REDUCING THE FLOWERING OF SPEAR THISTLES DURING MID-SUMMER BY GRAZING WITH GOATS

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Summary Angora goats were grazed on annual pasture infested with spear thistles (*Cirsium vulgare* (Savi) Ten.) for two weeks during mid-summer. Pasture availability was relatively low but short green grass was available. The thistles had stopped growing, were flowering and some thistles had died under the dry conditions which prevailed during mid summer.

The mean spear thistle density of 25 000 plants ha^{-1} provided 45% of the available forage dry matter equal to 690 kg dry matter ha^{-1}. The goats consumed approximately 540 kg of thistle dry matter equivalent to 16% of the total thistle biomass and 35% of the thistle flower biomass. In this study the mature spear thistles provided a valuable feed resource for the goats during mid summer. The thistles were less preferred than the shorter, and presumably more digestible, green grass.

To obtain the best control of spear thistles by grazing with goats, the goats should be strategically introduced when the thistles are rapidly growing. Based on this study, introduction of goats when the spear thistles are mature, but still green, when green grass is on offer will result in a significant reduction of flowers but will be less effective in removal of thistle leaves.

INTRODUCTION

Goats can be managed to be very effective agents in the control and elimination of a range of noxious pasture weeds (McGregor *et al.* 1992, Allan *et al.* 1993). With the impact of weeds increasing, the cost of controlling weed invasions with chemicals is becoming prohibitive. Increasing community concern about the potential health effects of chemicals and residues is driving a need to understand more about potential forms of biological weed control. Therefore the behaviour of goats when exposed to weed infestations must be studied to develop more effective management strategies for the control of particular weeds.

Previous research at this Institute, demonstrated that fibre goats substantially reduced the height, vigour and flowering of thistles in annual pasture (McGregor *et al.* 1990) when introduced to the thistles in late winter. The goats preferred the taller thistles and were ineffectual in controlling the short (4–12 cm) thistles during winter and spring. Repeated grazing by goats significantly reduced the incidence of thistles flowering during late spring, summer and autumn.

This work was designed to evaluate the effectiveness of goats grazing spear thistle infestations of annual pasture in mid summer.

MATERIALS AND METHODS

Design The study consisted of two levels (moderate and high) of spear thistle (*Cirsium vulgare* (Savi) Ten.) infestation.

Pastures, animals and management The site at the Victorian Institute of Animal Science, Werribee (144° 41'E, 37° 54'S, elevation 46 m, annual rainfall 549 mm) consisted of improved annual pastures sown with annual ryegrass (*Lolium rigidum* Gaud.), subterranean clover (*Trifolium subterraneum* L.) and other volunteer grasses and herbs. Superphosphate fertilizer had only been applied once in the previous 10 year period when the pasture had been resown two years prior to this study. The spear thistles had been present for five years and the infestation appeared to be expanding.

A 30 ha paddock had been subdivided into 2.5 ha plots and grazed by mobs of sheep at stocking rates ranging from approximately 10–40 per hectare during spring and early summer. Angora goat does (mean liveweight 45 kg) were introduced to the plots on 13 January and removed from plot 1 on 26 January and plot 2 on 28 January. Stocking rate of Angora goats was 34 ha^{-1}. Fresh water was available.

Observations To estimate the density and the mean height of spear thistles in each plot, the number of plants in a randomly chosen 1 m^2 quadrant (n=100) and the height of the thistles was measured to the nearest 0.5 cm.

From each plot on 10 January, 20 thistles representing the height range observed in the plots were removed at ground level with secateurs, weighed to the nearest 0.1 g and dried to constant weight (48 h) in a forced draught oven at 100°C and then reweighed. The number of flowers on these thistles was also recorded. The mean dry weight of the flowers from 25 randomly selected thistles was determined. On 28 January the dry matter content of the green thistle stems minus their leaves was determined on 25 randomly selected thistles. On 28 January observations were made of the evidence of grazing damage to 90 randomly selected thistles in each plot:number

of flowers eaten, amount of leaves eaten, other physical damage.

Pasture availability was visually estimated. Dry matter intake of thistles was estimated by the intake of thistle flowers and other plant parts based on both the observations and measurements.

RESULTS

Pastoral conditions Pasture availability was low as the plots had been grazed with sheep but short green grass had regrown in December. The thistles had stopped growing, were flowering and some had died due to the dry conditions which had prevailed.

Thistle density The density estimates of spear thistles were: plot 1 30 400 ha^{-1}
plot 2 19 400 ha^{-1}

Thistle height The mean height of spear thistles is shown in Table 1. The thistles in the two plots were part of the same population as their heights were not significantly different and when pooled they formed a continuous distribution (Figure 1).

Thistle herbage availability The relationship between the height (H, cm) and the dry matter content (W, g) of spear thistles on 10 January (excluding outliers, Figure 1) was (± se):

$\log_{10}W = 2.021\ (0.100)\log_{10}H - 1.718\ (0.156)$,
r^2=0.92, RSD=0.133

The equation shows that the weight of the thistles was proportional to height squared. Using this equation and the plot mean thistle height the mean dry matter content of thistles in each plot on 10 January was estimated

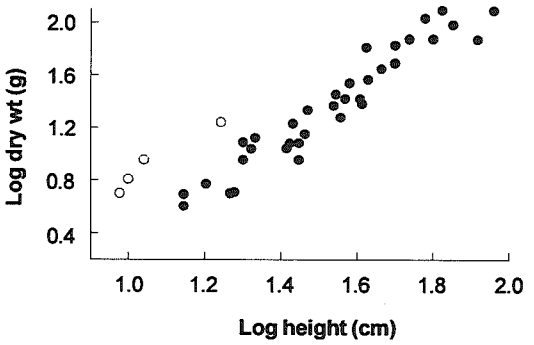

Figure 1. The relationship between the dry weight (g) and height (cm) of spear thistles growing in annual pasture at Werribee Victoria in late January. Four thistles which were outliers (O) are shown.

Table 1. The mean height and estimated mean dry matter content of spear thistles (g dry matter $plant^{-1}$).

Plot 10 January	Height ± sd (cm)	Dry matter content (g $plant^{-1}$)
1	33.4 ± 20.3	23.0
2	40.7 ± 20.2	34.3

Table 2. Availability of pasture and spear thistles (kg dry matter ha^{-1}).

Plot	Date	Pasture	Spear thistles
1	10 Jan	700	700
	28 Jan	400	630
2	10 Jan	1100	670
	28 Jan	700	520

(Table 1). Thistle herbage availability for 10 January was then estimated using the density of thistles (Table 2). Availability for 28 January was calculated by difference following the calculations of estimated dry matter intake and assuming that the thistles did not grow during this period.

The mean dry matter content of spear thistles at 10 January was 19.4 % and at 28 January was 31.2 %.

Intake of thistle dry matter The proportion of thistles with flowers and/or leaves eaten or physically damaged following grazing is shown in Table 3.

Intake of flowers The mean ± sd number of flowers per thistle on 10 January was:
plot 1 7.6 ± 11.0
plot 2 11.3 ± 12.5, (range 0 to 51)
The mean dry weight of thistle flowers (n=202) was 0.91 ± 0.63 g. The mean number of flowers eaten per thistle is shown in Table 3. The total intake of thistle flower dry matter (Table 4) was estimated by (mean number of flowers eaten per thistle) × (mean flower weight) × (density of thistles) × (area of plot).

Intake of leaves Observations on 28 January revealed that the proportion of thistles grazed to bare stems and the proportion of thistles with at least 5% of leaves eaten were: plot 1 5%, 18%
plot 2 10%, 55% respectively.
The mean weight of thistle leaves eaten was estimated by establishing a regression for the dry weight of thistle stems minus their leaves versus thistle height for thistles collected on 28 January. Using this regression and the mean thistle height for each plot estimated on 10 January the estimated amount of leaves eaten from thistles stripped to bare stems was:

plot 1 9.7 g
plot 2 18.2 g

The total amount of leaf consumed in each plot (Table 4) was estimated using the proportional leaf consumption observed in each plot, as shown above. The estimated total dry matter intake and intake per goat per day are shown in Table 4.

DISCUSSION

In this study the total forage availability of spear thistles (3.4 tonne of dry matter) represented 45% of the available feed resource. The combined total intake of thistles by the goats in both plots during the 14 day grazing period was estimated at 540 kg of dry matter representing 16% of the thistle dry matter.

Thistle flowers represented about 30% of total thistle dry matter availability in both plots 1 and 2. After 14 days the goats had consumed 22 and 48% respectively of thistle flower dry matter in plots 1 and 2. Pierce (1986) reported that goats ate significant numbers of saffron thistle flower heads resulting in the reduction of seed set and reduction of soil seed reserves. Goats have readily eaten spear thistle flowers when the thistles have been growing in late winter, spring and summer (McGregor *et al.* 1990).

The intake of thistle dry matter observed in this study would have supplied about one third of the maintenance requirements of these goats, providing a valuable source of nutrients during a period of the year when feed quality and quantity is usually deficient.

Based on the spear thistle dry matter availabilities measured in this study a large feed resource of unutilized spear thistles is wasted each year in western Victoria. Land managers currently slash and spray such thistles and suffer financial losses with vegetable matter contamination of wool when they could utilize the available forage and control infestations of spear thistles by grazing goats.

In my previous study goats readily ate regrowing spear thistles and thistle flowers during summer when the alternative feed resource was dry senescent annual pasture. In this study the shorter and presumably more digestible forage, short green grass, was preferred to the maturing spear thistles.

To obtain the best control of spear thistles by grazing with goats, the goats should be strategically introduced when the thistles are rapidly growing. Based on this study, introduction of goats when the spear thistles are mature but still green and with green grass on offer will result in a significant reduction of flowers but will be less effective in removal of thistle leaves.

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REFERENCES

Allen, C., Holst, P. and Campbell, M. (1993). 'Weed control using goats'. (NSW Agriculture, Sydney).

McGregor, B.A., Reid, C.J. and Scott, B.J. (1990). The effect of goats and sheep on the growth, flowering and longevity of tall, medium and short scotch and artichoke thistles. Proceedings of the 9th Australian Weeds Conference, pp. 497-500.

McGregor, B.A. (1992). Nutritional value of some exotic and indigenous plants browsed by goats in southern Australia. Proc. Aust. Soc. Anim. Prod. 19, 307-10.

McGregor, B.A., Hall, J., Weller, M. and Squire-Wilson, T. (1992). Goats for chemical free weed control. Proceedings of the First International Weed Control Congress Volume 2, 322.

Pierce, J.R. (1986). Control of saffron thistle *Carthamus lanatus* L. using goats. Proc. 10th National Noxious Plants and Animals Conf. (NSW Agriculture, Sydney).

Table 3. Observations of the proportion of thistles with various types of damage after grazing by Angora goats between 10 and 28 January and the estimated mean number of flowers eaten per thistle.

Plot	Thistles with flowers eaten (%)	Thistles with only leaves eaten (%)	Thistles pushed leaves eaten (%)	Thistles with no damage (%)	Number flowers eaten per thistle
1	40	11	10	40	1.7
2	95	5	–	–	5.4

Table 4. Estimated total dry matter intake of spear thistle flowers and leaves and dry matter intake of thistle per goat per day.

Plot	Total dry matter intake of thistle flowers (kg)	Total dry matter intake of thistle leaves (kg)	Total dry matter intake of thistle (kg)	Dry matter intake of thistle (g goat day^{-1})
1	127	43	170	154
2	258	112	370	290