WEED CONTROL WITH 2,6-DICHLOROBENZONITRILE AND RELATED COMPOUNDS

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Summary

Dichlobenil and 2,6-dichlorothiobenzamide (WL:5792) are very efficient herbicides for the control of germinating seeds but are well tolerated by established plants at herbicidal rates of application. If applied to an area which is free of established weeds, the compounds provide long-term weed control at low rates of active ingredient. They are insufficiently selective to permit pre-emergence use in most seeded crops. A review of the properties of this group of herbicides and a summary of the results of a number of trials are presented. Avenues in which the compounds show herbicidal promise are: Orchard and berry fruit areas; amongst ornamental shrubs and in forest and horticultural nurseries; in established pastures to control seedling weeds such as barley grass (*Hordeum murinum*); in market gardens for transplanting; and total weed control.

INTRODUCTION

PRELIMINARY REPORTS on trials carried out with dichlobenil were given by Houlker, 1961; Webster, 1961, and Thompson, 1961. The trials reported by these authors were concerned with the application of dichlobenil as a pre-emergent, post-planting spray to a wide variety of vegetable and crop seeds. It was generally concluded that dichlobenil, although providing good weed control, was insufficiently selective for most germinating crop seeds, and, only in the case of large-seeded crops such as peas and French beans, were results of possible practical importance obtained. Since those trials were laid down, a number of related compounds, discovered at the Woodstock Agricultural Research Centre of Shell in England, have become available. Along with dichlobenil they have been tested over a broad spectrum of weed control and some promising results have been obtained.

PROPERTIES

In addition to dichlobenil, the principal compounds evaluated were: α-amino-2,6-dichlorobenzaldoxime (WL:4929), its hydrochloride (WL: 4926) and 2,6-dichlorothiobenzamide (WL: 5792).

Although the compounds possess widely different physical and chemical properties, their herbicidal activities were broadly comparable in spectrum. In general, the thiobenzamide and the nitrile were closely comparable and more active than the oximes.

The thiobenzamide was selected for further development because of its relatively high activity and superiority over the nitrile under conditions with preclude the effective use of dichlobenil, namely, those adversely associated with its high vapour pressure *ca* 5×10^{-4} at 20°C and low water solubility *ca* 20 ppm at 25°C. As might be expected from its lower vapour pressure *ca* 5×10^{-7} at 20°C and higher water solubility *ca* 750 ppm at 25°C, the thiobenzamide compared with the nitrile performs with greater efficiency and consistency without incorporation.

The main herbicidal properties of dichlobenil and WL:5792 are:

(1) They possess a high toxicity to germinating seeds and young seedling plants.
(2) Established plants, notably woody species, show a high degree of tolerance and are unaffected by herbicidal application rates.
(3) They possess little inherent selectivity.
(4) They are of low mammalian and fish toxicity.
(5) They exhibit variable persistence, which is related mainly to their differing vapour pressure and water solubility, method of application, formulation and environmental conditions.

The remainder of this paper reviews some of the work which has been carried out with the compounds, with particular reference to New Zealand problems. (All application rates are quoted in terms of lb active ingredient per acre.)

SEEDLING WEED CONTROL

The high toxicity of the nitrile herbicides to germinating seeds has been adequately demonstrated. A number of trials have been laid down to investigate the possibility of preventing undesirable seedlings from infesting particular areas without affecting established pasture plants which may be growing there, or into which it is proposed to transplant desirable species.

A problem of some importance in areas devoted to single plant selection work has been the necessity to prevent the ingress of seedling volunteers of all plants, but particularly those of the same or related species. A. J. McNeur (pers. comm.) has laid down a number of trials with the compounds on areas in which selected plants were set out as single spaced plants for purposes of evaluation and/or breeding. The following summarizes the trials and results obtained.

Wettable powder formulations of dichlobenil and WL: 5792 were applied to weed-free surfaces at application rates of 1 and 2 lb incorporated and 2 and 4 lb surface sprayed. In one trial, established plants of most pasture species were oversprayed, whilst, in another, the plants were transplanted just after spraying. No damage was noted to desirable plants, nor did their rate of growth suffer. Degree of weed control achieved varied, depending on the rate and method of application. In all trials it was found that surface spraying gave better results than incorporation, particularly if the area tended to be of a cloddy nature. Virtually complete control of all weeds, including grasses, was achieved using 4 lb as a surface spray without mechanical incorporation. A few plants of Prince of Wales feather (*Amaranthus* spp.) germinated normally, but no other species established. A 2 lb surface spray was superior in these trials to the same rate incorporated, whilst 1 lb incorporated was inferior. A granular formulation was also tested. Results were good, but not equal to similar rates applied as sprays.

In trials to determine the effects of dichlobenil in a nursery area in which *Rhododendron* and *Camellia* spp. were planted following spray application, M. Richards (pers. comm.) demonstrated that excellent weed control was achieved without sign of damage to the desirable plants. Dichlobenil as a wettable powder was applied at 3 lb rate to freshly cultivated soil, after which the area was watered to assist penetration. Excellent weed control was achieved, despite the fact that the soil was disturbed to a depth of 6 in. when the young shrubs were planted. The area was still weed-free six months after application.

An interesting situation which is at present being investigated involves the possibility of controlling barley grass (*Hordeum murinum*) in established pasture. A trial was laid down in late

autumn, 1962, in which 2 lb dichlobenil was applied to an area known to be infested with barley grass. The dichlobenil was compared with sodium dichloropropionate at 1½ lb. Both products gave complete control of barley grass, but on the sodium dichloropropionate plots there appeared an infestation of annual weeds, particularly chickweed (*Stellaria media*). These latter treatments also indicated a slight depressing effect on desirable grass species, whereas on the dichlobenil plots no weed population appeared and these gradually filled up with desirable pasture species. An attempt to reproduce these results by an early spring spraying was relatively unsuccessful, probably because a proportion of the barley grass had established prior to spraying. Further trials have been laid down in May of this year to attempt to reproduce last season's result.

TOTAL WEED CONTROL

The possibility of using the compounds as wettable powders for soil sterilization and total weed control has been investigated, but so far with inconclusive results at the rates of 6 to 9 lb, these giving insufficient control of established plants. Soil incorporation is in most cases not feasible. It is, therefore, necessary to use granules, since the compounds exhibit greater persistence in this form. Combinations with other herbicides such as sodium dichloropropionate and 2,4-D in large volumes of water (300 to 500 gal/ac) to obtain penetration into the soil and thus reduce volatilization losses is desirable when a weed cover is present. In one trial, a mixture comprising 9 lb WL:5792, 18.5 lb sodium dichloropropionate and 1.8 lb octyl ester 2,4-D, compared with the same mixture minus WL: 5792, has given excellent weed control over a period of six months. The difference was most noticeable with flatweeds such as the plantains (*Plantago* spp.), catsear (*Hypochaeris radicata*), dandelion (*Taraxacum officinale*), etc., which ingressed rapidly on the sodium dichloropropionate/2,4-D plots, but were almost entirely absent when WL: 5792 was added. Further trials are needed before firm recommendations can be made for the use of the compounds in total weed control work.

WEED CONTROL IN CROPS

Mention was made earlier of the possibility of using the organonitriles as pre-emergent sprays in peas and beans. Work carried out since the trials mentioned by Webster (1961) and Houlker (1961) have indicated that successful results are too dependent on exact soil and climatic conditions. As there is a very narrow limit between weed control and crop damage under ideal conditions, it is unlikely that these compounds will be satisfactory pre-emergence herbicides in seeded crops.

In a trial carried out in Canterbury in a commercial crop of field peas, dichlobenil in the form of a 50% wettable powder was applied as follows: 1 and 2 lb incorporated, and 2 and 4 lb surface sprayed. Applications were made 4 and 0 days before the crop was sowed. Climatic conditions were warm and dry for some weeks after application. The following comments were noted:

(1) All treatments severely affected germination and vigour of peas to an unacceptable degree.
(2) A four-day delay between treatment and sowing reduced the phytotoxic effect.
(3) Surface applications appeared less severe on the peas than where the material was incorporated.

(4) Although all treatments gave a good initial control of weeds, the degree of weed control achieved was not satisfactory 7 to 8 weeks after sowing. (It is possible that climatic effects were in part responsible for this result.)

On the other hand, initial work suggests that the compounds are safe and effective herbicides to use with transplanted crops, applied just prior to planting. Amongst the crops in which further trial work is suggested are such transplants as cabbage, cauliflower, broccoli, leeks, celery, and tomato.

WEED CONTROL AMONGST WOODY PLANTS

A number of trials, both here and overseas, have shown that the compounds will be of considerable importance for weed control amongst woody plants. Sandford (1962) has demonstrated that top fruit exhibited remarkable tolerance to dichlobenil, the yield of apples being unaffected by 16 lb incorporated annually for three consecutive years. Pears, plums, cherries, gooseberries and black currants were unaffected by 8 lb incorporated. Raspberries appeared to be rather more sensitive and Sandford reported two cases of slight crop damage, although yields were not affected.

M. Richards (pers. comm.) obtained freedom from weeds in a shrubbery of established ornamentals for periods of up to 12 months with 3 lb dichlobenil worked into the soil. Amongst species in the shrub border were *Beautfortia sparsa, Chamaecyparis obtusa, Erica oatesii, Felicia angustifolia, Forsythia* hybrid, *Hydrangea hortensis, Juniperus chinensis, Leptospermum scoparium* var., *Leucospermum reflexum, Michelia doltsopa,* and *Thryptomene saxicola.*

The compounds have also shown to advantage for weed control in forest nurseries and for the control of couch (*Agropyron repens*). In this latter case, the compounds appear to inhibit the formation of roots on the stolons. A similar effect has been noted in connection with regrowths of buried roots of such plants as docks (*Rumex* spp.) and flat weeds. There is also evidence to suggest that *Oxalis* spp. may be adequately controlled by rates as low as 3 lb.

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