DISTRIBUTION AND CROSS-TOLERANCE OF MCPA-TOLERANT NODDING THISTLE

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SUMMARY

Problems experienced with the control of nodding thistle (*Carduus nutans* L.) on a Hawkes Bay farm using phenoxy herbicides have previously been shown to be caused by herbicide tolerance. This paper reports the discovery of at least 12 other sites in Hawkes Bay and Waikato where nodding thistle showed tolerance to MCPA. Slender winged thistle (*Carduus pycnocephalus* L.) showed a similar level of tolerance at the one site at which it was studied. Tolerance by nodding thistle of other herbicides, especially MCPB and 2,4-D, was shown. The herbicides which killed MCPA-tolerant thistles are generally unsuitable for selective weed control in pastures.

INTRODUCTION

Tolerance of MCPA in a population of nodding thistle at Argyll in Hawkes Bay has been demonstrated by Harrington and Popay (1987). Under field conditions, this population was shown to be over six times more tolerant of MCPA than usual.

Enquiries revealed that a number of farmers in Hawkes Bay and Waikato have experienced problems recently in obtaining satisfactory control of nodding thistle with 2,4-D or MCPA. There have also been reports from some Hawkes Bay farms of difficulties in controlling slender winged thistle using phenoxy herbicides. The tolerance of plants from some of these properties are investigated in this paper.

Harrington *et al* (1988) have shown that clopyralid is effective against the Argyll nodding thistle population. However, indirect evidence from earlier work (Harrington and Popay 1987) suggests these plants do tolerate 2,4-D. In order to establish what chemicals are tolerated by the Argyll thistles, 12 different herbicides were tested for effectiveness against these plants. The herbicides chosen are all used for nodding thistle control either in crops or pasture. Some are very similar in structure to MCPA (phenoxys), others have a similar mode of action to MCPA but are not phenoxys, and a few differ entirely from MCPA both in their structure and mode of action. This paper reports the results of these tests.

METHOD

Trial 1: Comparison of populations

Enquiries were made among Ivon Watkins-Dow employees and spraying contractors to locate farms with problems controlling nodding thistle with MCPA or 2,4-D. Seeds were collected from these properties in Hawkes Bay and Waikato (Table 1) in January 1988. Seeds were also collected from sites thought to have susceptible populations so that comparisons could be made, giving 22 sites in total. Their locations are listed in Table 1. At one Hawkes Bay property (Rotoma), the farmer was more concerned about poor control of slender winged thistle, so seeds of both this species and nodding thistle were collected from here.

Because some innate dormancy has been detected with nodding thistle seed (Popay *et al* 1987), the seeds were stored until May 1988 when they were germinated in petri dishes in 0.2% solution of potassium nitrate. The healthiest seedlings were planted into individual 230 ml plastic pots with a peat/sand/pumice mix in a glasshouse ranging in temperature daily from 15 ± 1 °C (standard deviation) to 18 ± 1 °C.

When they were 3 months old, 30 plants from each of the 23 populations being tested were individually sprayed with 5.0 ml of solution containing 3.0 mg ai MCPA

using the device described by Harrington (1987). At treatment, plants had an average (with standard deviation) crown diameter of 8 ± 2 mm (as measured just above ground level).

The numbers of plants killed were recorded after 4 months. Differences were compared using an adjusted chi-square analysis.

Trial 2: Comparison of herbicides

Nodding thistle seeds from the Argyll and Matapiro populations discussed by Harrington *et al* (1988) were sown in February 1988 in 230 ml paper pots with a peat/sand/pumice potting mix in a glasshouse ranging in temperature from 18 ± 1 °C to 22 ± 2 °C daily. The resulting seedlings were transplanted in April 1988 into a paddock near Massey University where the pasture had recently been killed with glyphosate. Rows of seedlings were 1 m apart with 1 m between plants. Argyll and Matapiro plants were alternated within the rows. The plants were individually labelled using plastic ear-tags nailed to the ground.

The relative susceptibility of these two populations to 12 different herbicides (Table 2) was tested in May 1988 when the plants had been in the field for 5 weeks and had an average crown diameter of 10 ± 2 mm. Each herbicide was applied to three different plots within the paddock, resulting in a total of 28-30 plants from each population being treated. Most of the herbicides were applied using a propane-powered precision plot sprayer with muslin screens around the sprayed plots to prevent drift on to neighbouring plots. Picloram was applied as granules and the DPX-L5300 was applied in 5 ml of water per plant using the same sprayer as in Trial 1 to simulate spot-application. All other herbicides were applied with 200 litres/ha of water except the paraquat/diquat which was applied in 400 litres/ha.

The numbers of plants killed were recorded after 3 months. Differences between the two populations were compared for each herbicide using an adjusted chi-square analysis.

RESULTS AND DISCUSSION

Trial 1: Comparison of populations

Nine of the sites in Hawkes Bay and five in Waikato had nodding thistle populations that were significantly more difficult to kill with MCPA than the Matapiro population (Table 1).

This trial was designed primarily to establish if Argyll is the only site with tolerant populations of nodding thistle. It thus gives no indication of the proportion of nodding thistle populations that have tolerance, nor has it measured the proportion of tolerant plants within such populations. Many of these sites had been sprayed with 2,4-D in the previous few months. This would have ensured there were no susceptible plants producing seed at the time collections were made, giving a bias to the sample.

Some sites such as Mananui had not been sprayed so there was a mixture of susceptible and tolerant plants at the time of seed collection. In this trial the Mananui population was not significantly different in tolerance to the Matapiro population. It is quite possible, however, that there are as many tolerant plants at Mananui as at the nearby Kia Ora site and that a recent spraying at Kia Ora had merely resulted in a higher proportion of "tolerant seeds" being collected.

It is very difficult to obtain details on the previous spraying history for each of the sites. Detailed records of spraying operations are seldom kept, and ownership of land over the past 40 years has often changed. However, it seems that many of the sites where tolerance was detected have been sprayed annually with phenoxy herbicides for at least 15 years.

Only 13% of the slender winged thistle plants grown from seed collected at Rotoma were killed by 3.0 mg of MCPA. This suggests these plants are as tolerant of MCPA as the Argyll nodding thistle plants.

It was claimed by Taylor (1977) that slender winged thistle is more tolerant of phenoxy herbicides than winged thistle (*Carduus tenuiflorus* Curt.). Although the results obtained by Taylor indicate that the tolerance he observed was not as marked as

TABLE 1: Percentage of nodding thistle plants from each population killed by 3.0 mg ai of MCPA.

Name of site	Location	Grid reference	% kill*
Maungatautari	Waikato	175°34'E 37°59'S	0
Waotu	Waikato	175°44'E 38°10'S	0
Argyll	Hawkes Bay	176°35'E 39°54'S	10
Waikareao	Hawkes Bay	176°40'E 39°49'S	10
Te Onepu	Hawkes Bay	176°37'E 39°49'S	13
Arohena	Waikato	175°36'E 38°13'S	17
Glenalvon	Hawkes Bay	176°42'E 39°45'S	20
Mangatutu	Waikato	175°28'E 38°13'S	20
Rotoma	Hawkes Bay	176°41'E 39°47'S	23
Kia Ora	Hawkes Bay	176°34'E 39°53'S	23
Raukawa	Hawkes Bay	176°41'E 39°46'S	30
College Road	Hawkes Bay	176°37'E 39°52'S	30
Tauhara	Hawkes Bay	176°42'E 39°37'S	43
Buckland	Waikato	175°44'E 37°55'S	70
Mananui	Hawkes Bay	176°34'E 39°51'S	80
Rangitoto	Waikato	175°15'E 38°20'S	90
Mason Ridge	Hawkes Bay	176°37'E 39°45'S	93
Limestone Downs†	Waikato	174°45'E 37°29'S	93
Ohutu†	Hawkes Bay	176°37'E 39°53'S	97
Awanui†	Hawkes Bay	176°47'E 39°43'S	97
Ohiti†	Hawkes Bay	176°45'E 39°37'S	97
Matapiro†	Hawkes Bay	176°41'E 39°37'S	97

* Populations with 70% kill or less are significantly different ($p = 0.01$) from the Matapiro population.

† Sites where nodding thistle populations were not thought to be tolerant at time of collection.

that found in the present trial, more work is required before claims can be made that the level of tolerance is increasing in this species.

Trial 2: Comparison of herbicides

MCPA, 2,4-D, both formulations of MCPB, the MCPB/clopyralid mixture and DPX-L5300 all killed significantly less Argyll than Matapiro plants (Table 2).

By using only one application rate of each herbicide when comparing its effectiveness on the two populations, the results obtained tend to be less conclusive than when dose response curves are produced (e.g. Harrington *et al* 1988). It is possible, therefore, that some of the other herbicides tested are also not tolerated to some extent by the Argyll population. However, the rates used were equivalent to recommended rates of application, so the results should give a good indication of which herbicides can be used to control Argyll nodding thistle plants.

The Argyll plants showed an increased tolerance to all the phenoxyacetic herbicides used, regardless of whether they were formulated as esters or salts. However, the phenoxypropionic herbicide tested (mecoprop) and the other "auxin-type" herbicides were effective against the Argyll plants. The poor control of the Matapiro plants by 2,4-D is difficult to explain.

Both this trial and an earlier experiment (Harrington *et al* 1988) have shown that clopyralid is effective against Argyll plants. In this trial there was probably insufficient clopyralid in the MCPB/clopyralid mixture tested to completely kill the Argyll plants. Popay (pers. comm.) and many farmers with tolerant populations have found that an application rate of MCPB/clopyralid double that used in this experiment will give good control of these thistles. Clover damage can become quite severe at this rate, however.

Results obtained in this trial confirm those of Martin *et al* (1988) that DPX-L5300 does not give 100% control of nodding thistle even with surfactant added. The fact that

TABLE 2: Percentage of Argyll and Matapiro nodding thistle plants killed by recommended rates of selected herbicides.

Herbicide	Application rate (ai)	% kill		Difference*
		Argyll	Matapiro	
MCPA (IWD MCPA)	1.1 kg/ha	21	93	72
MCPB (iso-octyl ester)	2.4 kg/ha	29	100	71
MCPB (IWD MCPB)	2.4 kg/ha	10	80	70
2,4-D (Hi-Ester 2,4-D)	1.1 kg/ha	0	39	39
DPX-L5300 (Express)	1.0 mg/plant	21	52	31
MCPB/clopyralid (Lontrel P)	0.5/0.014 kg/ha	71	100	29
paraquat/diquat (Preeglone)	0.36/0.18 kg/ha	23	48	25
dicamba (Banvel 200)	0.14 kg/ha	43	59	16
mecoprop (MEC 40)	2.8 kg/ha	100	100	0
clopyralid (Versatill)	0.15 kg/ha	100	100	0
picloram (Tordon 2G)	40 mg/plant	100	100	0
glyphosate (Roundup)	0.36 kg/ha	96	93	3

* Differences in % kill greater than 28 between populations are significant at $p = 0.05$.

both this herbicide and the paraquat/diquat mixture seemed to be less effective on the Argyll than the Matapiro plants was an unexpected result since all the other herbicides tolerated are phenoxyacetics.

All of the herbicides that adequately controlled the Argyll plants at recommended application rates are too damaging to pasture species to be used for selective control of nodding thistle. However, farmers at some of the sites where tolerance was detected still obtain reasonable levels of nodding thistle control using the phenoxy herbicides. They apply them when the plants are young and either use higher than recommended application rates or add some clopyralid.

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