RESPONSE OF DIFFERENT NODDING THISTLE (*CARDUUS NUTANS*) POPULATIONS TO HERBICIDES

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Resistance to phenoxy herbicides in nodding thistle is becoming a major concern to farmers, local bodies and agrochemical companies. The problem has arisen due to repeated use of these herbicides for control of this weed (Harrington and Popay 1987; Harrington 1990). In an effort to control these resistant populations, some farmers are resorting to herbicides that severely damage pastures. Research has been conducted with chemicals that may provide acceptable control with less pasture damage (Rahman *et al.* 1994). In this study we collected nodding thistle seeds from several farms to investigate the relationship between spraying history and resistance to phenoxy herbicides, and to further evaluate alternative herbicide formulations and combinations.

Ten nodding thistle sites with a range of use histories of phenoxy herbicides (Table 1) were identified in Waikato and seed collected from each population. Plants grown from these seeds were treated with 2,4-D (2,4-D Ester 80) to determine their response to this herbicide in two pot experiments. Seeds were pre-germinated and planted out into 150 mm diameter pots (one seedling per pot) containing Horotiu sandy loam soil on 20.4.94. For Experiment 1 the plants were maintained in the glasshouse and treated on 19.10.94 (26 weeks after planting) when they were about the same diameter as the pots. For Experiment 2 the nodding thistle plants were initially maintained in the glasshouse but were moved outside on 20.10.94 until the end of the experiment and were about 250 mm in diameter when treated on 1.2.95 (41 weeks after planting). Each treatment (Table 1) was applied to six randomly selected plants from each site with a moving belt pot sprayer using a single TeeJet 8003E nozzle to apply 300 litres/ha. Plants were assessed at 2 or 3 weekly intervals after treatment and were finally assessed as either dead or alive after about 2 months.

TABLE 1: Response (number of dead thistles; maximum = 6) of different nodding thistle populations grown in the glasshouse to 2,4-D sprayed 26 weeks (Exp. 1) or 41 weeks (Exp. 2) after planting.

Site	Spraying history of site (use of 2,4-D)	1.1 kg ai /ha of 2,4-D		2.2 kg ai /ha of 2,4-D	
		Exp. 1	Exp. 2	Exp. 1	Exp. 2
1	none for 10 - 15 years	6	6	6	6
2	none for 5 - 10 years	6	4	3	4
3	none for 5 years	1	0	1	2
4	1 or 2 applications in last 5 years	2	1	2	2
5	1 or 2 applications in past 5 years[a]	0	0	1	0
6	2 or 3 applications in last 5 years[a]	0	0	2	1
7	most years in last 5 years[a]	4	0	2	0
8	most years in last 5 - 10 years	0	1	1	1
9	most years in last 5 - 10 years	3	0	0	0
10	every year for last 10 years	0	0	0	0

[a] Sprayed with MCPA.

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There were no apparent morphological differences in the appearance of nodding thistle plants grown from seed from the 10 sites. However, their response to 2,4-D was quite varied. Only plants from Site 1 (no phenoxy herbicide use for more than 10 years) were completely susceptible to 2,4-D at normal use rates (Table 1). Plants from Site 2 (not sprayed for the last 5 - 10 years) were not all controlled by 2,4-D. Sites 3, 5 and 6 were from a property purchased by the present owner 5 years ago and documentation of the previous use of herbicides was not available. Nodding thistles from these sites were not controlled adequately by 2,4-D, even though no regular spraying had been done since the take over of the farm. Despite the lack of documented use of phenoxy herbicides, it is possible that these populations have developed resistance in the past. If this is the case, then it would appear that even sporadic use of phenoxy herbicides maintains resistance in the population. The site that had the most intensive use of phenoxy herbicides (Site 10) contained plants that exhibited the most resistance. Other sites that had intermediate histories of phenoxy herbicide use also exhibited resistance to 2,4-D.

Three field trials were also conducted in Waikato on nodding thistle populations with different spraying histories. Trials 1 and 3 were at a site with a long history of regular use of 2,4-D (Site 10, Table 1) and was suspected of containing phenoxy resistant plants. Trial 2 was on a site that had not been treated with any phenoxy herbicides in the previous 10 - 15 years. All trials were of randomised block design with four replicates and 2 x 10 m plots. The herbicides used were 2,4-D (2,4-D Ester 80 and 2,4-D DMA salt), MCPA (MCPA 400), dicamba (Banvel), metsulfuron (Escort), 2,4-D/picloram (Tordon 50-D) and clopyralid (Versatill). Treatments (Tables 2 and 3) were applied with a CO_2 powered precision sprayer using TeeJet 8003 nozzles at 210 kPa to apply 300 litres/ha. Nodding thistle damage was regularly assessed by three observers and plants counted on a whole plot basis when appropriate. The percent damage scores in Tables 2 and 3 represent an overall estimate of physical damage, plant density, size and vigour and the general appearance of the plants. Trial 1 was treated on 7.8.94 when the nodding thistle plants ranged from small to large rosettes. Trial 2 was sprayed on 12.8.94 when plants were medium size rosettes. Trial 3 was treated on 10.11. 94 when plants were large and in the bud stage.

TABLE 2: Response of a resistant (Trial 1) and a non-resistant (Trial 2) nodding thistle population to various herbicides.

Herbicide	Rate (kg ai /ha)	Trial 1 % damage		Trial 2 % damage	Thistles /20 m²	
		7.9.94	21.10.94	19.9.94	28.10.94	24.3.95
2,4-D ester	1.1	15	0	63	36	17
2,4-D ester	2.2	21	0	69	15	8
2,4-D DMA	1.1	14	5	55	42	17
2,4-D DMA	2.2	16	0	69	36	7
2,4-D DMA	3.2	24	28	70	19	10
2,4-D DMA + Nitrosol	1.1 + 0.5%	20	0	58	28	17
MCPA	1.1	23	10	60	18	8
MCPA + dicamba	1.1 + 0.09	43	60	64	4	1
2,4-D ester + dicamba	1.1 + 0.08	45	50	68	12	7
2,4-D DMA + dicamba	1.1 + 0.08	44	41	64	10	5
2,4-D DMA + dicamba	2.2 + 0.08	48	51	71	3	2
Untreated	-	0	0	0	400	300
LSD (5%)		6	14	6	16	15

Results from Trial 1 (Site 10) show that when used alone, only the high rate of 2,4-D (3.2 kg/ha) had any long term affect on the phenoxy-resistant plants under field conditions (Table 2). The use of dicamba in conjunction with 2,4-D or MCPA resulted in 40 - 60% damage but these plants, although stunted, still flowered and set seed. In contrast the nodding thistles in Trial 2 (Site 1) were readily controlled by all treatments, with the low rates of 2,4-D giving about 95% control and the combinations with dicamba resulting in 98 - 99% control at the final assessment. There was no difference in the level of control achieved by the two formulations of 2,4-D. Use of the nitrogen rich liquid fertiliser Nitrosol, which is used by some farmers as an adjuvant to 2,4-D (1.1 and 2.2 kg/ha), did not provide any benefit in terms of nodding thistle control. Results from these field trials are similar to those of Rahman *et al.* (1994) who found that use of other herbicides in combination with 2,4-D or MCPA gave increased control of the phenoxy-resistant nodding thistle, although, the overall level of control achieved in Trial 1 was not adequate for farming situations.

Results from Trial 3 show that even large, phenoxy-resistant nodding thistle plants can be controlled by herbicides but these usually result in severe pasture damage. The high rate of metsulfuron (10 g/ha), and 2,4-D with either picloram or clopyralid all provided good control of nodding thistle in this trial. These plants were completely browned off and did not set any seed. The 1.2 g/ha rate of metsulfuron, with or without 2,4-D, also severely affected the nodding thistle plants. Metsulfuron caused the flowers and growing points to die and rot but the bulk of the plant stayed green for a considerable time. At a lower rate damage was similar initially but did not persist and the plants soon produced new shoots from lower down the stems. It is difficult to assess if the 2,4-D in these treatments made any contribution to the level of control.

TABLE 3: Response of a resistant (Site 10, Trial 3) nodding thistle population to various herbicides applied at the bud stage in November.

Herbicide	Rate (g ai /ha)	% damage 21.12.94	17.1.95
2,4-D + metsulfuron	720 + 0.6	59	51
2,4-D + metsulfuron	720 + 1.2	64	68
2,4-D + picloram	800 + 200	70	88
2,4-D + clopyralid	720 + 300	81	93
metsulfuron	1.2	60	70
metsulfuron	6.0	58	81
LSD (5%)		5	17

The response of nodding thistle populations with different spraying histories evaluated in this study suggests that only populations with a very low exposure to phenoxy herbicides would be fully susceptible to them. As most infestations in Waikato would have had some exposure to phenoxy herbicides, the problem of resistance may be widespread. Phenoxy-resistant populations are difficult to control except with herbicides, such as metsulfuron, picloram, clopyralid and dicamba, which seriously harm the pasture. However, use of these herbicides or their combination needs to be judicious and alternative methods of application, such as spot treatment and carpet wipers, should be considered.

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REFERENCES

Harrington, K.C., 1990. Spraying history and fitness of nodding thistle, *Carduus nutans*, populations resistant to MCPA and 2,4-D. *Proc. 9th Australian Weeds Conf.*: 201-204.

Harrington, K.C. and Popay, A.I., 1987. Differences in susceptibility of nodding thistle populations to phenoxy herbicides. *Proc. 8th Australian Weeds Conf.*: 126-129.

Rahman, A., James, T.K. and Sanders, P., 1994. Control of phenoxy resistant nodding thistle (*Carduus nutans*) in pasture. *Proc. 47th N.Z. Plant Protection Conf.*: 68-74.