HERBICIDE ANTIDOTES — A NEW CONCEPT IN WEED CONTROL

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Summary

EPTC will provide effective weed control in maize (*Zea mays*). However, at normal recommended use rates it is not sufficiently crop selective. A combination of EPTC with R-25788 (N,N-diallyl-2,2-dichloroacetamide) at a 12:1 ratio greatly increases the maize tolerance without affecting the persistence or weed control properties of EPTC. R-25788 can also be combined with butylate to increase further the selectivity of this maize herbicide.

INTRODUCTION

The need for pre-emergence weed control in maize (*Zea mays*) is self-evident in New Zealand. EPTC is a nonpersistent thiocarbamate herbicide that will provide effective weed control (Matthews 1974). However, its use in maize has been limited because its margin of safety in regard to crop selectivity is too narrow.

Recently it was shown (Stauffer Chemical Co. 1972) that R-25788 (N,N-diallyl-2,2-dichloroacetamide) is an antidote which will protect maize against injury from thiocarbamate herbicides. This discovery permits the safe use of EPTC in maize at rates that were previously unacceptable because of crop injury. The required ratio of EPTC:R-25788 is 12:1.

Butylate can also be combined with R-25788 at a 24:1 ratio to increase further the selectivity of this maize herbicide. Butylate alone can occasionally cause slight crop injury under abnormal conditions of management or climate.

PROTECTION OF MAIZE BY R-25788

EPTC is a pre-plant soil incorporated herbicide that can cause maize injury at rates as low as 2 kg/ha. This usually occurs under soil or climatic conditions that retard the germination and early growth of the maize. When combined with R-25788, EPTC has prevented such injury at rates of 12 kg/ha (Appleby 1971).

TABLE 1: EFFECTS OF EPTC AND R-25788 ON MAIZE YIELDS*

<i>Treatment</i>	<i>Yield in kg/plot</i>
control (unweeded)	19.0
EPTC, 6.7 kg/ha	43.6
EPTC, 6.7 kg/ha + R-25788, 0.56 kg/ha	98.6
handweeded control	96.5

* Rains and Fletchall 1973.

Proc. 28th N.Z. Weed and Pest Control Conf.

New Products

In the USA, approval has been granted for the use of the EPTC:R-25788 combination at a 12:1 ratio at a rate of 6.7 kg EPTC/ha. This will provide control of important weeds, such as *Sorghum bicolor*, Johnson grass (*S. halapense*), Indian doab (*Cynodon dactylon*), nutsedge (*Cyperus rotundus*), and couchgrass (*Agropyron repens*). In addition, the combination will permit normal maize yields (Table 1).

No reduction in the control of 40 weeds by EPTC in the presence of R-25788 has been detected in the field or greenhouse.

An experiment was designed (Wright *et al* 1974) to determine whether some maize genotypes might respond differentially to the antidotal effect of R-25788. It was found that protection was apparent in all lines. However, late-season protection was sometimes less effective in those lines that were more susceptible to EPTC alone.

BEHAVIOUR AND PERSISTENCE OF R-25788

Greenhouse studies have shown that R-25788 leached from the soil more readily than EPTC. This difference was more apparent in soils of light texture and when water applications simulated high rainfall (Thomas *et al* 1974). This information is significant in understanding field performance of the combination in light soils experiencing high rainfall. In these situations late season protection may conceivably be less than complete due to insufficient concentration of antidote in the root zone.

The persistence of R-25788 in the soil has been shown to be equivalent to EPTC (Thomas *et al* 1974). Microbial action is responsible for the disappearance from soils. The combination of EPTC + R-25788 does not alter the residual life of the EPTC. Thus it offers a reliable weed control program in maize culture.

ACTION OF R-25788

Basic biochemical studies showed that the protection offered by R-25788 did not result from decreased uptake of EPTC by maize roots (Chang *et al* 1974; Gray 1974). Root or shoot uptake of the antidote provided protection in the meristematic region of the shoot where thiocarbamate injury is manifested.

A change in the metabolism of EPTC by maize plants in the presence of R-25788 did not fully explain the mode of action (Chang *et al* 1974).

TRIALS WITH THIOCARBAMATE — R-25788 COMBINATIONS IN NEW ZEALAND

Field trials in New Zealand have been done by the Ministry of Agriculture and Fisheries and by the technical staff of Neill, Cropper and Co. Ltd. The combinations used were EPTC + R-25788 and butylate + R-25788, each with and without the addition of atrazine. Table 2 shows data obtained by Porter and Cornwall (1974) in Gisborne.

The results in Table 2 show that combinations of EPTC + R-25788 or butylate + R-25788, particularly the former, are highly effective herbicides. Their activities can be further enhanced by the addition of atrazine at a rate which will prolong weed control but minimize carry-over effect onto succeeding crops.

TABLE 2: WEED CONTROL AND YIELDS IN NEW ZEALAND MAIZE OBTAINED BY THIOCARBAMATE/R-25788 COMBINATIONS

Treatments and Rates (kg/ha)*	Crop Vigour†	% Weed control‡		Yield in t/ha
		25 DAA	50 DAA	
EPTC + R-25788, 4.04 kg/ha	3.0	86	20	3.47
EPTC + R-25788, 6.06 kg/ha	4.0	91	60	6.09
EPTC + R-25788, 4.04 kg/ha + atrazine, 1.6 kg/ha	4.0	97	95	8.71
butylate + R-25788, 6.06 kg/ha	2.5	75	25	3.90
butylate + R-25788, 4.04 kg/ha + atrazine, 1.6 kg/ha	4.0	88	60	7.47
control (unweeded)	0.5	50	5	1.70

* EPTC:R-25788 ratio 12:1; butylate:R-25788 ratio 24:1.

† 50 days after application; 0 = poor vigor, 4 = full vigor.

‡ DAA = days after application.

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BIOLOGICAL CONTROL

CHAIRMAN'S SUMMARY

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As pointed out by Mr Valentine the objective of biological control is to stabilise or to assist in stabilising host populations at a level below economic significance. The present low populations of cosmopolitan army worm and high levels of parasitism by the *Apanteles* wasp liberated in 1971 and 1972 may indicate success in this respect and an end to devastating outbreaks of army worm in barley, maize and pasture in the North Island.

Mention of the continued search for noctuid predators and parasites and the statement that an egg parasite may be competing for hosts with an effective larval parasite of the silver Y moth, raised the question of the desirability of introducing one rather than a number of agents to counter a pest. Mr Valentine pointed out that restricting work to one agent at a time when several were available could delay success for many years. However with the apparent success of the *Apanteles* wasp there was no intention to introduce further enemies of the cosmopolitan army worm.

To avoid economic consequences a high incidence of parasite or predator is needed early in the development of a host population. The possibilities of commercial multiplication and distribution to meet this requirement were discussed. It was noted that most governmental agencies had very stringent requirements for clearance of micro-organisms and viruses for large scale release. To date only *Bacillus thuringiensis* has received general acceptance. Mass multiplication and inundative release at the appropriate time of the year or of the life cycle requires co-ordination of sophisticated prediction, multiplication and release services. Porina virus, widespread in New Zealand, or ladybirds at present being investigated for aphid control could be used for this purpose but at present the New Zealand market for any pest or group of pests appears too small for commercial exploitation.

The validity of coupling the decline of black beetle populations with the presence of a protozoan parasite *Adelina* sp. by Archibald *et al.* was questioned. The data presented are derived from an infested population. No comparable figures from a "healthy" population are presented to indicate whether the trends shown in figure 1 may be influenced by *Adelina* sp. or are the consequence of constant mortality factors. Dr Longworth, who presented the paper, contended that the laboratory rearing data presented in table 1 indicated that *Adelina* sp. had the ability to kill black beetle larvae and increased in incidence as the black beetle population declined. Discussion in the published paper shows that the present and future role of this parasite is highly speculative, the paper being in fact an interim report to the Conference of a facet of the research being carried out on black beetle.

The control of the wood wasp by a nematode and of nodding thistle by a receptacle-feeding weevil is similar in that reliance is placed on reducing the reproductive potential of the host. The efficacy appears to have been proved for sirex but the value of the weevil following its establishment remains to be proved. This work promises to produce valuable information on the dynamics of nodding thistle populations.

To an inquiry whether the weevil would attack plumeless thistle (*Carduus acanthoides* sometimes incorrectly called welshed thistle) or crosses between plumeless and nodding thistle, Mr Jessep said he had no information. However strains of *Rhinocyllus conicus* were very host specific. Weevils from the Rhine valley attacked nodding thistle and

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