Successful biological control of Paterson's curse.

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Property History

This paper reports on the biological control of Paterson's Curse that has been occurring on my property for the last 12 years.

In 1990 I purchased 'Koorrnong', which is a 1700 acre (690 ha) property located on the South-West Slopes of New South Wales, 10 km south of Tarcutta. At that time it had a small infestation of Paterson's curse at the front of the property of approximately 15 acres (6 ha), and about 30 acres (12 ha) out the back. Approximately 30% of the property had been sown down to Australian phalaris and subterranean clover by previous owners and the remainder consisted of native perennial grasses including, red grass (*Bothriochloa macra*), kangaroo grass (*Themeda australis*), weeping grass (*Microlaena stipoides*) and wallaby grass (*Austrodanthonia* spp.) with a range of naturalised and subterranean clovers.

I had come from a property that had not had a problem with Paterson's curse but I realised that if I didn't try to get rid of it, I would have a real problem on my hands.

Much of the infestation was located along the access road indicating that it had been brought in by vehicles. We immediately began a spraying program using MCPA on trafficable areas. In subsequent years we were advised to add LeMat® to the spray mix to control red-legged earth mite. In areas that could not be accessed for spraying, plants were removed by hand-chipping. At this stage we were operating a high input system which meant that we were adding large amounts of super and running excessive numbers of stock.

Impact of initial control measures

Spraying MCPA/ LeMat® and hand chipping continued until 1996 by which time the infestation at the front of the property had increased to 250 acres (105ha) and 300 acres (125ha) at the back of the property. In this time infestations had become particularly bad on ridgelines. It had become obvious to us that our control strategy was failing dismally. Also the battle we were waging with Paterson's curse was having a serious impact on our family life and on the operation of our other farm enterprises. From the autumn break through until late winter controlling Paterson's curse, particularly in non-trafficable areas had become our main focus. This involved all our children, Jenny and myself removing individual plants using knives. The children in particular felt the impact of this unsuccessful eradication strategy spending all of their weekends, after school and holidays chipping Paterson's curse. Additionally, our focus on controlling Paterson's curse adversely affected the timing of all other operations on our property. Basically, the effort and costs we were incurring as a result of our original control strategy was not stacking up, both on a personal and financial level. We had also become concerned over this time on the effect that the herbicide/insecticide mix we were applying was having on soil micro-organisms, beneficial insects (such as lady beetles), ourselves, and the food chain. We needed to look at alternatives

Venturing into biological control

We had first looked into biological control as early as 1991. At this time the only agent available was the leaf mining moth (*Dialectica scalariella*). This insect was released on my father's property in the Kyeamba valley where Paterson's curse covered approximately 4000 acres. This insect acted really only as a plant irritant. Some damage did occur on the leaves, but it did not impact significantly on plant vigour and survival. In 1993 I approached Matthew Smyth (formerly of CSIRO, Canberra) about three new biological control agents he was working with. Matthew needed a site where he could test these new agents in a relatively isolated environment. While our Paterson's curse infestation had increased dramatically from 1990, it was essentially still confined to three distinct areas of the property, so the chances of new agents escaping to neighbouring properties were minimal. The three agents released in 1994 were;

- Paterson's Curse crown weevil (*Mogulones larvatus*)
- Paterson's Curse root weevil (*Mogulones geographicus*)
- Paterson's Curse flea beetle (*Longitarsus echii*)

In this initial release only 30 of each agent was released at the front of my property near the house. When Mathew brought only 30 of each, I quizzed him and said is that enough. He informed me that they had only just been able to successfully change their

breeding cycle from the northern hemisphere to ours in the south and this was all that they had been able to breed in the cages at CSIRO in Canberra for release. The rest were to be used to increase the numbers at the research centre. I thought, boy I hope they are sexually active because that's not many.

In the first few years following the release it was difficult to find any of the agents so in 1996, a further 160 flea beetles were released at the front of the property. Another release of 220 flea beetles was made in 1997 and these were placed at the rear of the property. In 1998, 1050 root weevils were released as well as the flower feeding beetle. In 1999, 960 crown weevils were released. The root weevil and crown weevil can be found in small numbers but there is no sign of the flower feeding beetle. However, it wasn't until in 2002 an inspection of these sites found that the flea beetle numbers had built up to a point where considerable damage to Paterson's curse was beginning to occur. The flea beetle had been slow to establish, but we now know that the initial release numbers were too low. At least 1200 flea beetles need to be released in a confined area so that the population can increase rapidly to a point where an impact on Paterson's curse can occur.

Neither the crown weevil nor the root weevil have established particularly well. The flea beetle has the ability to survive drought and long periods of summer moisture stress without the host plant. During this stage, the flea beetle is dormant in the soil and emerges only after the autumn break. It is also able to easily get out of the road of livestock.

What impact has the flea beetle had on our Paterson's curse problem?

It took eight years from the initial release for the flea beetle to build up in numbers sufficient to have a significant impact on our Paterson's curse population. This was partly due to the low initial release numbers. With the release number now recommended at 1200 per release site, the lag phase until significant plant damage occurs can be reduced.

It was in 2004 that the real impact of the flea beetle became apparent. The adult flea beetles feed on the top side on leaves and if there are sufficient numbers, after a period of 7–10 days only a 'skeleton' of the leaf remains.

In areas where 2003 infestations had been very dense, the flea beetles attacked rosettes from late June onwards. By late July virtually all Paterson's curse rosettes had been eaten. The area that had been occupied by the rosette was then filled in by other pasture components, mainly phalaris and clovers. The only evidence of the dense 2003 infestation was the dry stalks of Paterson's curse. No new plants were growing in this area following the flea beetle activity in 2004. Once the flea beetle has eaten out an area it spreads out from this location. This means that in the next year there will be an infestation of Paterson's curse (from seedbank reserves), the beetle will then start to move back into the area and control the rosettes. Therefore there will continue to be pulses in Paterson's curse population until the seedbank is depleted. In 2005, all the areas where the flea beetle had eradicated of Paterson's curse the previous year were again reinfested. This was because of the seedbank but the flea beetle was found to have returned to the areas straight away and it is just a matter of time for the numbers to build up enough to remove the curse again.

On my neighbours in 2004, the infestation of Paterson's curse in one area was very severe. However in 2005, not one plant in the same area reached maturity, flowered and set seed due to the feeding activity of the flea beetle. It was from this area that the Weed Officers were able to collect flea beetles for distribution to other farmers. This year, it is expected that the curse problem will return to this area and the collection area will be back on my farm.

The impact the flea beetle has had on our property so far has been nothing short of amazing. Since we stopped using herbicides/pesticides we have also noted an increase in the population of other natural predators such as lady beetles. We are confident that over-time the flea beetle will reduce the Paterson's curse problem on our property to insignificant levels.

How far has the flea beetle spread?

In the Tarcutta area, since its initial release on our farm, the flea beetle has spread to a radius of at least 10 km (a rate of spread of about 1 km per year), and it is having an impact on Paterson's curse on neighbouring properties.

Following collection and release programs it is estimated that by this year, 2006, the flea beetle will be present in an area from Collingullie in the west to Carabost in the east and from Mundarlo in the north to Pulletop in the south.

Collecting the flea beetle for release in other areas.

We have been working with Matthew Smyth and other researchers to perfect a collection technique. We first attempted to harvest it using butterfly nets early in the morning but the flea beetle is not very active at this time of day due to low temperatures. We also found that the beetles were drowning in the dew once caught in the net. We moved onto harvesting in the middle of the day, but had trouble containing

the beetle once caught. A car fridge was brought in to immediately put the beetle into following capture. The low temperature of the fridge slowed the beetle down and this technique was reasonably successful. However, the strategy we now use involves dumping the beetle out of the butterfly net into a collapsible laundry basket. The basket is high enough to stop the flea beetle jumping out. A small vacuum cleaner is then used to collect the beetles for sorting and counting.

It is very important to have a minimum of 1200 flea beetles for release at new sites. When we had our first collection in 2002, Mathew Smyth was unsure of how many we would be able to collect so the releases for that year were 1000 each. Now that we have a good technique for collection and the numbers are so high it is possible to make each release 1200.

For those of you who are able to get a release on your property, the best place to release them is in an area of high infestation and fenced off. Within two years you will be able to see feeding on the plants. If you wish, you can still spray insecticides but the timing is important. It should be done while the insects are still underground. If you are unable to get a release it will probably be because they have already been released near you. The aim is to get them distributed to every part of Australia that has Paterson's curse.

Our farming enterprise now

Since herbicide/insecticide spraying ceased we have noticed an increase in the return of beneficial insects such as lady beetles, dung beetles and worm activity. At present, our aim is to increase the microbial activity in the soil and we are carrying out our program slowly and in small doses to monitor and observe the effects. Additionally there has been an increase in abundance of native grasses in our hill areas. We now run 1000–1500 superfine-fine soft rolling skin Merino ewes as a self-replacing flock. Currently we are not retaining the wether portion of our lamb drop. We also run 120 Murray Grey breeders, generally turning the steers off at around 400 kg live weight.

With the elimination of Paterson's curse, we have found that in some areas, other weeds have taken over the main one being capeweed (*Arctotheca calendula*).

Conclusion

Now that the lifecycle of the flea beetle has been successfully changed to suit the southern hemisphere, it is time to reinvestigate safe biological control of our other weed problems. The greatest problem facing this country is the introduction of unwanted guests to Australia. Be it plant or animal. Farming will not be viable in the future using the current methods of controlling our weeds and pests. Landcare has been a great concept but unfortunately nobody in the organisation seems to be able to realise the effects that the present control measures are having. These are both economic and environmental. We do not know what is happening in the soil.

It is time that more of our money that is taken from us in the way of levies, is spent on finding more safe biological ways to control our weed problems. This would be another way to improve our bottom line.

National Parks and the Forestry should also be contributing to research as it is on land in their care that many of the problems are hiding.

We need to use nature to help us. When done properly, biological control can be a great tool. These control agents work seven days a week. No holiday pay or sick leave and they love their work.