QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 823

# EFFECT OF TRIFLURALIN RESIDUES ON WINTER CEREALS

By S. R. WALKER, B.Agr.Sc.

## SUMMARY

**The effect of residues of trifluralin (2,6-dinitro-N, N-dipropyl-4-trifluoromethylaniline) on barley (*Hordeum vulgare*) and oats (*Avena sativa*) was investigated. Soil samples were collected from 28 sites which had been treated with trifluralin prior to planting a summer crop. Oats and barley were sown in these soil samples approximately seven-and-a-half months after trifluralin application. Trifluralin residues caused mild to severe stunting of the oats growing in treated soil from 12 of the 28 sites, with up to 39·5% reduction in height of the first leaf. There was significant stunting of barley at only one site. Oats cannot be recommended for planting during winter after a summer application of trifluralin.**

## I. INTRODUCTION

Trifluralin is a pre-planting, soil-incorporated herbicide used extensively in peanuts (*Arachis hypogaea*), soybeans (*Glycine max*), and navybeans (*Phaseolus vulgaris*) in the South Burnett district of Queensland. Double cropping with winter cereals after the summer crop is a common practice in the district.

However, stunting and distortion of winter cereal seedlings has been observed, and this has been attributed to the adverse effect of trifluralin residues from the preceding summer crop.

The objective of this experiment was to measure the effect of residues of trifluralin on barley and oats under a range of local conditions.

## II. METHODS

A number of sites were selected throughout the South Burnett district. There were 17 sites in the 1975–76 season and 11 sites in the 1976–77 season. These sites represented the main agricultural soil types: red clay loams Gn 2·1 and 3·1; and sandy loam Dy 5·4 (Northcote 1975). For each site the soil pH, clay content and organic carbon content were measured.

Trifluralin was applied at the recommended rate of 0·84 kg $ha^{-1}$ prior to planting a summer crop. It was incorporated into the soil to a depth of 8 to 10 cm immediately afterwards with either tynes and harrows, or offset discs. An unsprayed control area of 4 m x 15 m was left within the sprayed areas at every site.

Rainfall was recorded at all sites except those on the sandy loam soil type which were without recording facilities. Rainfall (mm) at the J. Bjelke-Petersen Field Station, Kingaroy during the experimental periods of 1975–76 and 1976–77 and the long term average for Kingaroy, are given in table 1.

**TABLE 1**

RAINFALL (mm) DURING THE EXPERIMENTAL PERIODS COMPARED WITH THE LONG TERM MEAN

| —— | 1975–76 | 1976–77 | Mean (30 years) |
|---|---|---|---|
| Oct .. .. | 95 | 52 | 60 |
| Nov .. .. | 76 | 135 | 77 |
| Dec .. .. | 105 | 45 | 105 |
| Jan .. .. | 94 | 0 | 109 |
| Feb .. .. | 117 | 81 | 96 |
| Mar .. .. | 47 | 38 | 85 |
| Apr .. .. | 39 | 24 | 45 |
| May .. .. | 19 | 70 | 34 |
| Jun .. .. | 11 | 5 | 47 |

After the harvest of the summer crop, surface soil samples (0 to 10 cm) were collected separately from the sprayed and unsprayed areas of each site. During the period between soil sampling and planting, the soil was kept in sealed paper bags. This soil was air dried, sieved through a 6-mm mesh and potted in 10-cm-diameter pots. The pots were watered up to field capacity, planted with ten seeds of barley or oats and the soil moisture content kept at between 50 and 100% of field capacity.

The bioassays were carried out in a heated glasshouse at J. Bjelke-Petersen Field Station, Kingaroy. The method of assessment was to measure the height of the first leaf of every plant, about 3 weeks after planting. The soil was also washed away from the root systems to observe any abnormalities. There were two separate trials each year, one planted with oats and one with barley. The experimental design of each pot trial was a 34 x 2 randomised block in 1976 and a 22 x 3 randomised block in 1977. The treatment, soil sampling, planting and assessment dates are given in table 2.

There was an average interval of 226 days between the application of the herbicide and the planting of the oats and barley.

**TABLE 2**

DATES OF SOIL TREATMENT AND SAMPLING, AND OF PLANT SOWING AND ASSESSMENT

| Season | Treatment Dates | Sampling Dates | Planting Dates | Assessment Dates |
|---|---|---|---|---|
| 1975–76 .. .. | 29 Oct 75–8 Jan 76 | 23 Jun 76–25 Jun 76 | 5 Jul 76 | 23 Jul 76 |
| 1976–77 .. .. | 5 Oct 76–15 Dec 76 | 6 Apr 77–28 Apr 77 | 23 Jun 77 | 13 Jul 77 |

## III. RESULTS AND DISCUSSION

Trifluralin residues caused mild or severe stunting of the oats growing in treated soil from 12 of the 28 sites, with up to 39·5% reduction in height of the first leaf (table 3). At site 14 there was yellowing and distortion of the leaves and distortion of the roots.

Rainfall was normal in 1975–76 but there was a dry summer in 1976–77 with December and January receiving well below average. Rainfall between trifluralin application and soil collection varied greatly among the sites, from 177 mm to 617 mm. The stunting of oats occurred irrespective of the soil type. Soil pH varied among the sites from 5·5 to 6·5, clay content from 7 to 71%, and organic carbon content from 0·50 to 2·22%. The degree of stunting, examined by linear regression, was unrelated to soil pH, organic carbon content, clay content, and rainfall ($R^2 = 0·03$, 0·02, 0 and 0·06 respectively).

**TABLE 3**

HEIGHT REDUCTION OF OATS AND BARLEY AS A PERCENTAGE OF CONTROL

| Site Number | Height Reduction of Oats as % of Control | Height Reduction of Barley as % of Control |
|---|---|---|
| 1976 sites: | | |
| 1 | 12·2* | 0 |
| 2 | 9·8* | 0 |
| 3 | 2·8 | 12·5 |
| 4 | 2·4 | 0 |
| 5 | 18·8* | 0 |
| 6 | 6·1 | 0 |
| 7 | 0 | 0 |
| 8 | 0 | 0 |
| 9 | 0 | 0 |
| 10 | 11·1* | 0 |
| 11 | 2·5 | 0 |
| 12 | 19·5* | 4·6 |
| 13 | 2·3 | 0 |
| 14 | 39·5** | 7·1 |
| 15 | 21·6** | 0 |
| 16 | 2·9 | 5·7 |
| 17 | 12·2* | 16·2 |
| 1977 sites: | | |
| 18 | 13·4* | 4·8 |
| 19 | 2·9 | 8·4 |
| 20 | 9·0 | 0 |
| 21 | 4·2 | 0 |
| 22 | 24·4** | 28·5** |
| 23 | 13·0* | 11·0 |
| 24 | 4·2 | 4·9 |
| 25 | 0 | 0 |
| 26 | 12·3 | 11·1 |
| 27 | 17·3* | 2·9 |
| 28 | 0 | 11·8 |
| C.V. †(%) 1976 | 5·6 | 8·3 |
| 1977 | 9·2 | 8·4 |

* These values are significant using LSD (P = 0·05)

** These values are highly significant using LSD (P = 0·01)

† C.V. = Coefficient of variation.

These results differ from those that several researchers have found overseas. Savage (1973) sampled 250 fields in U.S.A. for trifluralin residues and found that the herbicide residual levels were negatively correlated with the soil pH and were not significantly correlated with the soil texture. Horowitz *et al.* (1974) found that the trifluralin residues, as measured by sorghum bioassays, were significantly correlated with the organic matter content, but not with the clay content. However in soils with a low organic matter content, the activity increased with increased clay content. Probst *et al.* (1967) found that the rate of trifluralin breakdown in the soil increases with increased soil moisture.

There was significant stunting of the barley at site 22 only (table 3). No explanation could be found for this exception.

The sites used in this experiment covered the main agricultural soil types in the district and received rainfall which varied from above average to well below average. Considering the soil and seasons over which this experiment was conducted, it appears safe to plant barley following a summer application of trifluralin in the South Burnett district. However there may be enough residual trifluralin to have a toxic effect on oats.

## REFERENCES

HOROWITZ, K., HULIN, N., and BLUMENFELD, T. (1974).—Behaviour and persistence of trifluralin in soil. *Weed Research* 14:213-220.

NORTHCOTE, K. H., HUBBLE, G. D., ISBEL, R. F., THOMPSON, C. H. and BETTANEY, E. (1975).—'A Description of Australian Soils'. 1st edn (Wilke and Company Limited: Clayton).

PROBST, G. W., GOLAB, T., HERBERG, R. J., HOLZER, F. J., PARKA, S. J., VAN DER SCANS, C., and TEBE, J. B. (1967).—Fate of trifluralin in soils and plants. *Journal of Agricultural and Food Chemistry* 15:592-599.

SAVAGE, K. E. (1973).—Nitralin and trifluralin persistence in soil. *Weed Science* 21:285-288.

(Received for Publication 6 December 1978)

The author is an Agronomist with Agriculture Branch, Queensland Department of Primary Industries, stationed at Kingaroy, Q. 4610.