GRECIAN THISTLE PHENOLOGY AND CONTROL

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SUMMARY

Grecian thistle (*Ptilostemon afer* [Jacq.] Greuter) at present confined to somewhat stoney places in North Canterbury, is gradually extending its territory. Spot treatment with 2.5 or 5 ml shots of 2,4-D, 2,4-D plus picloram and MCPA at two rates all gave satisfactory control when applied in September or October, but only 2,4-D at the equivalent of 2.6 kg/ha in 500 litres water/ha killed all plants at all treatment times other than late bud stage. Cutting did not prevent regrowth unless cut below green tissue or the terminal capitulum had finished flowering. Whether a plant flowered depended on it having reached a critical size in the previous summer. The implications for control are discussed.

INTRODUCTION

Grecian thistle is the New Zealand common name for *Ptilostemon afer* (Jacq.) Greuter. The plant is native to the mountains of the Balkans from Greece north into Albania, southern Yugoslavia and western Bulgaria. A white flowered sub-species occurs in Asia Minor. In these areas Grecian thistle grows at elevations of 600 to 2300 metres in sunny sterile rocky places, moving gravels, stony stream beds, and arid pastures frequently derived from limestones but also from serpentine and sand (Greuter 1973). It occupies similar habitats in New Zealand presently at 50 to 700 metres. The first collection (1936) was recorded by Allan (1940). Its present distribution in North Canterbury is throughout the catchment of the Waipara River and the headwaters of the Kowai River (J.Capham pers. com.) with small areas in the Cheviot County (J.Duncan, pers. comm.) and Amuri County (I.Frizzell pers. comm.). The furthest north that it occurs is in the headwaters of the Lottery River about 70 km from the locations recorded by Healy (1946).

Grecian thistle has an attractive silvery-grey appearance with purple flowered capitula. However, its spiny leaves, stems and phyllaries make it hazardous to approach and completely unattractive to stock. Because of its limited distribution and the presence of other suitable habitats elsewhere in the South Island the Noxious Plant Council gave special project status to Grecian thistle with a view to containment and eventual eradication.

This paper reports on the phenology of Grecian thistle, investigated between 1981 and 1988, and trials conducted on spot treatment and cutting for its control.

METHOD

Spot treatment

The trial site was a partly consolidated gravel outwash formed by occasional floods in a normally dry valley-floor creek. Treatments were applied with a lance equipped with a trigger-operated metering device delivering 2.5 ml per shot through a solid cone tip to cover a 25 cm diameter target area. MCPA as potassium salt (Agroxone 4), 2,4-D as ethyl ester (Ethone) and 2,4-D plus picloram as amine salts (Tordon 50D) were applied at two rates in approximately 500 litres water/ha at monthly intervals from September 1981 to January 1982 inclusive. The low rate of MCPA and 2,4-D plus picloram were also applied as a 5 ml shot, i.e. equivalent to the high rate at twice the volume (Table 1).

Plots consisted of 10 similar sized thistles located by distance and angle from a central peg.

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Cutting treatments

Groups of thistles on a river terrace bank were cut on five occasions during November and December 1987 (Table 2). Cut portions were saved to observe seed development.

Phenology

A long term quadrat enclosing 30 plants was established at the gravel outwash site in November 1981 and the number of leaves and the diameter were measured. Plants were remeasured annually until March 1988. In January 1982, a short term quadrat with 50 plants was established and plant diameter and growth stage recorded. The measurements were repeated in May and November.

In May 1982 and February 1985, glyphosate was sprayed in a metre-wide strip across thistles growing on partially consolidated gravel to kill all vegetation in order to observe the developments of seedlings. A second strip in May 1982 was laid across a grassy area about 3 m from the trial site.

RESULTS**Spot spraying**

Almost all plants were killed by all treatments when thistles were sprayed as rosettes in September and October (Table 1). Plants treated in November as the flowering axis began to elongate, varied in response to treatment. Some were killed, some produced capitula and then died and some, by May, were growing again. All thistles treated at late bud stage on December 23 produced capitula with some plump 'seed' and were dead by mid-February. Some of the December or January treated rosettes had produced capitula by May, but not all were killed. MCPA was least effective while 2,4-D (2.6 kg/ha) killed all plants (Table 1). Two of the plots were re-examined in January 1983. In the January 1982 MCPA (1.3 kg/ha) plot one plant was still a rosette while the other plants were all dead having produced one to four stems with capitula in January 1983. In the other plot, 2,4-D (1.4 kg/ha plus picloram 0.35 kg/ha) five plants had died as rosettes and five after producing one to four stems.

TABLE 1: Number of Grecian thistles growing in May 1982 following treatment at rosette stage. (20 plants/treatment).

Treatment	Rate kg ai/ha	Month of treatment (1981-82)				
		Sept.	Oct.	Nov.	Dec.	Jan.
1 MCPA	1.3	0	1(1)	4(16)	20	20
2 MCPA	2.6	0	0	1(8)	12	10
3 2,4-D	1.3	3(2)*	0	0(20)	3	2
4 2,4-D	2.6	0	0	3(0)	0	0
5 2,4-D	0.7					
+ picloram	0.18	0	0	0(20)	2	15
6 2,4-D	1.4					
+ picloram	0.35	0	0	4(11)	4	19
7 MCPA	2.6	-	-	4(0)	4	19
8 2,4-D	1.4					
+ picloram	0.35	-	-	4(0)	-	-

*() No. of plants which produced capitula before dying.

Treatments 1-6 were applied as 2.5 ml/thistle, treatments 7-8 as 5 ml/thistle, equivalent to 500 and 1000 litres/ha respectively.

Cutting trial

Complete kill was only achieved by cutting the stem near ground level after the terminal capitulum had finished flowering (Table 2). Cutting at the first sign of colour in the flowers was also successful provided there was no green tissue below the cut. Multiple stem re-growth occurred if green tissue was present below the cut at the time of cutting except when the cut was made below the inflorescence at the end of December.

Delay in cutting delayed maturity, height of stems and size of capitula. At assessment the regrowth stems of the first cut plants were 30 to 50 cm tall with the capitula normal in size and mature, the second cut plants had finished flowering and the third cut were flowering. The capitula of the December cut plants were very small, some with colour but most were in the green bud stage and of doubtful vigour. Cutting just below the lowest visible bud caused regrowth below the cut with numerous very small capitula.

The growth removed at cutting was examined when dry. Stems cut in November produced no 'seed'. When cut in mid December some capitula which had colour in the flowers produced 'seeds' 33-50% of which were hollow. Capitula with no colour in the flowers did not produce 'seed'. The December 31 cut stems produced 120 to 150 'seeds' in the terminal capitulum.

TABLE 2: Effect of time of cutting at 10 cm above ground level on Grecian thistle recovery. Plant condition on 15 February 1988.

Date 1987	Plants		Cut	No	% alive	Surviving plants		
	Height cm	Bud stage				No* Stems	Height* cm	No* Capitula
2 Nov	20-30	Not visbl	(b)	13	100	3	40	9
16 Nov	25-80	Terminal visb	(b)	18	78	4	30	11
30 Nov	60-105	Full green	(b)	18	39	3	15	9
21 Dec	60-100	Termnl fl	(a)	10	10	3	5	3
			(b)	15	40	2	8	6
31 Dec	40-120	Termnl end fl	(a)	18	0	-	-	-
			(b)	6	0	-	-	-
			(c)	6	44	1	-	-

(a) = no green tissue below the cut

(b) = green tissue below the cut

(c) = cut below lowest visible axillary bud

* Mean values

Phenology

Some seedlings emerged in April and May but most emergence occurred in September and October. The first true leaves were narrow, tomentose and sparsely toothed. Subsequent development appeared to depend on the degree of aridity and inter-plant competition. Those adversely affected maintained a two to four leaf state for a year or more by the progressive death of earlier leaves as new leaves developed. Some plants gradually built up the number of active leaves, other plants died. Leaves of rapidly developing plants were more persistent and became irregularly toothed from the third leaf with vein endings developing spines at varying angles.

TABLE 3: Progressive diameters (cm) of the thistles from the 1982, 50 plant quadrat which survived the observation period.

Diameter class	21 Jan.		6 May.		25 Nov.		Growth Stg
	Mean	Range	Mean	Range	Mean	Range	
10	4.9	3-8	6.6	3-9	7.9	2-13	Rosette
10-20	14.1	10-20	17.5	10-30	21.2	13-30	Rosette
26-40	31.4	26-40	37.1	25-50	31.6	25-50	Green Bud

Number of plants in classes were 15, 8 and 16 respectively.

Populations of thistles encompassed a wide range of sizes and ages (Table 3). All thistles decreased in diameter over winter through death of outer (older) leaves. Of the eight plants in the long term quadrat that had cotyledons in November 1981, one was still alive in 1988 but was not yet of flowering size. Of 14 two leaf to seven leaf plants without evident cotyledons, one flowered in 1985, three in 1986 and one in 1987, while two were still rosettes in 1988. In the May 1982 grassy strip a group of thistles at one end

of the strip flowered in January 1985, three summers after emergence. However, the majority of the many hundreds of seedlings in the strips had not flowered by 1988. No plants in the 1985 sprayed strip had flowered by 1988. Thus a minimum of three summers was required to reach flowering size and some plants survived at least 7 years without flowering.

Flower stem elongation commenced in mid October, flower buds were visible by mid November and colour was evident in the upper capitula late in December (Fig.1). Flowering plants were not seen later than early February. Later flowering as a consequence of damage occurred in the cutting trial. All undamaged fruiting plants were dead by the end of February (Fig. 1). Capitula averaged 14 per plant, range 5-19.

Fig. 1: Grecian thistle phenology diagram.

DISCUSSION

Rosette thistles of similar size were susceptible during the spring to the chemicals used but became less so as the season progressed, probably due to seasonal factors. Increasing the rate of chemical, particularly 2,4-D, maintained effectiveness. Cutting has a very limited application for reducing soil 'seed' reserves. Though committed to flowering (and death), thistles retained the ability to regrow, until some 'seed' was ripe, if green growth was present.

The observations made (Table 3) suggest that there are at least two requirements for plants to change from vegetative to reproductive growth. They must reach a minimum size and this must be reached in the summer previous to flowering. Plants with a diameter of 25 cm or more in January appear to be committed to flowering in the following summer whereas those of lesser size will remain as rosettes for at least one more summer. Leaf number, although more difficult to measure, may be a better indicator of critical size than diameter. The summer before flowering plants which were 30 cm in diameter had 30 to 35 leaves. Three plants which reached the suggested critical diameter but had only 10, 13 and 15 leaves, required one, two and three more summers to reach leaf numbers indicative of flowering size. Popay *et al* (1979) showed a similar relationship between leaf number, rosette diameter and time of flowering for nodding thistle (*Carduus nutans*), though some nodding thistle plants reached flowering size outside the main flowering period.

Grecian thistle with its strictly limited flowering period (Fig. 1) and susceptibility to herbicides is an ideal subject for an eradication programme, in that an initial condition for success is to kill the population prior to reproduction. 'Seeding' is prevented if thistles are treated in the spring or early summer before the first sign of colour in the flowers; there is no need for a rigorous search for small plants; large rosettes from December on, will not flower until the following summer (Fig. 1) and so an annual programme can be planned for a fixed date.

However, since Grecian thistle habitats are of extremely low productivity and there is no indication that they can invade pasture (winter die back may be significant in this respect), there is little incentive for farmers to eradicate them once they have established on a property. Thus emphasis must be placed on prevention of invasion of this undesirable plant. This is best served by publicity in districts at risk and by the vigilance of Noxious Plant Officers.

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