EFFECT OF PASTURE COMPETITION ON THE SURVIVAL AND FLOWERING OF NODDING THISTLE

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SUMMARY

Nodding thistle *(Carduus nutans)* seedlings were transplanted into pasture which was either untreated or treated with paraquat beforehand. Those planted in areas bared by paraquat treatment grew more quickly than those planted in untreated pasture and most behaved as winter annuals. Almost all of those sown into untreated pasture behaved as biennials. The possible use of this information for the control of nodding thistle is discussed.

INTRODUCTION

Medd and Lovett (1978) found that nodding thistle plants required vernalisation for floral initiation. As a result, thistles which emerged in autumn always flowered the following summer. Those emerging in June or July flowered in either the first or second summer and those emerging in late winter or spring did not flower until the second summer.

Popay and Thompson (1980) found that most nodding thistle seedlings emerged during autumn and that there was high mortality among young thistle plants. They also observed that nodding thistles could behave either as winter annuals, flowering in the first summer after autumn germination, or as biennials, flowering in the second summer. They suggested that part of the reason for the variable behaviour of individual thistles was pasture competition which affected the growth rates of individual thistles and therefore their flowering behaviour.

An experiment was therefore carried out to determine the effect of pasture competition on the survival and flowering behaviour of nodding thistles.

MATERIAL AND METHODS

The experiment was carried out in 1980 on a nodding thistle-infested pasture at Argyll in Hawkes Bay. Nodding thistle plants were grown from seed in a glasshouse and hardened off in a shade house. At the second true leaf stage, they were transplanted by pushing the roots into a small slit in either untreated pasture or pasture desiccated with paraquat (Gramoxone 20% A.C.) at 0.6 kg ai/ha one month before transplanting. The procedure was repeated, with new batches of seedlings grown each time, for five transplanting dates — 14 April, 12 May, 18 June, 13 August and 18 September. Plot size was 2 x 2 m and the treatments were arranged in four randomised blocks. The soil was moist at all transplanting times except for 18 September when the soil was beginning to dry out.

Fifty seedlings were transplanted into marked locations in each plot at 10 cm spacings. Methiocarb (Mesurol 2% bait) was applied to newly transplanted plots for snail and slug control. Hand weeding of volunteer thistles in the pasture plots and of all volunteer plants in the paraquat treated plots was carried out at each visit.

The major pasture species were perennial ryegrass *(Lolium perenne)*, crested dogstail *(Cynosurus cristatus)*, bromus mollis *(Bromus mollis)* and sweet vernal *(Anthoxanthum odoratum)* Thistle diameters were measured at monthly intervals. The area was set stocked with sheep from autumn to early summer and with cattle from early summer to late autumn. The pasture was grazed to less than 3 cm throughout the experiment.

Soil samples taken from the experimental site in February 1981 and analysed by MAF Quick Test Methods showed that the soil was very fertile (pH 6.5, P 53, Ca 20, K 32, Mg 31).

RESULTS

Table 1 shows the percentage of transplanted thistles which survived to flowering. Thistles in the paraquat treatment had a significantly greater chance of surviving to flower than those in the pasture treatment. Transplanting date also had a significant effect on the numbers of thistles which flowered, and the interaction between pasture treatment and transplanting date was significant. Thistle survival was highest from the June or August transplanting times.

TABLE 1: Percent of plants transplanted, surviving to flowering.

	Date of transplanting						
Preliminary pasture treatment	14 April	12 May	18 June	13 August	18 Sept	Mean	LSD (5%level)
paraquat	34.5	27.0	57.0	56.5	6.0	36.2	4.72
none	1.0	6.0	12.5	21.0	3.5	8.8	
LSD (5% level)			10.56				

Table 2 shows that in the paraquat treatments, 94% of the thistles flowered in the first year. Time of transplanting had no significant effect on this proportion although there was some indication that thistles transplanted in September had a greater chance of being biennial than did those transplanted earlier. In the pasture treatments, 95% of the thistles behaved as biennials. Only four thistles, transplanted in August, flowered in the first year.

TABLE 2: Percent of flowering plants which behaved as annuals or biennials.

	Transplanting date	% flowering year 1 (annuals)	% flowering year 2 (biennials)	Total number
pasture treated with paraquat	14 April	89	11	69
	12 May	96	4	54
	18 June	96	4	114
	13 August	97	3	113
	18 September	75	25	12
Over all dates		94	6	362
pasture untreated	14 April	0	100	2
	12 May	0	100	12
	18 June	0	100	25
	13 August	10	90	42
	18 September	0	100	7
Over all dates		5	95	88

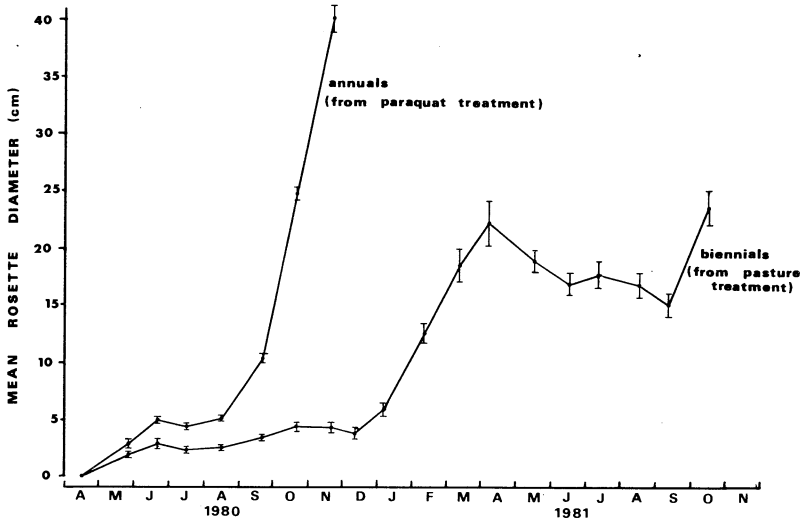

Fig. 1: The mean diameters of thistles from the first three dates of transplanting which behaved either as annuals or biennials. Vertical lines indicate standard error of mean.

Figure 1 shows the diameters of thistles, from the first three dates of transplanting, which behaved as annuals or as biennials. In the first winter and spring, thistles that behaved as annuals increased in diameter more quickly than those behaving as biennials. The biennial thistles remained small in their first winter, spring and early summer, grew rapidly during late summer and autumn, tended to become smaller in winter and then grew rapidly again in their second spring.

DISCUSSION

The results confirm that pasture competition does have a major influence on the survival, growth rates and flowering patterns of nodding thistles.

Thistles which germinate in early autumn are more likely to do so on bare ground or in open, drought affected pasture (Phung and Popay 1981) and so have a good chance of establishing and growing quickly without competition for a period until the pasture re-establishes itself. The thistles transplanted into untreated pasture in this experiment had strong competition from the start. This could account for the majority of surviving thistles behaving as biennials, whereas Popay and Thompson (1980) found that natural populations of autumn-germinated thistles behaved mostly as winter annuals.

Other factors such as soil fertility, density and climate may also affect the fate of thistles. Doing *et al* (1969) found that thistles grown by themselves in pots in a glasshouse usually behaved as biennials, but were annuals under a high fertility treatment. Medd and Lovett (1978) did not find any significant effect of density or fertility on nodding thistle development.

Medd and Lovett (1978) found nodding thistles plants did not become reproductive unless exposed to low temperature vernalisation. In our experiment most thistles transplanted even as late as mid-September in the paraquat treatments behaved as annuals and thus must have had enough vernalisation to stimulate flowering in the first year.

Popay *et al* (1979) noted that nodding thistle rosettes could become smaller in diameter over summer, probably as a result of drought stress. In our experiment the biennial thistles showed a steady reduction in rosette diameter over their second winter, followed by rapid growth in spring before bolting. The reduction in rosette diameter is probably due to a combination of grazing, and natural leaf senescence.

The effect of pasture competition in increasing the mortality of young thistles, and slowing the growth of survivors, could be used to help control them. The main management tools for increasing pasture competition in nodding thistle areas are the use of drought-tolerant pasture species, and good grazing management. The aim should be to encourage early, rapid growth of pasture in the autumn to reduce the numbers of established thistle seedlings. Strong pasture competition during winter and spring would continue to reduce plant numbers. Any survivors would grow more slowly and mostly behave as biennials, allowing more time before flowering for the effects of pasture competition, grazing, climate or chemical treatment to further reduce numbers.

ACKNOWLEDGEMENTS

The authors wish to thank Lindsay Lyttle and Thai Phung for technical assistance and Anthony Byett and Don Wright for statistical analysis. Also Tom Hobson for use of his land and allowing thistles to grow unchecked.

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