INSTITUUT VOOR BIOLOGISCH EN SCHEIKUNDIG ONDERZOEK
VAN LANDBOUWGEWASSEN
WAGENINGEN

Verslagen
nr. 70, 1974

Studies on residues of ethofumesate in soil

by

C. Zaragoza* and A. Reisler

* OECD Fellow from March to September, 1974.
Present address: Centro regional de investigación y desarrollo agrario no. 3 Elro, Zaragoza, Spain.

CONTENTS:

Introduction

At harvest of sugar beets Schweizer (1) found soil residues of 13 to 15 % of the ethofumesate dosage applied pre-emergence. In the Netherlands a figure of about 17 % was found by van Dord and Naber (Pers. Comm.). We may wonder what the effects of such residues are on following crops. Since ethofumesate will hardly leach into deeper soil layers (2, 3) there is a potential hazard of damage. (Winter)-wheat is most important in this respect because of its acreage and extreme sensitivity to this herbicide.

Dilution of the herbicide from the top layer by tillage could reduce the phytotoxic effects, but homogeneous mixing of the soil is usually not achieved.

Toxic effects to cereals in early growth stages have been observed (4). On the other hand, little is known about possible chronic effects usually not evident in deformations, but in reduced vegetative growth or yields possibly caused by continuous root uptake of the herbicide during the growing season.

The present work describes 3 experiments:

A. Estimation of soil residues in the field.
B. Effect of some concentrations of ethofumesate in different soil layers upon wheat seedlings.
C. Effect of various concentrations of the same herbicide homogeneously mixed with the soil upon growth of wheat, also in combination with a pre-emergence application of metoxuron.

Methods and results

A. Estimation of soil residues in the field.

The soil samples studied were taken from top layers of 0 - 2.5 cm and 2.5 - 5 cm of field plots located at the experimental farm "Droevendaal" near Wageningen, at October 1, 1973. The sandy soil of these plots contained about 3-4 % organic matter, 5-10 % clay and 90 % sand, and had been sprayed

with 10 l per ha of the commercial product. (Tramat, 20 % a.i.) on March 3, 1973. During the season the plots were treated as follows:

C 1 - uncropped, no tillage
C 2 - Fodder beets till harvest September/October
C 3 - Fodder beets till 18 July, soil tillage with a cultivator then sowing of some crops.
C 4 - uncropped, 15 may soil tillage after which some crops were sown
15 September crops removed, soil tillage and sowing of some other crops.
C 5 - uncropped, 15 May soil tillage after which some crops were sown.
G 1 - as C 1
G 2 - as C 2
G 3 - as C 3, but no soil tillage
G 4 - as C 4, " " " "
G 5 - as C 5, " " " "

To estimate soil residues of ethofumesate a bio-assay method was used (5). The test plants of spring wheat (var. Orca) were grown in small plastic cups, each containing 200 g dry soil of the samples. The fresh weight of the plants compared with those from standard series of untreated soil grown under similar conditions.

The estimated residues are given in table 1. on page 3.

The soil residue ranged between 10 and 20 % of the initially applied dosage, the main part found in the top layer of 2.5 cm. The variation in residue of ethofumesate between the various treatments in the plots is difficult to explain. Soil tillage does not seem to reduce the residues appreciably in the top soil. Especially the high residue in the C 3 treatment is quite unexpected. However, most of the soil residues are within the range previously reported.

Table 1.

Residues of ethofumesate in various soil layers.

Treatment	Soil layer	Concentration in ppm	Estimated percentage of initial dosage*)	
C 1	0 - 2.5 cm	0.6	9	12
	2.5 - 5 cm	0.2	3	
C 2	0 - 2.5 cm	0.5	8	15
	2.5 - 5 cm	0.5	7	
C 3	0 - 2.5 cm	1.3	20	24
	2.5 - 5 cm	0.3	4	
C 4	0 - 2.5 cm	0.5	8	8
	2.5 - 5 cm	0	0	
C 5	0 - 2.5 cm	0.6	9	99
	2.5 - 5 cm	0	0	
G 1	0 - 2.5 cm	0.9	14	14
	2.5 - 5 cm	0	0	
G 2	0 - 2.5 cm	0.5	7	9
	2.5 - 5 cm	0.2	2	
G 3	0 - 2.5 cm	0.9	15	18
	2.5 - 5 cm	0.2	3	
G 4	0 - 2.5 cm	0.7	11	18
	2.5 - 5 cm	0.4	7	
G 5	0 - 2.5 cm	0.6	10	10
	2.5 - 5 cm	0	0	

*) Note: starting from an initial dosage of 2 kg a.i. per ha and a soil density of 1.3, the initial concentration per 2.5 cm was calculated at about 6.2 ppm

B. Effect of some concentrations of ethofumesate in different soil layers on wheat seedlings.

In a pot experiment the soil layers of 0 - 2.5, 2.5 - 5, 5 - 7.5 cm or 7.5 - 10 cm were mixed with ethofumesate to obtain concentrations of 0.5 and 1 ppm, corresponding to residues of about 10 % and 20 % of an initial rate of 1.5 kg/ha. Four replications were carried out.

This experiment simulated the extreme situation, in which the top soil layer of 2.5 cm with the residue was kept in place or was brought as a whole to depths of 2.5 - 5, 5 - 7.5 or 7.5 - 10 cm by tillage.

The clay pots without bottom-holes contained 1300 g of "Born Zuid" sandy soil, almost the same soil type as used in experiment A. The main supply of water was to the peat, in which the pots were placed. Eight seeds of spring wheat (var. Orca) were sown at a depth of 2 cm; of this 5 plants were kept after emergence.

Twenty days after sowing plant weights were determined. The results are given in Table 2 on page 5.

No visible growth retardations were oberved at concentrations of 0.5 ppm. At the higher concentrations of 1 ppm in the 0 - 2.5 cm layer growth was considerably inbibited, immediately after emergence: that of plants with a treated soil layer of 2.5 to 5 cm showed much inhibition in the younger leaves 3 - 4 days later.

Although the plants of both of these treatments recovered after some days, a considerable drop in production remained ultimately.

C. Effect of various concentrations of ethofumesate homogeneously mixed with the soil on growth of wheat.

For this experiment Mitscherlich pots were used, each containing 5.75 kg "Born-Zuid" sandy soil. The treatments are given in Table 3.on page 5.

Table 2
Effect of ethofumesate in various soil layers on shoot weight of wheat seedlings.

Concentration in ppm	Treated soil layer	Mean shoot weight in g per pot fresh	dry
0	-	3.47	0.434
0.5	0.0 - 2.5 cm	4.12	0.495
0.5	2.5 - 7.5 cm	3.81	0.468
0.5	5.0 - 7.5 cm	3.44	0.425
0.5	7.5 - 10.0 cm	3.84	0.469
1.0	0.0 - 2.5 cm	2.27	0.266
1.0	2.5 - 5.0 cm	2.59	0.319
1.0	5.0 - 7.5 cm	3.78	0.467
1.0	7.5 - 10.0 cm	3.46	0.430

Table 3
Homogeneous mixing of ethofumesate through the soil

Treatment	ethofumesate kg/ha	metoxuron kg/ha	conc. ethofumesate after incorporation. ppm
1	0	0	0
2	0.1	0	0.055
3	0.2	0	0.110
4	0.3	0	0.165
5	0	2.4	0
6	0.1	2.4	0.055
7	0.2	2.4	0.110
8	0.3	2.4	0.165

Ethofumesate was sprayed at 3 rates given in table 3 and mixed throughout the soil in the pots (18 cm depths). The given initial concentrations per pot are calculated from the surface area of the pots (315 cm^2) and the soil weight. Immediately after sowing of spring wheat (var. Orca) at a depth of 2 cm, one half of the pots was sprayed

Placing indifferent soil layers as well as homogeneously mixing through the soil rather poorly simulate what may happen with residues present in the top layer after tillage and cultivation operations in the field. The results of these experiments however could indicate that damage to a wheat crop may occur at high residue levels of ethofumesate in the soil.

Summary

Bio-assays on residues of ethofumesate in a sandy soil indicated that 10 - 20 % of the initially applied dosage was present in the top soil of 5 cm after a growing season of 7 months with fodder beets.

In glasshouse experiments a concentration of 1 ppm ethofumesate in the top layers of 0 - 2.5 or 2.5 - 5 cm resulted in reduced growth of spring wheat seedlings, whereas 0.5 ppm and deeper layers at both concentrations did not affect seedling growth.

Homogeneous mixing of 0.300 kg/ha through 18 cm of soil (about 0.17 ppm) reduced the kernel yield of spring wheat to some extend, but that of 0.100 and 0.200 kg/ha had no effect in glasshouse experiments.

References

1. Schweizer E.E., Persistence and movement of NC 8438 in soil. Intern. Symp. on Nortron 14th Jan. 1974, Cambridge.
2. Baker C., Horne S.D. and Whiteoak R.J. Mode of action, specificity and soil behaviour of Ethofumesate. (Nortron) - Intern. Symp. on Nortron 14th Jan. 1974, Cambridge.
3. Neururer H., Untersuchungen über das Verhalten von Nortron in verschiedenen Böden. Intern. Symp. on Nortron 14th Jan. 1974, Cambridge.
4. Hübl H., Freilandversuche zur Nachbaufrage nach Anwendung von Tramat (Nortron). Intern. Symp. on Nortron 14th Jan. 1974, Cambridge.
5. Reisler A., Bio-assay of soil samples for content of photosynthesis inhibiting herbicides. IBS, Wageningen. Verslagen nr. 61, 1972.