SIMAZINE

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For reasons not entirely under our control this paper must be a general review rather than a detailed survey of experimental results.

Quite extensive field investigational work both overseas and in New Zealand indicates that simazine is likely to prove a useful addition to the present range of weedkillers. This paper briefly reviews the characteristics of simazine and its likely fields of application as a result of overseas experimental work and confirmatory field results in New Zealand conditions.

Simazine is a weedkiller developed by J. R. Geigy, Basle. The chemical name is 2-chloro-4, 6-bis(ethylamino)-s-triazine; a chemical which is virtually insoluble in water.

(It should be noted that all references to rates in this paper refer to the **active** chemical.)

The insolubility of simazine in water contributes two important characteristics:

- (a) It has virtually no acute toxicity to warm-blooded animals.
- (b) It resists leaching and thus has a considerable degree of permanence in its activity.

MODE OF ACTION

Simazine is taken up almost exclusively by the roots of plants, which leads to a yellowing in the leaves, the withering of the leaf tips and edges, and finally the death of the plant. Its mode of action is apparently due to some interference in photosynthesis.

Plants are most susceptible at the seedling stage, but an interesting aspect which has been noted in New Zealand trials is that germination may continue to take place in simazine-treated soil and the toxic effects do not become evident until the seedling roots penetrate into the soil zone containing simazine.

Plant species vary greatly in their susceptibility to simazine and this together with the characteristics of water insolubility and resistance to leaching permit the use of simazine at relatively low rates as a selective weedkiller. It can be used as a selective weedkiller in maize, because maize is resistant even though most grasses are very susceptible. It can also be used for selective weed control round plants with a root zone below the level to which the simazine penetrates. Inversely, of course, weeds with strong, deep root systems are not easily controlled by simazine. In general, the great majority of plants are controlled at the seedling stage by 1 to 2 lb of simazine per acre, whereas established plants require 5 to 10 lb.

FACTORS AFFECTING WEED CONTROL

The main factors affecting the efficiency of simazine are:

- (a) **Soil structure:** Simazine does not generally penetrate at all deeply, but in very permeable soils it may be carried down mechanically. Clay soils impede the downward movement of simazine and there may be absorption on the clay colloids, thus reducing the simazine available to plants.
- (b) **Humus content:** A high humus content reduces both the initial and the residual effect. High organic-type soils require the highest dosages, gravels and ballast the least.
- (c) **Weather:** The weather exercises very little influence on the effect of simazine. It is not leached out of the soil to any great extent by rain; in fact rain shortly after application assists penetration to the root zone.

SIMAZINE AS A SELECTIVE WEEDKILLER

This section deals briefly with the main field of application as a **selective** weedkiller in the light of overseas results together with supporting evidence of New Zealand trials.

Weed Control in Vines

In overseas trials vines have tolerated up to 10 lb of simazine, which was adequate to give control of annual weeds for a considerable time. At this rate, however, only a check was given to deep rooted perennials. Simazine is under trial for this purpose in New Zealand, but as yet no final conclusions have been reached.

Weed Control in Asparagus

Overseas trials have shown that though seedling asparagus plants are rather sensitive to simazine, the established plants are much more resistant. Five pounds of simazine were necessary to give a season's control from a single spring application. There was evidence that split applications might prove more efficient.

Again local trials have been conducted for the control of weeds in asparagus and as a result of this work tentative recommendations are being made for the use of straight simazine at 1 to 2 lb per acre applied in the early spring.

Weed Control in Maize

One outstanding feature has been the ability of maize to tolerate simazine. This tolerance must have a physiological basis, because all the most important varieties of this species will tolerate relatively high doses of simazine at all stages of growth. Overseas work indicates that pre-emergence treatment at 1 to 2½ lb per acre will maintain a satisfactory degree of weed control.

The Department of Agriculture has kindly made available results of trials on sweet corn in the Hauraki Plains. Simazine was applied pre-emergence at 2 to 4 lb per acre on 7 November and compared with the sodium salt of 2,4-D at 1½ lb per acre and amine salt of 2,4-D at 1 lb per acre applied post-emergence on 27 November. Simazine at 4 lb per acre as well as the 2,4-DB and the sodium 2,4-D treatments gave yields significantly greater than the controls. Results with simazine in this trial were disappointing, because even at the higher rate of 4 lb per acre simazine gave only 25 to 50 per cent control compared with 90 to 95 per cent control with the 2,4-D products. Yet yields were significantly better than control.

Simazine and 2,4-DB had no adverse effect on the crop, whereas 2,4-D caused reduction in height and produced some distortion.

Selective Weed Control in Other Crops

Simazine has been under trial for some years for selective weed control in the following crops: strawberries, bush fruit, fruit trees, and roses.

Recent work at Oxford University Agronomy Unit has shown that on certain soils simazine has little toxicity to field beans at dosages up to 2 lb per acre, at which rate it is capable of controlling many annual weeds. It has been suggested that the combination of strip spraying together with inter-row mechanical cultivation may reduce the costs and also any risks regarding persistence affecting subsequent crops.

SIMAZINE FOR TOTAL VEGETATION CONTROL

Needless to say the most promising field of application for simazine is in the controversial problem of total vegetation control. This is because of three main characteristics.

1. Its effectiveness against a wide range of weeds and grasses.
2. Its insolubility and
3. Its resistance to leaching, particularly as regards lateral movement.

For this weed problem simazine has been tested out both alone and in a mixture with various other herbicides.

From quite extensive overseas and local work it is evident that simazine will play an important role in total vegetation control because it is long lasting, non-inflammable, non-poisonous, and virtually non-corrosive to spraying equipment. One overseas trial indicated that simazine at 10 lb per

acre reduced a 60 to 70 per cent ground cover of mixed weeds and grasses to a 1 per cent cover in four weeks and prevented further growth so that after 13 months there was still less than 1 per cent weed cover.

Preliminary trials in New Zealand indicated:

(a) That the **initial** reaction to simazine is **slower** than with contact weed-killers because of the time factor involved in the penetration of simazine to the root zone and its absorption by the plant roots.

(b) Simazine was best used as a prophylactic treatment applied to the soil before the germination of weed seedlings. In other words the "bare soil" application technique.

(c) If a quick knockdown of existing vegetation as well as long residual action was required, simazine should be mixed with a knockdown chemical such as amitrol. This conforms with various overseas findings, but is a problem which can be overcome if users can be educated to apply simazine to bare soil before the germination of weeds.

Very extensive local trials have been conducted with simazine alone and mixed with other chemicals right throughout New Zealand. The outstanding feature has been the length of residual toxicity which has exceeded all other chemicals under trial. In Taranaki trials, that is, high rainfall and permeable soil, simazine has maintained 100 per cent weed control for at least 15 months. In lower rainfall areas the period of control has been longer than this.

Paspalum has proved resistant to quite heavy rates of simazine, which means that alternative mixtures must be used, at least as a preliminary treatment, in paspalum areas.

The Department of Agriculture has also made available results on a total vegetation control trial at Invermay. Monuron and simazine were applied at rates varying from 10 to 80 lb per acre. In this trial, observations six months after treatment (a relatively short period) indicated that 40 lb of simazine gave a 90 per cent bare ground, whereas 40 lb of monuron gave 100 per cent bare ground.

WEED CONTROL ON RAILWAYS

Simazine (alone and in combination with other chemicals) is being tested out very extensively overseas and in New Zealand for weed control on railways. An important feature is its lack of conductivity which obviates complications with signal systems. It has been quite widely adapted for this purpose in Switzerland and Germany.

WEED CONTROL IN DRAINS

Simazine alone was tested out in comparison with other compounds such as dalapon and dalapon mixed with amitrol. In this particular case, particularly when the economics were considered, dalapon alone and dalapon mixed with amitrol were the best treatments.

PASPALUM CONTROL

At the outset it was hoped that simazine as a long-term soil sterilant would give effective control of paspalum. Early trials showed that simazine alone even at heavy rates up to 20 lb per acre was relatively ineffective. Trials with amitrol in conjunction with simazine were more encouraging, but again control was disappointing.

MECHANICAL ASPECTS

The problem associated with the application of wettable powder formulations of any chemical is the abrasive effect of the formulation on spraying equipment.

Simazine performs very well in this respect due to:

- (a) The exceedingly fine particle size of the powder and
- (b) The physico-chemical nature of the chemical.

Quite critical tests have shown that correctly formulated simazine products are virtually non-abrasive to all the usual types of spraying equip-

ment, including gear pumps, and nylon roller and plunger pumps. The fine particle nature of the product does, however, introduce one problem. Though it is very easily dispersed and remains in suspension with a normal agitation, it will partially settle out over a period of time when agitation ceases. If this settling is allowed to occur for a relatively long period, for example, over a weekend, special attention is necessary to ensure that subsequent agitation is adequate to resuspend the settled material.

SUMMARY

Simazine is an interesting addition to the range of weedkillers and its main fields of application appear to be:

- (a) Total vegetation control, particularly in combination with knock-down chemicals such as amitrol, and
- (b) Long-term selective weed control for tolerant species.

As regards total vegetation control one must acknowledge that results in New Zealand are not quite as outstanding as results in overseas countries mainly due to the wide range of species involved throughout New Zealand, particularly the deep rooted perennials and also the general high fertility of our soils and the very substantial plant growth impulse due to our favourable climate.

With its particular characteristics of insolubility, selectivity, and lack of lateral movement simazine is still subject to the principles that have been becoming increasingly evident, that is that with all weedkillers considerable skill is required as regards the timing of application in relation to the stages of plant growth and the tolerance and susceptibility of various plant species.

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DISCUSSION

Q.—Could Mr Gordon give the cost of simazine compared with monuron for total weed control?

A.—Only recently have we finalised on cost. I think they will work out about the same.

Q.—Could Mr Gordon give us the price?

A.—Simazine powder 50 per cent will be 47s. 6d. per lb.

Comment: Initially the cost should not matter. The efficiency of the material should be determined first.

Q.—What was the main weed in the maize trial at Kerepehi?

A.—*Polygonum hydropiper*. Simazine gave initially good control and later germination was sufficiently retarded to allow the maize to get away.

Q.—Does Mr Gordon think there is any danger to bush fruit?

A.—Not unless excessive rates of simazine are applied.

Q.—Is there lateral movement on a slope?

A.—In one trial the line at the bottom was clear cut.

Comment: Work should be done on the length of persistency for following crops.