EMERGENCE OF NODDING THISTLE SEEDLINGS IN PASTURE AT TWO SITES IN THE WAIKATO

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SUMMARY

Counts of nodding thistle (*Carduus nutans*) seedlings emerging each month from small plots of continuous or desiccated pasture were made at two sites in the Waikato region. The annual seedling emergence pattern is described and its implications for control programmes discussed. Most nodding thistle emergence in pasture occurred during summer or autumn but significant numbers also emerged later. Desiccation of the pasture encouraged seedling germination throughout the year.

INTRODUCTION

The emergence pattern of nodding thistle seedlings is a critical component of any control programme for this weed. In the Hawkes Bay, Popay and Thompson (1979) and Popay and Kelly (1986), have shown that the majority of seedlings emerge in the late summer and autumn of most years, coinciding with autumn rains which follow a typically dry summer. The latter study found that on average 84% of annual seedling emergence occurred within a 2 month period (February-March or March-April) and that seedlings emerging in autumn were more likely to survive than seedlings which emerged at other times. It is generally accepted that younger plants are more susceptible than older plants to the phenoxy herbicides commonly used for nodding thistle control (Delahunty 1960), so the current recommendation is to spray in the late autumn or early winter soon after the main flush of germination. However, where thistle germination is not confined to the autumn, the level of control derived from autumn herbicide applications will be reduced. Hurrell *et al* (1983) observed at one of their sites in Canterbury, that germination was still occurring in the late autumn with the result that herbicide treatments applied in March, April and May were less effective than those applied in September, October and November. At two other sites, autumn and spring treatments were equally effective. In the South Waikato, following herbicide treatment in late August, Thompson (1979) observed significant nodding thistle germination in the spring (approximately 10% of pre-spraying plant numbers). Between 15 and 51% of the spring-germinated plants survived to the following February with 9-30% of them flowering.

The purpose of this study was to determine the emergence pattern of nodding thistle under pasture in the Waikato region and to evaluate the effect of removing the pasture cover at monthly intervals throughout the year.

MATERIALS AND METHOD

Two trials, one on a Tirau sandy loam soil near Hinuera and the second on a Taupo silty sand at Whakamaru, were begun in January 1986 and repeated in 1987. The pastures in the trial areas were mainly grazed by sheep but were occasionally mown when stock were not available. Pasture cover was maintained within a range of 1000-2000 kg DM/ha, approximately 3-12 cm high. In the spring of 1985 the sites for 1986 trials were not sprayed, allowing thistles to flower and set seed to improve the distribution of seed over the trial areas. The thistles in the 1987 trial area at Hinuera were spot sprayed during October 1986, while the 1987 trial area at Whakamaru was grazed by goats resulting in very few plants producing seed.

The trial was a randomised block design with 12 pairs of plots per replicate. Near the beginning of each month each member of one pair was randomly assigned to either of two treatments:

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1. Pasture maintained, all nodding thistle rosettes and seedlings removed by hand.
2. Pasture desiccated by mowing to 3 cm and treating with paraquat (Gramoxone) at 2 g/litre.

Six replicates were used in 1986 and four in 1987. Newly emerged nodding thistle seedlings were counted and removed at approximately 2 week intervals for 2 months after treatment. Sampling was made from a 0.375m² quadrat on Treatment 1 and a 1.0m² quadrat on Treatment 2. A 0.25m² quadrat was sometimes used in 1987 on desiccated plots where estimated counts were greater than 200 seedlings/m². All quadrats were permanently marked to ensure the same areas were counted at each sampling date. Monthly seedling emergence was calculated by averaging the total seedling count in each month from plots which were treated early in that month and those treated early the previous month.

RESULTS

The total annual seedling count and the percentage of annual germination that occurred under pasture in any month at both sites is shown in Table 1. Nodding thistles emerged in pasture throughout the summer and autumn whenever there was sufficient moisture, but numbers varied widely from month to month (Table 1). Usually 1 or 2 months during summer or autumn had significantly greater germination than other times with 49 to 71% of the annual germination occurring in such periods.

TABLE 1: Average nodding thistle seedling emergence under pasture expressed as a percentage of the annual germination, derived from data in Table 2.

Month	Hinuera		Whakamaru	
	1986	1987	1986	1987
January	20	11	1	57
February	51	7	8	14
March	7	49	36	8
April	9	6	26	4
May	7	3	8	1
June	1	1	2	1
July	1	8	1	2
August	1	3	1	1
September	1	2	2	3
October	3	5	4	4
November	1	3	7	4
December	1	2	4	2
100% No/m ²	1021	277	533	327

The number of seedlings emerging in pasture had always decreased by May or June by which time approximately 87% of annual germination had occurred. However, significant numbers of seedlings continued to emerge after this time. Late winter and spring germination (August onward) varied between 33 and 99 seedlings/m² (4% and 18% respectively) over the four trials.

Desiccation of the pasture allowed an increase in the number of seedlings emerging each month compared to emergence under pasture (Table 2). The only exceptions were in January 1986 and February 1987 at Whakamaru when relatively dry conditions prevailed for most of the month. As in pasture, seedling emergence on desiccated plots varied between months. Counts were generally highest over the autumn and spring with similar numbers of seedlings emerging at both times even though very little seed fell from flowering plants after April. Lowest seedling emergence on desiccated plots usually occurred in May, June and July.

TABLE 2: Average monthly nodding thistle seedling emergence (seedling/m²).

Month/Treatment*	Hinuera				Whakamaru			
	1986		1987		1986		1987	
	1	2	1	2	1	2	1	2
January	204	973	31	168	5	3	187	603
February	525	807	20	71	42	94	47	47
March	76	908	135	427	190	262	26	219
April	94	442	16	81	142	440	13	38
May	68	173	7	63	42	115	4	9
June	11	60	2	44	8	9	<1	5
July	7	148	22	27	5	6	7	14
August	2	825	7	497	6	113	2	100
September	2	315	6	171	12	243	9	92
October	29	481	15	240	22	752	13	328
November	1	68	9	136	37	590	13	55
December	2	174	6	180	22	232	6	74

* Treatment 1: Pasture maintained, all nodding thistle rosettes and seedlings removed by hand at the beginning of the month.
 2: Pasture desiccated by mowing to 3 cm and spraying with paraquat (Gramoxone 2 g ai/litre) at the beginning of the month.

TABLE 3: Estimated number of the flowering nodding thistle plants per hectare in summer following a 100% successful spray at the end of June, derived from data in Table 2.

Percent of seedlings surviving to flower	Hinuera		Whakamaru	
	1986	1987	1986	1987
15	64 500	97 500	156 000	75 000
3	12 900	19 500	31 200	15 000
1	4 300	6 500	10 400	5 000
0.25	1 075	1 625	2 600	1 250

DISCUSSION AND CONCLUSIONS

The results presented here show that a continuous pasture cover reduces nodding thistle seedling emergence, especially during the late winter and spring. However emergence was not reduced to acceptable levels. The pattern of emergence at the two sites followed a similar trend to that reported by Popay and Kelly (1986) although the main flush of germination was spread over a longer period. Most seedling emergence had occurred by the end of autumn with 5-23% occurring after the end of June. Consequently late autumn spraying would have failed to treat a significant proportion of the nodding thistle seedlings that emerged. Popay and Kelly (1986) found that seedlings that emerged outside of autumn had a survival rate of approximately 2.8%. In the Waikato region, Thompson (1979) found that spring-germinated seedlings had a survival rate closer to 20% with 10-30% of those survivors flowering in the first summer.

Table 3 presents a simple model of the probable effect of herbicide applied at the end of June. The number of flowering plants per hectare expected in the summer was calculated assuming that the herbicide controlled 100% of plants present at the time of spraying and that all plants emerging after herbicide application that survived to the summer, flowered. If we further assume that plants that emerged after September would not flower in the first summer, the number of flowering thistles/ha would be approximately one third those shown in Table 3. This model and data presented earlier

indicate that in some autumn or winter sprayed pastures in the Waikato region there may be significant numbers of new plants requiring some follow up treatment to prevent flowering and seeding.

Various factors will influence just how important spring emergence is and these will be site specific. Areas where significant numbers of nodding thistles have been allowed to flower over several seasons (building up a high seed reserve in the soil) will be at greatest risk of having significant winter and spring germination. Pasture condition and grazing management will also greatly influence the emergence pattern. Removal of the pasture cover at any time following a period of dense sward cover will encourage seedling emergence. These conditions arise under systems employing long rotation intervals and/or hard sheep grazing at certain times. Continuous hard grazing during periods of slow pasture growth will also produce conditions conducive to seedling emergence.

In conclusion, it has been shown that maintaining an adequate pasture cover will provide considerable protection against nodding thistle seedling emergence throughout the year, but that timely herbicide treatment is still required to achieve adequate control. Furthermore, pasture management will influence the emergence pattern of nodding thistle seedlings and so influence the success of early herbicide applications (early winter) in controlling nodding thistle populations.

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