LATEST DEVELOPMENT WITH TRIAZINES

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Summary

The introduction of methylthio substituted triazines such as prometryne which can be applied at the two- to three-leaf stage of cereals and which control weeds relatively resistant to phenoxyacetic herbicides has led to greater cereal yield responses than are possible with the latter.

Studies over three seasons included influence on cereal yield of varieties, growth stage, rate and volume of application, and different weed associations with use of prometryne. Variations in control of the same and different weed species are discussed.

Prometryne is also selective to undersown legumes and to seedling pastures of grasses and legumes.

INTRODUCTION

CHEMICAL WEED CONTROL in cereals is an important question, more acres of small grain being treated than any other one crop or group of crops (Klingman, 1961). Thus up to 95% of cereal acreages in some districts of Eastern England are sprayed (Church *et al.*, 1962). The use of phenoxyacetic herbicides in cereals has been the most widely accepted herbicide programme. However, their continued use has led to the build-up of populations of weeds relatively resistant to normal doses of these compounds. Numerous workers have shown that the dose cannot be increased without the risk of severe damage to the cereal crop and, moreover, the herbicides cannot be safely applied until the crop has reached the pre-shooting stage (Helgeson *et al.*, 1948; Price and Klingman, 1958).

By this practice the crop reduction due to competition early in the life of the cereal cannot be avoided. The potential crop reduction can be very serious as studies on crop-weed competition have shown (Burrows and Olson, 1955). Swan and Furtick (1962) showed that one yellow burr-weed (*Amsinckia intermedia*) plant per square foot reduced wheat yields by 20 bushels per acre.

The use of some of the new triazine compounds in cereals in Europe to control largely gramineous weeds which have increased after use of other herbicides has been reported (J. R. Geigy, 1960; Faivre-Dupaigre and Rognon, 1964; Rademacher *et al.*, 1964). These compounds included several methylthio substituted triazines, such as prometryne and ametryne, which are leaf absorbed and possess strong post-emergent properties. With at least one of this group, prometryne, wheat can safely be sprayed at the three-leaf stage (Gregory and Weiss, 1963). Prometryne has been extensively tested in Australia by the authors and the various State Departments of Agriculture between 1962 and 1964. The aim was mainly to control a number of phenoxyacetic-resistant weeds including some gramineous weeds.

In such cases, use of MCPA and 2,4-D can show unprofitable results (O'Neill, 1964). O'Neill (1963b) concluded that prometryne was the most consistent chemical, with control of red and white fumitory (*Fumaria muralis* and *F. parviflora*), deadnettle (*Lamium*

amplexicaule) and corn gromwell (*Lithospermum arvense*) at less than 6 oz (all rates are given in oz active ingredient per acre). Deadnettle showed the greatest variation in control (O'Neill, 1963a).

During the course of cereal trials, the selectivity of prometryne to undersown clovers and medics was observed. Thus trials were also conducted on newly sown and established pastures. In England, Fisons Pest Control recommend the use of prometryne in any established grass species for seed production.

EXPERIMENTAL

Trials were conducted in the first place with exponential applications of herbicides by logarithmic sprayers and later by laying down a series of properly replicated yield trials, based on randomized blocks, using constant pressure knapsack sprayers with a boom.

CEREALS

The prime purpose of applying a selective herbicide is to kill or check weeds with the least possible damage to the associated crop. This was, in fact, the main aim when investigations in cereals were begun in South Australia in 1962. It soon became apparent, however, that excellent weed kill and substantial grain yield increase could be combined by the judicious use of prometryne.

Thus, prometryne at 4 oz applied at the three-leaf stage of cereals gave a mean yield increase over three years of 6.92 bushels per acre for barley and 4.72 bushels per acre for wheat. These were based on 43 wheat and 17 barley trials. In wheat trials in 1964, the probability of a two bushels per acre increase was 99.7% and of a three bushels per acre increase 98.2%. No significant yield increases were recorded where the amine salt of 2,4-D was applied at the normal fully tillered crop stage.

Several aspects of crop safety were studied. One of these was the definition of the limits of growth stage (more particularly the downward limits when weed competition may be most severe) at which the crop may safely be sprayed. To eliminate different weather conditions, three sowings were made and one- two- and three-leaf stages were sprayed on the one day with 4 and 8 oz of prometryne. There was a trend towards decreasing grain yield with decreasing leaf number in both wheat and barley although differences were not significant. However, since weeds will still be small at the three-leaf stage of cereals, application appears preferable then.

Increasing dosage rate, even of the most highly selective chemicals, can be expected to give rise at some stage to a negative crop response. It is essential, however, to establish as a minimum requirement that twice the recommended dosage rate is not unduly harmful to the crop, since overlapping of spray can occur. In all trials no significant yield depressions were recorded at the recommended 4 oz or at 8 oz. Indeed, in the 50 trials in 1964 and in the 27,000 acres of wheat and barley treated commercially, there was no indication of crop damage, as regards yield.

Although some yellowing of crop foliage occurred in South Australia in 1964, this was only temporary and was often followed one to two months after spraying by apparent crop stimulation as noted in a visibly stronger and taller growth. The crop stimulation symptoms were noted also in Victoria where previous yellowing was either rare or did not occur. This crop response may be due mainly to the prevention of early weed competition. However,

there is some preliminary evidence that such things as leaf area may be increased even in the absence of weed competition.

Within each species, crop varieties may exhibit variations in susceptibility. However, in variety trials covering 25 wheat and three barley varieties, none gave significant yield depressions at 4 and 8 oz of prometryne. Prometryne also proved safe to a further 12 wheat varieties and one oat variety which occurred in other trials.

As far as crop safety was concerned, our results over the past three years indicated that seasonal effects have not been important. Considering crop response as a measure of crop safety, there was virtually no difference in the mean yield response of wheat or barley between 1962 and 1963 in South Australia during both of which seasons barley gave a mean yield increase of over 4½ bushels per acre and wheat of 1¾ bushels per acre. However, in 1964 the trend was reversed so that wheat gave a mean increase of 3½ bushels per acre, while barley gave only 2¾ bushels per acre. The late rains in 1964 may have stimulated the wheat response, while the early dry period in the same year may have had a permanent depressing effect on the earlier maturing barley which the late rains did little to mitigate.

Volume of application was shown not to be critical. Thus, between the extremes of 2 and 100 gal per acre, adequate crop safety combined with good weed control was obtained.

One trial was carried out where post-emergence treatment with prometryne followed a pre-emergence treatment with di-allate. Yield depressions occurred in both wheat and barley as well as a reduction in leaf number and total dry weight. However, it is not known if the advantages of gramineous weed control would compensate for this depression as the trial was carried out in the absence of these weeds.

Comparisons of emulsifiable concentrate and wettable powder formulations of prometryne indicated that the former was far less selective, especially in barley.

Prometryne is a compound which is applied as a foliar spray but some of which necessarily falls on the ground. It is not only active through the foliage but also, in common with other triazines, is active through the roots of plants. The latter mode of entry, however, is of secondary importance at the low rates used in cereals. Thus glasshouse studies showed no effect on deadnettle at 4 oz and incomplete kill at 8 oz when prometryne was applied to the soil only. However, 4 oz was sufficient to kill the plants when applied to the foliage only.

WEED CONTROL

Cereal yield responses were obtained in spite of variable weed control. However, prometryne at 4 oz consistently gave excellent kill of yellow burr-weed (*Amsinckia hispida* and *A. lycopsoides*), fumitory, corn spurrey (*Spergula arvensis*), chickweed (*Stellaria media*), stagger-weed (*Stachys arvensis*) and poppies (*Papaver* spp.). Yield responses were greatest where yellow burr-weed or the corn spurrey, chickweed, stagger-weed complex were dominant and less where fumitory was dominant.

Control of deadnettle, corn gromwell, spiny emex (*Emex australis*) and black bindweed (*Polygonum convolvulus*) appeared to be influenced by seedling size, rate of prometryne and climatic conditions. Kill of these species varied from 100% to less than 20%. In the glasshouse 2 oz of prometryne was sufficient to kill two- to four-leaf soft-grown deadnettle, while only 50% and 75%

kill with 4 and 8 oz, respectively, was obtained with hard-grown plants.

Similarly, in the field 3 oz of prometryne controlled soft black bindweed but the addition of wetting agent or doubling the rate to 6 oz was necessary on hard plants. Field trials also showed that after very dry conditions prometryne even at 8 oz gave a kill of spiny emex of 20% or less. However, following moist, soft growth conditions, 4 oz or less gave 90% to 100% kill of four- to five-leaf seedlings.

Wireweed (*Polygonum aviculare*) and hexham-scent (*Melilotus indica*) when present were seldom or insufficiently controlled. However, hexham-scent was easier to control although ametryne was superior to prometryne in this regard. Satisfactory control of wireweed was obtained with 8 oz of prometryne under moist conditions.

Gramineous species such as wimmera ryegrass (*Lolium rigidum*) and brome (*Bromus* spp.) were not controlled and appeared to minimize the crop response by themselves responding to prometryne. However, some control of barley grass (*Hordeum leporinum*) and silver grass (*Vulpia* spp.) was obtained with prometryne.

PASTURES

Where legumes were present in cereal trials, prometryne application mostly resulted in the legumes becoming dominant. Results in specific pasture trials have shown that, except initially, no suppression of subterranean clover (*Trifolium subterraneum*), burr medic (*Medicago denticulata*), barrel medic (*Medicago tribuloides*) or lucerne (*Medicago sativa*) seedlings with two or more trifoliate leaves was recorded below 8 oz of prometryne.

Prometryne at 8 and 16 oz also proved selective towards ryegrass (*Lolium* spp.), tall fescue (*Festuca arundinacea*) and cocksfoot (*Dactylis glomerata*) seedlings with three or more leaves.

Besides the weeds controlled in cereal trials, prometryne at 4 to 8 oz applied to weedy pastures has controlled seedling capeweed (*Cryptostemma calendula*), cranesbill geranium (*Geranium molle*) and Paterson's curse (*Echium plantagineum*). Prometryne at 4 oz gave 80% to 90% kill of three- to six-leaf capeweed, 8 oz giving 95% to 100% kill. Preceding conditions had less influence on the results with this species than others such as spiny emex.

Since the satisfactory establishment of improved pastures depends on freedom from weed competition in the critical early stages, the development of selective herbicides such as prometryne should allow control of some previously hard-to-kill weeds. The choice of sowing time then need not be dictated by the potential weed competition.

Where longer periods of weed control in established pastures are required, other triazines such as simazine and atrazine have been used alone or in combination with prometryne and ametryne to give a greater knock-down of weeds.

These developments with triazines, especially prometryne, have enabled better weed control in cereals and pastures as well as opening up new possibilities of increased yields. Several questions still remain to be answered which may lead to still further developments in this field.

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