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ON THE EFFECT OF PLACEMENT AND SOIL MOISTRUE UPON THE HERBICIDAL ACTION OF ETHOFUMESATE

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Previous studies showed that the herbicidal action of ethofumesate (2-ethoxy-2, 3-dihydro-3, 3-dimethyl-5-benzofuranyl methanesulphonate) is mainly associated with the soil. Its availability to germinating seeds and emerging shoots is of primary importance [6, 7]. Especially the moisture content of the surface layer of the soil could be a determining factor. Therefore some experiments were conducted in which herbicide placement and soil moisture were varied, and the phytotoxic action and leaching were studied.

MATERIALS AND METHODS

All experiments were carried out under greenhouse conditions in the autumn and winter of 1973 at the Institute for Biological and Chemical Reasearch in Field Crops and Herbage—Wageningen.

In all experiments the 20% emulsifiable concentrate was used, and a sandy soil with 3—4% organic matter and 7% clay (fraction $< 16\mu$).

The effect of moisture of the upper soil layer was studied in boxes ($3 \times 15 \times 30$ cm) with a glass front, placed at an angle of 25° from the vertical.

These four boxes were first partly filled with untreated, moist soil (15% water). Oat seeds (5 per box) were then put in with the root initials downwards and more or less covered with a plastic sheet for separation from the following soil layers. The latter were varied as follows:

1 cm buffer layer	1 cm top layer
untreated, air-dry	untreated, air-dry
untreated, air-dry	ethofumesate 10 ppm, air-dry

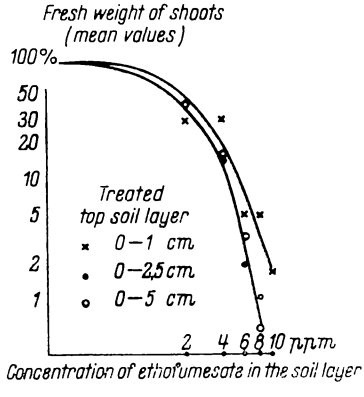
untreated, moist (15% water)	ethofumesate 10 ppm, moist (15% water)
untreated, moist (15% water)	untreated, moist (15% water)

No replicates of glass front boxes were included. Shoot and root lengths of individual plants were measured after 8 days and mean values determined.

Leaching of ethofumesate was compared to that of atrazine both in dry and moist soil, using the thick soil layer chromatography method described by G e r b e r et al. [2]. All plates were first filled with air-dry soil. Then half of them were wetted by infiltration until complete saturation. At the start of the experiment the moisture equivalent of the soil in these plates was 19 to 19.5%.

Of each herbicide 0.5 mg a.i. was pipetted in 0.2 ml water in a shallow furrow in the soil 2 cm from the top. The commercial product of atrazine used was a 50% wettable powder. After 15 minutes 147 mm leaching water was applied (descending technique). *Triticum vulgare* (spring wheat var. Orca) was used to assay for ethofumesate and *Spirodela polyrhiza* for atrazine in the different soil layers. Two replicates were included.

The effect of herbicide placement was studied by mixing various concentrations of ethofumesate in different top layers of the soil (see Fig. 1). Clay pots of 13 cm diam. without bottomholes were used. The initial moisture level was about 15%. Three replicates were adopted.



Effect of ethofumesate herbicide placement on response of *Echinochloa crus-galli*

In these pots barnyardgrass (*Echinochloa crus-galli*) was seded at 1.5 cm depth immediately after filling of the pots.

In order to exclude downwards leaching of the herbicide in this experiment, the pots were placed in moist peat. In this way, water could be supplied to the peat because of infiltration through the porious pot walls.

One month after sowing the fresh weight of the shoots was determined.

RESULTS AND DISCUSSION

EFFECT OF SOIL MOISTURE

The results are given in Table 1. Ethofumesate reduced shoot length when incorporated into 1 cm of wet top soil, but failed to do so in a similar layer of dry soil. The results suggest that uptake of ethofumesate through emerging shoots only take place at sufficient soil moisture, possibly because of the higher proportion of the herbicide available in moist soil. Apparently soil moisture is also needed as a medium to penetrate into the emerging shoot. Under field conditions one would expect a gradual range of phytotoxicity. In general, various results have been obtained with different types of herbicides [e.g. 3, 4, 11] as other adsorption and or penetration patterns might have been involved.

Tabela 1

The effect of surface soil moisture on the action of ethofumesate upon oats

D-U	D-E	W-U	W-E
Lengths of oat shoots in cm /mean values/			
10.6	11.5	8.2	3.4
Lengths of longest root in cm /mean values/			
13.1	14.8	12.3	13.4

Explanation: Top soil layer
D-U = dry soil untreated
D-E = dry soil treated with ethofumesate
W-U = wet soil untreated
W-E = wet soil treated with ethofumesate

LEACHING

Table 2 gives the results of the leaching experiment with dry and moist soil. Leaching of ethofumesate was increased when the herbicide was applied to the air-dry soil, whereas that of atrazine was practically not influenced by soil at the moment of application. Movement of the waterfront itself was slower in the wet soil after complete saturation of the dry plates.

Soil moisture could affect herbicide movement by inducing swelling of colloids and diminishing air volume which affect by-passing of water [5] and adsorption — desorption capacities [8, 9, 10]. The higher water solubility of ethofumesate as compared to that of atrazine might result

Tabela 2

Effect of initial soil moisture on leaching of ethofumesate and atrazine

Leaching depths /cm/			
dry soil		wet soil	
Ethofumesate			
18	18	12	12
Atrazine			
14	16	14	16

in easier by-passing in the water phase in dry soil in this experiment.

Under field conditions this phenomenon could be important for leaching to germination zones, since the top soil layer may often fluctuate in moisture content. In deeper soil layers such fluctuations are probably less extreme.

SOIL PLACEMENT EFFECT ON *ECHINOCHLOA CRUS-GALLI*

Figure 1 (log. paper disp.) shows that incorporation of ethofumesate at concentrations of 6 to 8 ppm into a moist top soil layer of 1 cm already gave almost complete controlof barnyardgrass. Increase in thickness of the treated soil layer at these concentrations hardly increased phytotoxicity. This is also evident with the lower concentrations of 2 and 4 ppm where control of the barnyardgrass was incomplete.

The efficacy of soil-incorporated herbicides is determined by their interaction with soil, but the nature of herbicidal activity should also be taken into consideration. These results with ethofumesate could be interpreted by its interference with plant germination and early seedling growth. The presence of ethofumesate in deeper layer does not contribute to its direct activity, but delays to later growth stages in which the plants are less sensitive [7]. This is in contrast to the results obtained with inhibitiors of photosynthesis [Van der Z w e e p, 12].

Probably, uptake of ethofumesate by emerging shoots is more effective than that by early root uptake. However, uptake by roots from the upper soil layer cannot be excluded, since D a w s o n [1] observed that barnyardgrass develops a strong root system above the first internode.

Since in the field various factors (rainfall, water evaporation, soil type etc.) will determine leaching and uptake, it is clear that weed control can be rather variable, especially when the late germination of the barnyardgrass and its moderate susceptability to ethofumesate [5, 7] are taken into account.

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Я. ОСТРОВСКИ, А. РЕЙСЛЕР

О ВЛИЯНИИ РАЗМЕЩЕНИЯ В ПОЧВЕ И ВЛАЖНОСТИ ПОЧВЫ НА ГЕРБИЦИДНОЕ ДЕЙСТВИЕ ЭТОФУМЕСАТА

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Резюме

Большое содержание влаги в поверхностном слое почвы увеличивало фитоцидное воздействие этофумесата (2-этокси-2,3-дигидро-3,3-диметил-5-бензфуранилметносульфонат) на сеянцы овса.

Область вымывания (перемещения) этофумесата водой возрастала при предшествующим применении этого гербицида на песчаную сухую почву, в то время как атразин перемещался одинаково в сухой и влажной почве.

Этофумесат размещенный в верхнем слое почвы толщиной 1 см, 2,5 см или 5 см проявлял одинаковую эффективность в борбе с *Echinochloa crus-galli.*

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O WPŁYWIE LOKALIZACJI W GLEBIE I WILGOTNOŚCI GLEBY NA DZIAŁANIE HERBICYDOWE ETOFUMESATU

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Streszczenie

Duża zawartość wilgoci w powierzchownej warstwie gleby uintensywniała fitocydalne oddziaływanie etofumesatu (metylosulfolian-2-etoksy-2,3-dwuhydro-3,3-dwumetylo-5-benzofuranylu) na siewki owsa. Zakres wypłukiwania (przemieszczania) wodą etofumesatu wzrastał przy uprzednim zastosowaniu tego herbicydu na suchą glebę piaszczystą, podczas gdy atrazyna była przemieszczana podobnie przy glebie suchej i wilgotnej.

Etofumesat zlokalizowany w wierzchniej warstwie gleby grubości 1 cm, 2,5 cm lub 5 cm wykazał zbliżoną skuteczność w zwalczaniu *Echinochloa crus-galli.*

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