Chemical Control of Canada Thistle

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Chemical Control of Canada Thistle[1]

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Abstract. Field studies were conducted to evaluate the effectiveness of one, two, and three annual applications of atrazine [2-chloro-4-(ethylamino) -6-(isopropylamino)-*s*-triazine], 2,4-D [(2,4-dichlorophenoxy) acetic acid], dicamba (3,6-dichloro-*o*-anisic acid), and a three way mix of dicamba, mecoprop [2-[(4-chloro-*o*-tolyl) oxy]propionic acid], and 2,4-D at a ratio of 7:5:20 at different stages of development for the control of Canada thistle [*Cirsium arvense* (L.) Scop.]. Two consecutive annual applications in all atrazine treatments achieved the same level of control as cultivation every 5 weeks. In the year of the last treatment, Canada thistle was controlled with two or more consecutive annual applications of the hormone-type herbicides (2,4-D, dicamba, and the three way mix); however, in the year following the last treatment, regrowth occurred.

INTRODUCTION

Canada thistle is a deep rooted dioecious perennial weed found throughout the northern half of the United States and the southern parts of most Canadian provinces (11). Calculations by Hunter and Smith (6) from a survey by Alex (1) showed 8.9 million hectares of cultivated land of the prairie provinces of Canada infested with this weed.

Phenoxy compounds applied from the bud to flowering stages have controlled Canada thistle in graminaceous crops (10). However, the use of these compounds at the reproductive stage to control Canada thistle in corn (*Zea mays* L.) will not eliminate 6 to 10 weeks of weed competition. Besides several annual applications were often necessary to effectively control Canada thistle (5). There is the need then to develop herbicides which will not only be effective at an early stage of application but also require fewer annual applications to control Canada thistle. Saidak (12) found that atrazine at 4.5 kg/ha applied either as a soil incorporated treatment or postemergence in non phytotoxic emulsified mineral oil effectively controlled the *horridium* variety of Canada thistle. Atrazine at 2.2 kg/ha applied prior to plowing also provided excellent control of Canada thistle (9).

MATERIALS and METHODS

A study to determine the influence of stage of growth at application of atrazine and several hormone-type herbicides for 1 to 3 consecutive years was initiated in the fall of 1970. The study was located in Elora, 16 km north of Guelph, Ontario, on a loam soil naturally infested with Canada thistle. The design of the experiment was randomized complete block with four replications. Herbicide treatments are listed in Table 1 and all rates were active ingredient per hectare. Plot size was 7.5 m by 3.0 m and the same plots were used throughout the experiment.

Herbicides were applied with a bicycle wheel precision plot sprayer operated to deliver 224 L/ha of spray solution at 4.2 kg/cm^2 pressure. Treatments which were applied prior to plowing were done in mid November and preplant incorporated treatments were applied prior to weed emergence in mid May and incorporated immediately with a double disk. Early postemergence treatments were applied in June of each year when the height of corn in adjacent fields was about 7.5 cm. Application at the bud stage was when over 50% of all the main shoots were in the reproductive stage. The test area was sprayed with glyphosate [*N*-(phosphonomethyl)glycine] in the spring of 1972 and 1973, before the thistle shoots had emerged, to suppress quackgrass [*Agropyron repens* (L.) Beauv.].

The control of Canada thistle was determined in early September of each year, following shoot count, according to the following calculation (9):

$$100 - \frac{\text{Shoot number of Canada thistle per treatment}}{\text{Shoot number of Canada thistle per untreated check}} \times 100 = \% \text{ control}$$

RESULTS and DISCUSSION

The Canada thistle infestation was significantly reduced in all atrazine treated plots in the first year (Table 1). However, none of the atrazine treatments was as effective as cultivation. Control was affected by the stage at which the thistles were treated. Application of any of the hormone-type herbicides at the early stage did not reduce the weed infestation significantly; however, significant improvement in control was obtained with applications at the bud stage.

Two consecutive annual applications of atrazine at 4.5 kg/ha prior to plowing were nearly twice as effective as a single application (Table 1). There were similar improvements in control when atrazine, at 2.2 kg/ha prior to plowing and followed by 2.2 kg/ha postemergence in mineral oil, was applied in 2 consecutive years. Repeated applications of the hormone-type herbicides also provided excellent control in the year of the last treatment. The stage of application did not influence the effectiveness of any of the hormone-type herbicides and there were no differences in effectiveness among the herbicides applied at the same stage of Canada thistle in the second treatment year.

Single annual application in all atrazine treatments provided some measure of control in the first and second years after

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treatment. Two consecutive annual applications of atrazine at 2.2 kg/ha applied prior to plowing and followed by 2.2 kg/ha postemergence in mineral oil were as effective in the year following the last treatment as three consecutive annual applications of the same treatment. However, the most efficient atrazine treatment in terms of cost was 2.2 kg/ha applied prior to plowing in the first year only, and followed up with 2.2 kg/ha postemergence in mineral oil in the first and second years. This difference in levels of atrazine present the year after application is due to (a) timing of the application and (b) incorpora-

Table 1. Control of Canada thistle as influenced by stage of development, herbicide and 1, 2, and 3 annual applications.

Treatment	Rate and stage of application (kg/ha)	No. annual application	Weed control as at Sept. 71 (%)	Weed control as at Sept. 72 (%)	Weed control as at Sept. 73 (%)
Atrazine	4.5 prior to plowing	1	31.4 c-g[a]	50.7 k-m	69.7 b-h
Atrazine	4.5 prior to plowing	2	47.7 c-e	96.3 a-g	82.7 a-h
Atrazine	4.5 prior to plowing	3	49.3 c-e	90.1 a-j	100.0 a-d
Atrazine	2.2 pp + 2.2 early post in oil[b]	1	56.8 cd	64.1 h-m	67.5 c-j
Atrazine	2.2 pp + 2.2 early post in oil	2	63.5 c	92.0 a-h	99.6 a-e
Atrazine	2.2 pp + 2.2 early post in oil	3	66.4 bc	97.2 a-g	100.0 a-d
Atrazine	2.2 preplant incorp'd + 2.2 ep in oil	1	56.8 cd	64.1 h-m	67.5 c-j
Atrazine	2.2 preplant incorp'd + 2.2 ep in oil	2	65.6 c	95.3 a-g	98.7 a-e
Atrazine	2.2 preplant incorp'd + 2.2 ep in oil	3	70.4 b	93.5 a-g	100.0 a-c
Atrazine	2.2 prior to plowing[c] + 2.2 ep in oil	1	50.5 c-e	69.6 g-l	70.2 b-h
Atrazine	2.2 prior to plowing[c] + 2.2 ep in oil	2	59.2 c	93.0 a-h	100.0 ab
Atrazine	2.2 prior to plowing[c] + 2.2 ep in oil	3	52.4 cd	93.1 a-h	100.0 ab
Three way mix	.56 early post (corn 7.5 cm)	1	8.6 g-h	52.4 k-m	56.4 g-k
Three way mix	.56 early post (corn 7.5 cm)	2	4.3 g-h	93.0 a-h	61.8 g-k
Three way mix	.56 early post (corn 7.5 cm)	3	13.5 f-h	96.9 a-g	83.9 a-h
Three way mix	.56 bud stage	1	57.8 cd	74.2 d-l	60.1 g-k
Three way mix	.56 bud stage	2	56.5 cd	97.6 a-g	82.9 a-h
Three way mix	.56 bud stage	3	46.1 c-e	99.6 a-k	82.8 a-h
Dicamba	.28 early post (corn 7.5 cm)	1	17.2 e-h	61.7 i-m	63.6 f-k
Dicamba	.28 early post (corn 7.5 cm)	2	11.2 g-h	90.9 a-h	66.2 d-j
Dicamba	.28 early post (corn 7.5 cm)	3	12.7 g-h	100.0 ab	99.5 a-e
Dicamba	.28 bud stage	1	56.8 cd	70.6 e-l	63.7 e-k
Dicamba	.28 bud stage	2	67.5 bc	98.7 a-g	89.7 a-g
Dicamba	.28 bud stage	3	60.9 c	100.0 ad	97.2 a-e
2,4-D	.56 early post (corn 7.5 cm)	1	12.7 g-h	47.5 l-m	38.1 h-k
2,4-D	.56 early post (corn 7.5 cm)	2	9.3 g-h	93.8 a-g	80.8 a-h
2,4-D	.56 early post (corn 7.5 cm)	3	5.4 g-h	87.2 b-j	100.0 a
2,4-D	.56 bud stage	1	49.3 c-e	88.3 a-j	76.0 b-h
2,4-D	.56 bud stage	2	27.8 d-h	100.0 a-c	88.2 a-h
2,4-D	.56 bud stage	3	42.7 c-f	99.5 a-d	92.8 a-f
Hoed check		1	100.0 a	39.9 m	35.3 jk
Hoed check		2	100.0 a	100.0 ab	84.3 a-g
Hoed check		3	100.0 a	100.0 a	100.0 a
Weed check			0.0 h	0.0 n	0.0 k

[a]Means within the same column followed by similar letters do not differ significantly at the 5% level, according to Duncan's multiple range test.
[b]Non phytotoxic emulsified mineral oil at 16.8 L/ha.
[c]Applied only in the first year of treatment.

tion by plowing. As postemergence atrazine treatments were applied in midsummer it is possible that the high temperatures (8) and the addition of mineral oil might enhance foliar penetration and translocation of atrazine (13). Also, midsummer application coincided with minimum root reserves (2) and a well developed leaf area in Canada thistle and these factors tend to increase the retention of herbicidal spray. Incorporation of atrazine by plowing will tend to decrease its persistence as a result of (a) detoxification by ultraviolet rays (3), (b) photodecomposition (7), (c) volatilization (4), and (d) adsorption to soil colloids. Three consecutive annual applications of any of the hormone-type herbicides, regardless of stage of growth at application, provided excellent control in the third year of treatment.

Results from the field studies tend to confirm the susceptibility of Canada thistle to atrazine as indicated by Parochetti (9) and Saidak (12). However, two or more consecutive annual applications were necessary to effectively control Canada thistle. More than a single annual application of 2,4-D, dicamba, or the three way mix was necessary for effective thistle control in the year of the last treatment.

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