account in understanding why farmers use specific combinations of control strategies, and their willingness to trial new control options.

CONCLUSION

The research reported in this paper has three principal implications for future SLN extension. First, since potential impact on property values is a key driver for farmers in controlling SLN, this needs to be given greater emphasis in extension in addition to the current focus on production impacts. Second, greater emphasis is needed on the time and labour cost benefits of adopting best practice SLN control strategies. Third, when developing regionally-specific best practice approaches to controlling SLN, emphasis needs to be given to the ways in which best management SLN control strategies may (a) complement existing chemical use, and (b) be integrated with other effective non-chemical control practices.

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