SEASONALITY OF EMERGENCE, AND SURVIVAL, OF NODDING THISTLE

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SUMMARY

In pasture an average of 94% of nodding thistle (*Carduus nutans*) seeds germinated in late summer, autumn or early winter (January to June). The proportion which germinated in spring increased if the pasture sward was treated with paraquat.

Thistles which germinated between January and June survived two to five time better than those germinating at other times.

These results confirm that late April, or May, is the best time for killing nodding thistles with herbicide. Even if the herbicides open up the pasture by damaging clovers, there is no evidence that this causes further thistle germination.

INTRODUCTION

Nodding thistle (*Carduus nutans*) is regarded as a major pasture weed in many parts of New Zealand, including Hawkes Bay. Times of seedling emergence and seedling survival, are important in determining the timing of effective herbicide applications.

Popay (1978) and Popay and Thompson (1979, 1980) observed that, at one Hawkes Bay site, most nodding thistle emergence occurred in autumn. Survival rates of autumn-germinated thistles varied between 3 and 19%. Spring treatment of pasture with glyphosate (Popay and Thompson 1979) encouraged the immediate germination of large numbers of thistles, of which about 28% flowered.

The purpose of this paper is to present further data on field emergence of seedlings, along with information on survival of plants emerging at different times of the year.

METHODS

Seedling emergence was assessed in small plots (Table 1) at three sites: Raukawa Road near Bridge Pa in Hawkes Bay, Argyll Road near Waipawa in Hawkes Bay, Midland Road near Colyton in the Manawatu. Nodding thistles were present at each site. All plots were open to grazing and no herbicides were applied near the plots at any time. Each plot was scrutinised at approximately monthly intervals and new seedlings were counted and either removed or mapped and left (Table 1).

In the plots where seedlings were left, and in other, nearby plots, the fate of individually identified thistles was followed until they died.

TABLE 1: Sizes and treatment of plots in which seedling emergence was observed.

Site	Dates	Plot Size	No. of Plots	Seedlings
Raukawa Road	24.9.76-22.2.78	6 x 2 m	3	Left
	30.3.78-15.8.80	1 x 1 m	6	Removed
Argyll Road	1.3.79-11.3.81	0.2 x 0.2 m	6	Left
	13.3.81-11.3.82	1 x 0.5 m	8	Left
	13.5.81-10.1.84	3.3 x 1.5 m	10	Removed
	3.8.84-22.4.86	10 x 0.5 m	5	Left
Midland Road	17.7.84-23.4.86	10 x 0.5 m	5	Left

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TABLE 2: Nodding thistle seedlings emerging in each 3 month period, expressed as a percentage of numbers emerging in each year.

	J F M	A M J	Months		Total/m ²
			J A S	O N D	
Raukawa Road					
1977	12	78	9	1	40
1978	13	84	3	tr	127
1979	94	5	0	1	220
1980	99	1	0	na	163
Argyll Road					
1979	95	3	1	1	373
1980	80	3	14	3	28
1981	4	92	4	tr	20
1982	97	tr	2	1	357
1983	3	84	7	6	61
1985	91	9	tr	tr	425
Midland Road					
1985	1	91	6	2	113

tr = < 0.05% of the total

na = not available

TABLE 3: Fate of nodding thistle seedlings emerging in different seasons.

Season	Site	Year	Percentage of seedlings surviving to flower	Number of seedlings
Autumn	Raukawa Road	1977	18.6	872
		1978	5.5	200
		1979	2.9	68
	Argyll Road	1979	3.0	100
		1982	16.9	414
		1984	6.0	970
		1985	1.0*	3748
	Midland Road	1984	14.4	224
		1985	6.2*	1480
		Mean	8.3	
Winter-Spring -Summer	Argyll Road	1980 (Jan)	0	30
		1984 (Aug-Dec)	0	303
		1984/5 (Dec-Feb)	2.7*	183
		1985/6 (Jun-Jan)	0.4*	455
	Midland Road	1984 (Sept-Dec)	0	50
		1984/5 (Dec-Apr)	6.0*	48
		1985/6 (Jun-Feb)	10.7*	181
		Mean	2.8	

* Percentages based on rosettes still alive in April 1986 corrected for flowering rates in 1985/86 of thistles present in April 1985.

In May 1982, paraquat was applied to five 5 m² strips of pasture at Argyll Road. Pasture frames were placed around the sprayed strips to exclude livestock. Nodding thistle seedlings were counted and removed at approximately monthly intervals, and plots were re-treated with paraquat at the same time.

Also in 1982, the effect of clover-damaging sprays on emergence of nodding thistle seedlings was studied in three Hawkes Bay experiments in which MCPA was applied to pasture in April, May and June. Plots were examined at monthly intervals for new thistle seedlings.

RESULTS

Emergence of new seedlings, in 3-monthly periods, is shown for all years and sites in Table 2. On average 94% of the seedlings which emerged in a year did so in the first 6 months. Over the 11 season-site combinations, 84% of seedlings appeared within 2 consecutive months — February and March in five cases, March and April in three cases and April and May in three cases.

Survival rates of populations of autumn-germinated thistles varied from 1% to 19%, with a mean of 8.3% (Table 3). Survival rates of thistles germinating at other times of the year were between 0% and 11%, and averaged 2.8%. Except for Midland Road in 1985-86, autumn-germinated thistles had survival rates two to five times higher than those germinating at other times in the same year.

Application of paraquat to pasture in May 1981 increased the proportion of seeds germinating in spring (Fig. 1).

Where MCPA was applied to pasture, clover content was reduced and the pastures were more open, but no seedlings emerged after spraying.

DISCUSSION

In grazed pasture, 94% of nodding thistle seedlings emerged between January and June. Furthermore, seedlings which emerged in this period had a two to five times better chance of surviving to flower than those emerging at other times. Therefore, we estimate that, on average, 98% of flowering nodding thistle plants are derived from autumn-germinated seedlings.

Applying paraquat to pasture in late autumn led to increased germination of seeds in the spring. This effect is similar to that observed with glyphosate applied in spring (Popay and Thompson 1980) and provides further evidence that the presence of pasture in the spring inhibits the germination of nodding thistle seeds, as indicated by Phung and Popay (1981). However, clover-damaging herbicides such as MCPA did not open up the sward enough to encourage additional winter or spring germination.

The predominance of autumn germination is presumably partly due to summer pasture damage caused by drought, insect attack and over-grazing. The timing of the autumn germination varies considerably (Table 2), and depends on when the first effective rainfall occurs.

The greater survival rate of autumn-germinated thistles is probably also due to the slow recovery of pastures after suffering drought and other stresses, and to the ability of thistles to germinate and grow quickly. Thistles germinating in winter or spring would generally be subject to greater pasture competition, and those germinating in summer would be subject to drought stress.

Roberts and Chancellor (1979) examined the periodicity of emergence of nodding thistle seeds sown in autumn into soil in containers kept outside. Some seeds germinated soon after sowing, but most germinated the following April (northern spring) and none in August to December. There is no obvious explanation for the difference between their results and ours, unless it represents ecotypic variation.

The importance of autumn emergence in terms of both numbers of seedlings and their survival rate explains why autumn herbicide application is so effective in controlling thistles (Delahunty 1960). However, the variability in emergence dates in the autumn suggests that some care is needed to ensure that the bulk of germination has occurred before spraying is undertaken. Hurrell *et al* (1983) discussed this point. In this context, it is interesting to note that the autumn flush of germination is usually limited to 1 or 2 months.

Fig. 1: Emergence pattern of nodding thistle seedlings. Monthly totals expressed as % of total emerging June 1981 to May 1982.

A. Paraquat applied in May: total number emerged = 225/m²

B. No paraquat applied: total number = 80/m²

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