THE USE OF ATRAZINE FOR WEED CONTROL IN MAIZE AND SWEET CORN

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Summary

The use of atrazine in maize and sweet corn is reviewed under the headings of crop tolerance, and weed control, and factors affecting its performance are discussed. Yield results from one replicated trial and two unreplicated field assessments are given. The experience with atrazine residues are detailed.

INTRODUCTION

YIELDS of maize and sweet corn are substantially reduced by weed competition in the early growth stages. In Gisborne, the main growing area, two classes of weeds are involved. The first includes the summer growing annual grasses, of which barnyard grass (*Echinochla crus-galli*) is by far the most important, and the second, annual broadleaf weeds. Traditional weed control practices involved inter-row cultivation together with an overall spraying with the amine salt of 2,4-D. This treatment was not effective in controlling barnyard grass and in some cases heavy infestations of this aggressive weed species caused paddocks to be taken out of maize production.

After preliminary trial evaluation, atrazine was commercially released in 1963 for early post-emergence weed control in maize and sweet corn. To evaluate the performance of the material under varied field conditions, detailed observations were made on crops in the Gisborne and Hastings areas over the last four years. These observations, together with the results of two unreplicated and one replicated yield trials form the basis of this paper.

Throughout the paper rates quoted are in terms of lb active ingredient per sprayed acre.

CROP TOLERANCE

Both maize and sweet corn exhibit physiological tolerance to atrazine. This tolerance is due to the presence in the plants of the cyclic hydroxamate, 2,4-dihydroxy-3-keto-7-methoxy-1,4-benzoxazine, which converts atrazine to the inactive hydroxy analogue (Montgomerie and Freed, 1960, 1961; Castelfranco *et al.*, 1961; Roth and Knulsi, 1961).

While later work by Couch and Davis (1966) indicated that this detoxication mechanism can be overloaded, atrazine applied as recommended can be regarded as completely selective to these crops.

WEED CONTROL

BARNYARD GRASS

Excellent control has been achieved by the use of 3.2 to 4.0 lb of atrazine applied as a directed post-emergence band spray when barnyard grass was up to 1½ in. high and actively growing. For this post-emergence use, the addition of a non-ionic wetting agent at the rate of 0.5% v/v

of the spray mix was essential. Results were less satisfactory when barnyard grass was larger, or in a hardened growth condition, or when faulty technique resulted in a lower rate of application.

Under dry conditions it has proved an advantage to lightly mould the rows one to two weeks after treatment. This practice assists control of emerged, hardened barnyard grass in the row and helps to conserve moisture in the treated band, which improves control of subsequent germinations.

Evidence on the control of other summer growing grass weed species such as crabgrass (*Digitaria sanguinalis*) and pigeon grass (*Setaria* spp.) has been inconclusive owing to the lack of uniform infestations. It is suggested that there may be differences in the times of emergence of the various grass species. Hence the timing of atrazine application for barnyard grass control may not be optimum for control of other summer growing grasses.

One unreplicated but randomly sampled yield assessment was made in 1966 in an area badly infested with barnyard grass. Others weeds included amaranthus (*Amaranthus hybridus*), black nightshade (*Solanum nigrum*), and fathen (*Chenopodium album*). The figures shown for plant and cob numbers in Table 1 are the totals from four samples each half a chain by one row.

TABLE 1: RESULTS OF CROP YIELD ASSESSMENT—TRIAL A

Treatment	Plant Nos.		Cob. Nos.	Grain Yield (bu/acre)
atrazine 4.0 lb		167	162	88.5
Untreated		151	99	18.7
Treated c/w				
Untreated 100		110	164	471

The great difference in yield is a reflection of the failure of many untreated maize plants to produce cobs and shows the effect of weed competition within the row on crop vigour.

BROADLEAF WEEDS

Where atrazine was applied at 3.2 to 4 lb, broadleaf weed control was excellent and no problem species appeared. Weeds controlled included fathen, amaranthus, cornbind (*Polygonum convolvulus*), thorn apple (*Datura stramonium*), and black nightshade.

Much of the maize and sweet corn area near Gisborne and Hastings is close to vineyards and other hormone-sensitive areas. Because atrazine is not a hormone type material, a trial was laid down near Hastings to evaluate low rates of atrazine strictly for broadleaf weed control.

The crop was maize, variety Wisconsin 525, and was heavily infested with broadleaf weeds. The treatments were applied to randomized plots 30 ft by 6 ft (four rows), with a Drake & Fletcher plot sprayer at 30 gal/acre. Six replicates were used. The two inside rows of each plot were harvested for yield purposes.

Atrazine treatments were applied on November 8, 1967, when the crop was 4 in. high and weeds at the 2- to 4-leaf stage, and 2,4-D amine on November 20, 1967, when the crop was 9 in. high and weeds 2 to

6 in. Weed species present at the first spraying time were amaranthus 90%, fathen 5% and black nightshade 5%. By the time of the 2,4-D spraying, odd plants of mallow (*Malva* spp.), Californian thistle (*Cirsium arvense*), nettle (*Urtica* spp.), speedwell (*Veronica* spp.) and barnyard grass had also appeared. The band sprayed treatments were hand-hoed in the inter-row areas, otherwise the plots were left untreated following spraying.

Yield results in Table 2, expressed as bushels per acre of grain, are corrected to 15% moisture. Weed control was assessed visually and rated on a 1 to 10 scale (1 = no effect, 10 = complete control). Weeds showing at nine weeks in the atrazine treatments were odd plants of Californian thistle and barnyard grass in the 1.6 lb treatments, with these and some mallow at the lower rate. In the 2,4-D plots the main weeds were amaranthus and fathen with mallow and speedwell completely uncontrolled.

TABLE 2: ASSESSMENT OF WEED CONTROL AND CROP YIELD—TRIAL B

<i>Treatment (lb)</i>		<i>Weed Control 9 wk</i>	<i>Crop Height (ft) 9 wk</i>	<i>Grain Yield (bu/acre)</i>
atrazine (band) 0.8		9.5	6.0	128
atrazine (overall) 0.8		9.5	6.5	133
atrazine (band) 1.6		9.9	6.0	131
atrazine (overall) 1.6		9.9	6.5	137
2,4-D amine (overall) 0.75		4.0	3.75	51
Untreated		1.0	2.5	0

While the trial was designed to evaluate atrazine for broadleaf weed control, the failure of maize to produce any grain when subjected to severe weed competition is notable. The difference in yield between 2,4-D and any of the atrazine treatments, taken with the difference in crop height at nine weeks, suggests that maize is particularly susceptible to weed competition in the very early stages. While the 2,4-D treated plants subsequently made up most of the height difference shown, grain production was still seriously affected.

In addition, one field evaluation was made comparing yield results from overall spraying with atrazine at 0.8 lb and 2,4-D amine at 0.75 lb. This crop was substantially less weedy than that in Trial B. The results are shown in Table 3 in terms of bushels per acre, corrected to 15% moisture, each figure being based on the yields from six random samples, each 30 ft by 1 row.

TABLE 3: RESULTS OF CROP YIELD ASSESSMENT—TRIAL C

<i>Treatment (lb)</i>		<i>Plant Nos.</i>	<i>Cob. Nos.</i>	<i>Grain (bu/acre)</i>
atrazine (overall) 0.8		42	41	117.8
2,4-D amine (overall) 0.75		43	41	105.8

ATRAZINE RESIDUES

Because atrazine is a soil residual material, there has been concern that, either in one season, or as a result of build-up due to repeated applications in successive seasons, atrazine residues could cause damage to subsequent susceptible crops.

Damage has not occurred where recommended application rates and cultivation practices subsequent to the treated crop were followed. Three confirmed cases of residue damage have been inspected. In two of these, green feed barley sown in March following sweet corn crops band sprayed with 4 lb atrazine in November was affected. In both of these cases, shallow cultivation to a depth of 3 in. only had been carried out prior to sowing the barley and this was insufficient to dissipate the residues of atrazine. In the third case, through careless application, rates of atrazine probably approaching 12 lb per acre were applied to the headlands in a maize crop treated in November. Wheat sown on the headlands the following spring was severely affected.

A particular check has been kept on one paddock which was planted with sweet corn for five successive seasons, each crop being treated with atrazine at the rate of 3 to 4 lb per band sprayed acre. The crop was harvested in February to March each year and, after thorough cultivation, followed by a greenfeed crop. In the most recent season this feed crop was a mixture of short-rotation ryegrass (*Lolium* hybrid) and soft turnips, which showed no signs of atrazine damage.

CONCLUSIONS

Atrazine, applied as an early post-emergence spray, has given good control of the main weed species in maize and sweet corn in the Hawke's Bay and Poverty Bay areas. For control of barnyard grass, atrazine must be applied under good growing conditions and before the grass is more than 1½ in. high. At lower rates, atrazine has given excellent control of the main broadleaf weed species and, being non-hormone in nature, will be of particular value for this use in hormone-hazardous areas.

In no case where directions regarding application rate and subsequent cultivation practices have been followed has damage from atrazine residues been observed.

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