Control of Saffron thistle by grazing management

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ABSTRACT

Saffron thistle is a widespread and troublesome pasture weed in much of the grazing land in southern Australia, where standard control methods may not be economic. This study investigated the potential for strategic resting and grazing with sheep to control saffron thistle. A grazing strategy that spells the pasture in autumn, followed by heavy grazing may reduce the number of saffron thistle rosettes. Fewer rosettes survived if autumn grazing was deferred for one month. Rosettes, which are usually flat, grew more upright, and so were available to sheep. Older saffron thistles were killed by grazing once they begin to bolt. Rotational grazing appeared to limit saffron thistle density in farms surveyed in northern New South Wales.

KEY WORDS

Saffron thistle, strategic grazing, competition, pasture rest.

INTRODUCTION

Saffron thistle (*Carthamus lanatus*) is a major concern to graziers throughout much of southern Australia. It is widespread in New South Wales, Queensland, and Western Australia (11), in sheep grazed pastures in the 500 to 875 mm rainfall areas (10), and costs Australian agriculture over $100 000 pa (Paul Jupp, unpublished data). Control by grazing management offers an attractive and low cost solution, compared to spraying and cultivation.

Manipulating the grazing pressure of domestic livestock may offer a cheap and environmentally acceptable method of managing some pasture weeds. Strategic grazing can successfully control other thistle species (3, 7, 13) and other broadleaved pasture weeds. Saffron thistle is susceptible to both competition and grazing (6), so grazing management should incorporate strategic rest periods to increase competition and weaken the plant, with grazing strategies that encourage stock to eat it.

Saffron thistle rosettes are palatable and have few spines; it is their flat habit that makes them unavailable to sheep (11). Plant morphology may be altered by competition from surrounding plants, and the frequency and severity of grazing, e.g. slender thistle rosettes became elongated, with raised crowns in pastures that were rested in autumn or winter (3).

Saffron thistles are vulnerable to grazing when they first produce upright stems (6). As stems elongate they become more accessible to stock, and grazing before plants become too spiny can reduce seed production. Sheep at high stocking rates consumed 10 to 54 % of the saffron thistle heads (12), and strategic grazing has also been used to reduce seed production of a range of other broadleaved plants. High stocking rates can encourage animals to eat plants that would not be eaten under standard continuous grazing regimes (5). The effects of a rest period followed by grazing on thistle survival can vary between sites (3), any results should therefore be verified over as many sites as possible.

The effects of grazing management on saffron thistle populations have not been specifically investigated. These experiments, which are part of a wider study of saffron thistle population dynamics, aimed to understand how a strategic rest period, followed by grazing could be used for the control of saffron thistle.

Investigations were designed to measure the effects of autumn rest on saffron thistle rosettes, and the effects of grazing on plants as they begin to produce upright stems, or bolt.

METHODS

Rosettes

These studies were conducted near Armidale, and the site has been described previously (6). Thirty rosettes per treatment were mapped and tagged, and the heights of the longest leaves and crown of each rosette were measured every 14 days. Any grazing damage incurred by plants in the experiment was subjectively scored (0 = untouched: 4 = eaten to ground level). Pasture foliage cover was measured monthly, by dropping three pins at random around each tagged thistle rosette. Pin touches were recorded as the total number of touches on grasses, legumes, litter or neighbouring saffron thistle plants.

The autumn-rested plots were fenced off from 2 April 1999, while the adjacent set stocked plots were grazed throughout. After one month, fences were removed from the autumn-rested plots, and stock allowed access to the plots. The paddock was stocked with young rams at 16 dry sheep equivalent (DSE)/ha throughout the experiment. Survival was analysed using proportional hazards models (2).

Bolting plants

In an adjacent paddock, blocks of saffron thistles were allocated to two treatments; grazed or ungrazed in mid-October 1999, when most rosettes were beginning to bolt. The paddock was stocked with ewes at *c.* 5 DSE/ha. Eighty plants were tagged and monitored until 21 December 1999, when most plants had commenced flowering. Grazing damage was scored as described above.

Comparison of farms

The densities of saffron thistles on four farms in northern New South Wales that use rotational grazing were compared with their continuously grazed neighbours. None of the paddocks surveyed had received any fertilisers or herbicides within the last three years. Numbers of saffron thistles in five 0.25 m^2 quadrats were counted at five randomly chosen sites near the fence line on each farm. Pasture cover was monitored by taking BOTANAL assessments (15) at three randomly placed points near the quadrats used for calculating thistle density. Thistle density data were analysed by general linear models, with gamma error distributions, and proportion BOTANAL data were arcsine transformed, and compared between farms and between treatments using linear models.

RESULTS

Rosettes

Fewer rosettes survived in the autumn-rested treatment than in the continuously grazed treatment ($0.1<P<0.05$), although this difference was not significant at 5% level. After three months, 42% of the rosettes in the autumn-rested plots, and 33 % of those in the continuously grazed plots had died. Once the fences were removed, sheep grazed the previously rested plots more intensely than the continuously grazed plots.

There was a clear relationship between the foliage cover of the surrounding pasture and the height of rosette leaves and crowns. Leaf height increased significantly with the number of pin touches on legumes, grasses, litter and saffron thistle. Pasture density had a stronger effect on thistle leaf height in the autumn-rested treatment ($P<0.05$). The heights of rosette crowns were not affected by legumes in continuously grazed plots ($P>0.1$), but were strongly affected by legumes in the autumn-rested plots ($P<0.05$).

Once fences were removed, taller plants were more likely to sustain heavy grazing damage than shorter plants. Mortality was not correlated with grazing damage incurred in the experimental period (P>0.05), or the number of times a plant was grazed (P>0.1).

Bolting plants

More bolting saffron thistle plants subsequently died in the grazed than in ungrazed treatments (P<0.05). After two months 21% of thistles in the grazed plots had died before they commenced flowering, while only 2% had died in the ungrazed plots.

Comparison of farms

The farms surveyed that use rotational grazing had significantly fewer thistles (P<0.05) than their continuously grazed neighbours (Figure 1). Rotationally grazed farms also had higher percentages of perennial grass cover than their continuously grazed neighbours.

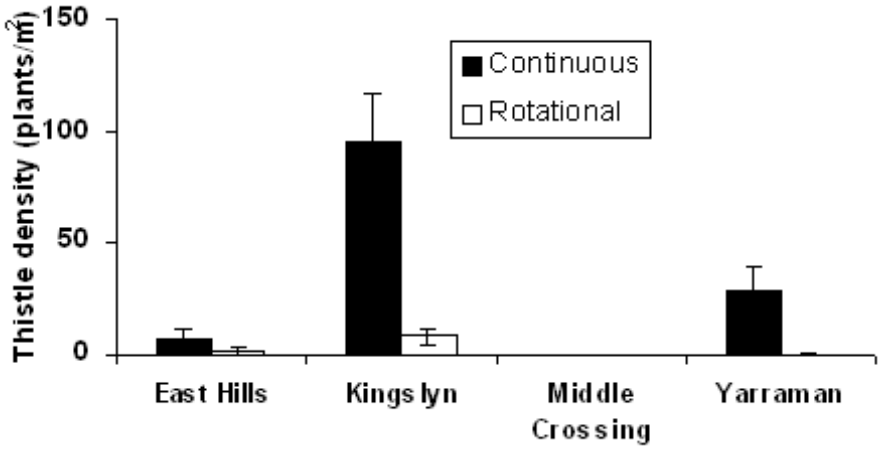

Figure 1. Density of saffron thistle (plants/m^2) on four rotationally grazed farms compared with their continuously grazed neighbours. Error bars show standard errors.

DISCUSSION

Rosettes

One short rest period, followed by grazing decreased the survival of saffron thistle rosettes, although this effect was not significant at 5% level. Other workers have achieved similar results with other thistle species (3, 7). Competition from other pasture species, especially legumes, resulted in saffron thistle rosettes growing more upright. Conversely, in glasshouse experiments, saffron thistle rosette leaves grew horizontally regardless of shading from other thistle species (1).

Legumes were more effective per pin touch than grasses in forcing saffron thistle rosettes to grow upright. The pasture in these experiments was dominated by the fine leaved *Vulpia* spp., which offered less shading and had less biomass per touch than legumes. Coarser leaved, winter-growing perennial grasses would presumably be more effective in making leaves grow upright, but the ability of various pasture species to compete against saffron thistle warrants further investigation, under a range of grazing strategies. In this experiment, grasses and legumes were much more effective in forcing leaves to grow upright in autumn-rested treatment than in continuously grazed plots. This indicates that grazing management can affect competitive interactions between pasture species.

Rosette crown height responded to pasture density in a similar way to leaf height. Crowns grew highest when the plots were not grazed, as found for slender thistles (3). The grazing treatment affected the relationship between saffron thistle crown height and density of the surrounding pasture, as was found for leaf heights.

Taller plants appeared to be more likely to be grazed. Elevating crowns by grazing management would make the meristems more susceptible to grazing. Indeed, the reduction in crown height after sheep were allowed back into the autumn rested plots appeared to be a result of sheep eating the taller thistles. The effects of removing meristems on saffron thistle rosettes is unknown, but warrants further investigation. Saffron thistle rosettes which suffer insect attack may become multi-stemmed adult plants (14), but because saffron thistle is a strict annual and not capable of postponing flowering for another year, seed production is unlikely to be increased as a result of grazing.

Bolting plants

Saffron thistle plants can be killed by grazing when they begin to bolt. Saffron thistle plants that have been grazed and survived would be expected to produce fewer seeds than ungrazed plants. Indeed, slashing saffron thistle 10 cm above ground level at first flowering drastically reduces seed production (8). This reduced seed production, when combined with increased mortality rates, indicates that high stocking rates when the thistles begin to bolt may be a useful control measure.

The fact that saffron thistle was grazed by sheep at moderate stocking rates is also promising, since grazing at higher stocking rates may force stock to eat species that are generally avoided at low stocking rates (4, 5). Stocking rates in the grazing trial were typical of continuously grazed systems in the area. Higher mortality rates might occur if high stock densities typical of rotational grazing systems were used.

If grazing was used to kill bolting plants in summer, then care must be taken to prevent overgrazing, as saffron thistle seedlings require bare ground when the opening autumn rains come to emerge (6). Producers should carefully monitor the state of the pasture, and adjust stocking rates accordingly.

Comparison of farms

Surveyed farms that used rotational grazing had fewer saffron thistles than did their continuously grazed neighbours. This was possibly due to thistles being killed by appropriate grazing management as above, or alternatively, the higher proportion of cover provided by perennial grasses on the rotationally grazed farms may have limited seedling emergence.

General discussion

Published accounts of successful use of grazing management to change species composition tend to have flexible, rather than calendar-based management plans (9). When controlling saffron thistle with grazing, "management skill is just as critical for success as it is with the alternative 'spray-grazing' technique" (12). Adjustments in effective stocking rates can be achieved by strategic de-stocking, concentrating on one or two paddocks at a time, shifting the farm towards rotational grazing, providing supplementary feed, or even by changing the time of lambing.

CONCLUSIONS

These experiments showed that a grazing strategy that spells the pasture in autumn, followed by heavy grazing may kill some saffron thistle rosettes. Older saffron thistles can be killed by grazing once they begin to bolt. Rotational grazing appeared to limit saffron thistle density on farms surveyed in northern New South Wales.

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