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COMPARATIVE WEED INVESTIGATIONS IN WHEAT AND MAIZE CROPS CULTIVATED TRADITIONALLY AND TREATED WITH WEEDICIDES III. CHANGES IN THE WEED CONDITIONS IN MAIZE PLOTS UNDER SIMAZIN, ATRAZIN (HUNGAZIN PK) POST-EFFECT AND THE DEMONSTRATION OF THE AMINOTRIAZINE CONTENTS OF THE SOILS

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Abstract

In a number of study sites an examination was made of the extent to which the weedicidal effect of the chemical is manifested in the year following spraying, in areas treated with aminotriazines. The aminotriazine contents of the soils were also investigated by biological methods.

The weedicidal action in the year subsequent to spraying was not sufficiently manifested even at the beginning of the growing time, and thus cultivation work became necessary even then; nevertheless, there was a significant weed-cover (70%) compared to the control. *Echinochla crus-galli* appeared in large masses in the areas under the post-effect.

The 5—6 kg/kh basic treatment, and the annual 3 kg overtreatment with Atrazin (Hungazin PK) on the areas systematically treated with aminotriazine for several years should theoretically have been enough to free the maize crops from weeds, and thus the weed-cover was not caused by a deficiency of the chemical.

An appreciable amount of the chemical remains in the cultivation layer in the following spraying with 5—9 kg Hungazin PK, and under suitable conditions this may still result in a certain weedicidal effect at the beginning of the growing time.

Introduction

At the time these investigations were begun (in 1963) it was the generally accepted view that the larger doses (4—6, and even 8 kg/kh) of Simazin, Atrazin (Hungazin PK) used in Hungary were sufficient to maintain maize crops free of weeds in the year following the spraying too, or at most would require one cultivatoring, or possibly a Dikonirt spraying (UBRIZSY, 1960; 1962; SZIGETHY, 1960; 1961; 1963; VIRÁG et al., 1962). At the same time one reference was found suggesting that the weedicide effect was uncertain in the year following the spraying (KACSÓ, 1963). For this reason it seemed advisable to carry out a study of the weed vegetation of maize crops under the first and second year post-effects of the spraying.

Materials and Methods

The investigations were made at the same sites as reported in the first paper of this series. Maize crops under the first year post-effect (sprayed in 1962, but not treated is 1963) were surveyed at all study sites (generally in several sub-units too) with the exception of Lábod, but crops under the second year post-effect (sprayed in 1961) only at Mezőhék and Enying. Information on the conditions and method of survey, and on the aspects of the compilations of the tabulated data, is given again in the first paper (FEKETE, 1973).

The weedicides and their doses applied in 1962 to the areas now under the first year post-effect are listed in Table 1. (There were plots in both sub-units of the Mezőnagymihály State Farm, and these received 6 or 9 kg weedicide.)

The same doses were applied to the areas under the second year post-effect (sprayed in 1961): at Mezőhék 5 kg Simazin, and on some plots Atrazin, and at Enying 5 kg Atrazin per cadastral acre (0.57 hectares). In the latter farm the area also received a Dikonirt spraying (1.1 kg/kh) in 1962.

Information on the times, means and method of weedicide treatment is given below.

All of the maizes under post-effect at Fehérgyarmat, on the Klementina sub-unit of the Mezőnagymihály State Farm, and at Enying received two, and at Kaposvár three mechanical and one manual row-hoeing, while on the Bagjas sub-unit of the Mezőnagymihály State Farm they were cultivatored only twice. The plots at Mezőhék under post-effect underwent the traditional treatment: three mechanical and two manual row-hoeings. By the time of the first surveys the crops at Mezőhék and Enying had received one hoeing over the entire area, the former directly before the surveys, and the latter 2—3 weeks earlier. Cultivatoring had also been carried out on the other farms 2—3 weeks before the first surveys. The second cultivatoring and row-hoeing took place immediately after the first surveys.

The method used to demonstrate the amount of the chemical remaining in the soil was the *Sinapis alba* germination test devised by VIRÁG et al. (1960). For this purpose the soils were in all cases collected in 10 cm layers from 0 to 40 cm. 10 samples were taken from each layer. An average sample was prepared by mixing the 10 samples, and 100 seeds of *Sinapis alba* were planted in each mixed soil in large Petri dishes. The germination was carried out in a greenhouse at 20 ± 2 °C, in 3 repetitions. The percentage loss of the seedlings used in each test refers to the 15th day. Germination in soils from the same collecting site, but not treated chemically, and on wet filter paper served as control: the germination capacity of the mustard seed in these cases was 95—97%.

Results and discussion

1. Change of the weed conditions in maize crops under aminotriazine post-effect

a) Weed cover of crops under first year post-effect

It can be seen in Table 3 and Figs. 1 and 2 that in the crops under the first year post-effect of Hungazin treatment, but not treated in the year of the investigation, in spite of the agrotechnical procedures employed a significant restoration of

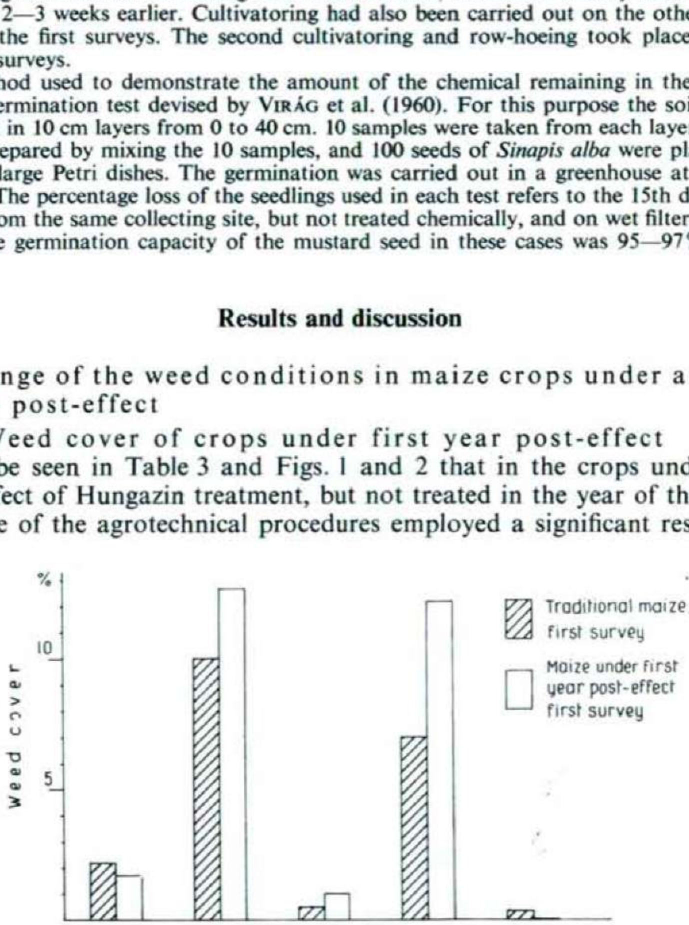

Fig. 1. Distribution according to life forms of early-summer weed vegetation in maize crops under first year Hungazin PK post-effect.

the weed situation had proceeded, for the average weed cover by the end of the growing time had increased by about 70% compared to that in traditionally cultivated maize plots. Fortunately, this unfavourable picture was not completely general. For example, the weed cover of the maizes under the first year post-effect at Mezőhék and Enying were relatively satisfactory. In contrast, from the beginning of the growing time on, the post-effect maize crops on the Fehérgyarmat, Mezőnagymihály and Kaposvár State Farms were characterized by a huge increase in the weed cover, which was naturally further enhanced until the autumn.

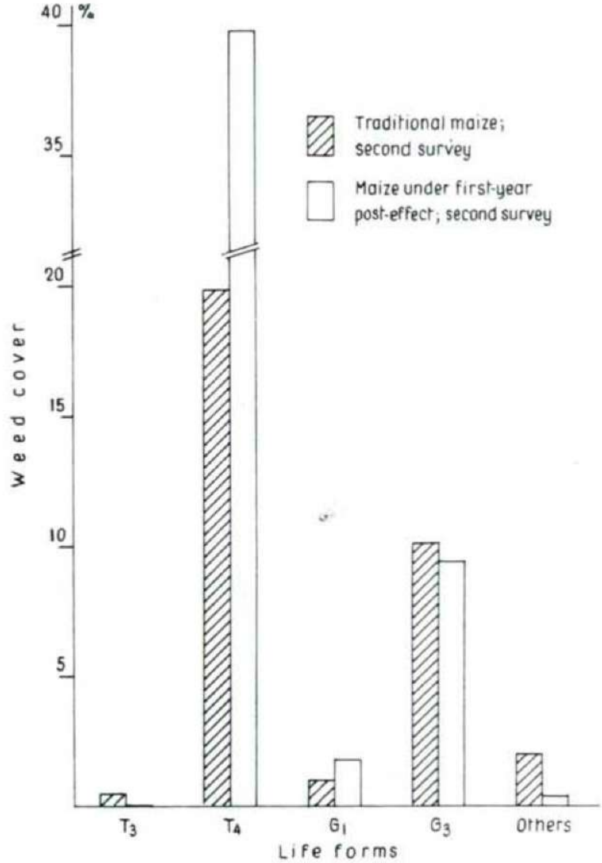

Fig. 2. Distribution according to life forms of late-summer weed vegetation in maize crops under first year Hungazin PK post-effect.

Examination of the composition of the weed vegetation revealed a particularly striking increase in the late-summer varieties (T_4), and primarily *Echinochloa crus-galli*, mainly on the last-mentioned farms. It can be conceived to what extent this took place, for instance, for ripening at the end of summer on the Bagjas sub-unit of the Mezőnagymihály State Farm it attained a 32% cover in the dry state. This enormous weed mass ripened and disseminated an unbelievable amount of seeds, and hence contaminated the soil for years. The mass appearance of *Echinochloa* in the wheat crops of the farm under Simazin post-effect can also certainly be attributed to the fact that a similarly large amount may have occurred in the maize crops under first year post-effect in the previous year (FEKETE, 1964; 1973). Such a large-scale multiplication of *Echinochloa* was also observed on the Fehérgyarmat and Kaposvár State Farms. In contrast, this phenomenon could not be perceived at all at Mezőhék and Enying.

The root-like couch-grasses (G_3) similarly appeared with higher covers in maize crops under the post-effect, than in those cultivated traditionally; this increase in the weed cover was mainly due to *Rubus caesius* and *Convolvulus arvensis*.

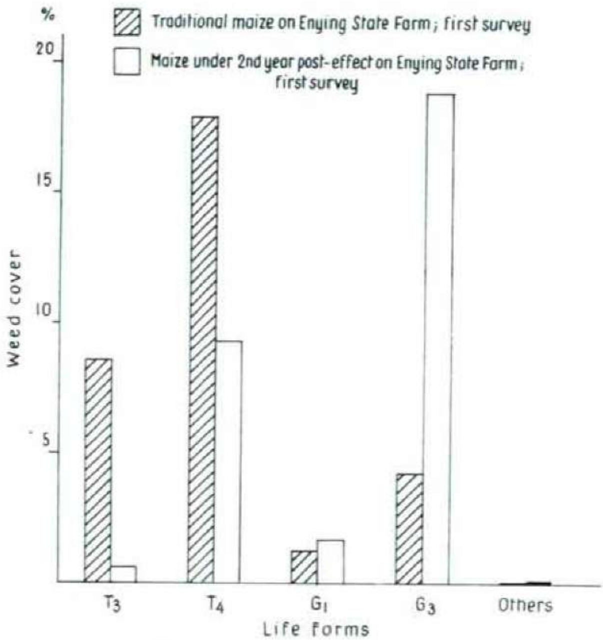

Fig. 3. Distribution according to life forms of early-summer weed vegetation in maize crops under second year Atrazin post-effect on the Enying State Farm.

In the present case, therefore, the data of the surveys do not support the earlier findings; thus, the weedicide effect had not materialized sufficiently at the beginning of the growing time in the maize plots treated with aminotriazine in the previous year, and accordingly hoeing had become necessary everywhere. But even so, despite the additional hoeing, there was a massive accumulation of *Echinochloa crus-galli* in places (3 farms, 5 sub-units). At the same time the maizes at Mezőhék and Enying were comparatively good, their weed covers being somewhat less than in the traditionally cultivated crops, but naturally, as already mentioned, agrotechnical procedures were also applied in these to eliminate the weeds.

Although the weedicide effect did not prove satisfactory, nevertheless the action of the chemical could be seen in the early-summer weed cover: great reductions could be observed in the sensitive dicotyledonous species, and indeed, on the application of large doses (9 kg/kh), in the monocotyledonous species too.

b) Weed cover of crops under second year post-effect

The data of the weed covers of the crops under the second year post-effect are comprised of the data from the surveys of an almost completely clear area (at Mezőhék, weed cover 0—13%) and a fairly weedy area (at Enying, weed cover 30—52%). Naturally, this is not reflected in the averages. This calculation was carried out only for the sake of uniformity. More information is given in Table 4 and Figs. 3 and 4 with regard to the more important weeds in these crops at Enying.

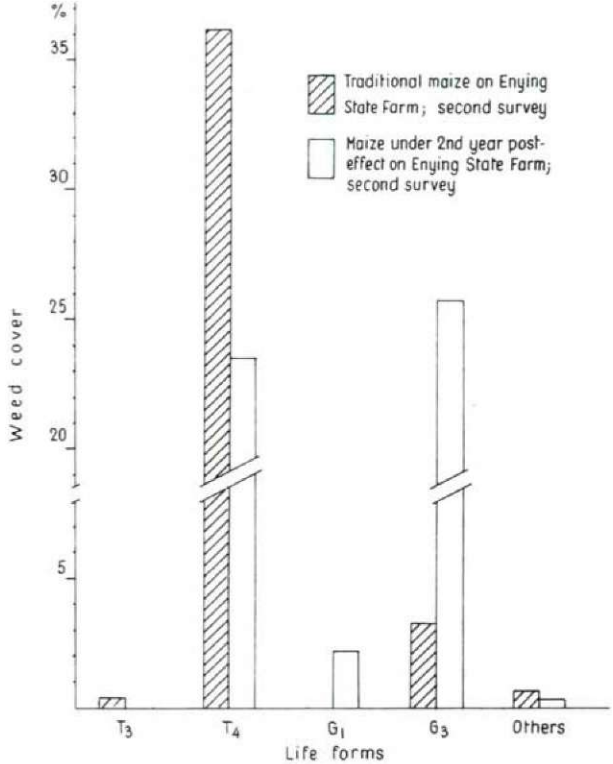

Fig. 4. Distribution according to life forms of late-summer weed vegetation in maize crops under second year Atrazin post-effect on the Enying State Farm.

It is clear from the data of Table 3 that the total weed covers of these areas did not attain the levels in the hoed crops. In fact, however, the clearing of the soil was observed only at Mezőhék, where the crops received exactly the same number of hoeings as the traditionally cultivated crops. At Enying, on the other hand, because of the lack of the post-effect the applied treatment (two mechanical and one manual hoeing) proved insufficient, and there was an appreciable weed cover in the crops. Here the perennials which had multiplied in the previous year (*Rubus* and *Convolvulus*) as a result of the chemical treatment, together with the newly appearing annuals (T_4), comprised a larger weed mass (52%) than in the untreated areas.

2. Demonstration of the aminotriazine content of the soils by a biological method

One of the reasons for the determination of the weedicide content of soils treated with Simazin or Atrazin (Hungazin PK) was to obtain an answer to the question of whether there is a difference between the autumn and spring sprayings as regards the utilization of the chemical, and its washing-down into the deeper layers of the soil. Other questions were whether the amount of weedicide applied was sufficient in the case of crops over-treated with Hungazin for several years; and whether the soils of the areas under post-effect still contain any of the chemical at all, considering the extensive weeding-up of the maize crops.

Table 1. Weedicides applied in areas under first year post-effect (sprayed in 1962)

Studi sites	Dose applied per kh in 1962	
Fehérgyarmat	5 kg 2.5 kg	Simazin-1961 Hungazin PK
Mezőnagymihály	6 kg 9 kg	Hungazin PK Hungazin PK
Mezőhék	4.6—5 kg	Hungazin PK
Enying	5 kg 1.1 kg	Hungazin PK + Dikonirt
Kaposvár	5 kg	Simazin

On the occasion of survey 2 (autumn) to decide the above questions, soil samples were taken from the chemically treated maize crops, and under the post-effect, and the weedicide contents of these samples were determined with the *Sinapis alba* test, as described under "Methods".

a) Comparison of weedicide contents of soils sprayed in autumn and in spring

The examination data show that in the case of the automn spraying the weedicide is not washed down into the deeper layers of the soil, not even as a result of the significant winter precipitation: the percentage loss of the *Sinapis alba* at the end of the growing time in the soil of maize sprayed in the autumn was roughly the same (and even a little higher) than the corresponding value for the spring spraying (84% and 75—76%, respectively).

As regards the decomposition or utilization of the chemical, or its washing-out from the cultivation layer there is no difference between the autumn or spring sprayings with Hungazin; in principle, therefore, approximately the same weedicide effect can be reckoned with in the two cases.

Table 2. More important weed species and their % covers in maize crops under Hungazin post-effect, compared with traditionally cultivated crops at the same study sites (overall data)

Treatment	Traditional		1st year Hungazin post-effect		2nd year Aminotriazine post-effect	
Survey	I	II	I	II	I	II
G_1 *Equisetum arvense*		0.73	0.12	0.35	0.56	1.00
G_3 *Rubus caesius*	0.49	2.64	2.55	4.99	5.86	8.13
G_3 *Convolvulus arvensis*	4.27	5.46	7.62	7.86	3.51	4.24
T_4 *Hibiscus trionum*	0.27	1.35	1.32	2.46	0.12	3.31
T_3 *Sinapis arvensis*	2.19	0.09	1.25	0.02	0.30	0.04
G_3 *Lepidium draba*	0.23	0.08	1.01	0.15		0.01
T_4 *Ambrosia elatior*	0.69	1.72	0.27	0.94	2.73	5.63
G_3 *Cirsium arvense*	1.44	1.57	0.98	1.78	0.01	2.19
T_4 *Chenopodium album*	1.37	3.72	0.25	1.82	0.09	0.70
T_4 *Amaranthus retroflexus*	0.77	2.49	0.15	3.54	0.01	0.94
T_4 *Digitaria sanquinalis*	0.02	0.58	0.02	1.00		
T_4 *Echinochloa crus-galli*	2.57	3.31	5.99	20.18	0.09	0.17
T_4 *Setaria glauca*	1.44	2.15	0.65	4.13	0.23	1.13
T_4 *qetaria viridis*	0.22	1.08	2.58	4.40	1.21	3.33

Table 3. Numbers and % covers of weed species belonging to the individual life forms as overall averages for the study sites according to treatments

Treatment	Traditional				1st year Hungazin post-effect				2nd year Aminotriazine post-effect			
Survey	I		II		I		II		I		II	
Species no. (1) % Cover (2)	1	2	1	2	1	2	1	2	1	2	1	2
Life forms:												
Annuals												
T_1	2	0.01	9	0.27	3	0.01	5	0.17				
T_2	7	0.02	5	0.07	3	0.03	5	0.05			1	0.01
T_3	4	2.23	5	0.50	6	1.73	7	0.18	2	0.31	2	0.04
T_4	38	10.00	45	19.86	28	12.69	33	39.79	14	4.68	14	16.86
Total T	51	12.26	64	20.70	40	14.46	50	40.19	16	4.99	17	16.91
Biennials							2	0.01				
Perennials												
H_2			1	0.08								
H_3	4	0.31	4	0.35	2	0.01	3	0.14	2	0.01	2	0.14
H_4							1	0.01				
H_5			3	1.17			1	0.01				
Total H	4	0.31	8	1.60	2	0.01	5	0.16	2	0.01	2	0.14
G_1	5	0.54	10	1.00	5	0.98	6	1.80	2	0.87	3	1.12
G_2	1	0.02	1	0.06	1	0.04	1	0.05	1	0.04	1	0.06
G_3	9	6.95	10	10.12	7	12.22	6	14.82	4	9.38	5	14.56
Total G	15	7.50	21	11.18	13	13.24	13	16.67	7	10.29	9	15.74
Overall totals	70	20.07	93	33.48	55	27.71	70	57.03	25	15.29	28	32.79

b) Weedicide contents of maize soils treated with Simazin or Atrazin (Hungazin PK) for several years

The percentage loss of the test plant (90—100%) in the soils of the areas systematically treated with aminotriazine for 2—3 years indicated that the 0—10 cm layers of these soils, and at Lábod even the 10—20 cm layer too (80% loss), contained very much weedicide.

Accordingly, the chemical content of the soil, after the application by spraying for 2—3 years of the amounts of weedicide given in the first paper, should theoretically be sufficient to free the maize crops from weeds. The fact that in spite of the high chemical content of these soils they were nevertheless weed-infested can be attributed to two factors: in the areas under consideration species resistant to aminotriazines predominated, and the amount of precipitation which fell in the spring months was not enough for the weedicide to exert its effect.

From the satisfactorily high chemical content of the soils, therefore, only the destruction of the weeds sensitive to aminotriazine can be expected, and the weedicide effect can be exerted only in the event of the sufficient moistness of the soil.

Table 4. Percentage covers of more important weeds in maize crops of Enying State Farm under traditional and second year Atrazin post-effects

Treatment	Traditional		2nd year Atrazin post-ffect	
Survey	I	II	I	II
Equisetum arvense			1.12	1.99
Rubus caesius		0.64	11.72	15.00
Convolvulus arvensis	2.83	2.23	7.03	8.12
Hibiscus trionum		0.01	0.25	2.87
Sinapis arvensis	8.54	0.39	0.61	0.06
Ambrosia elatior	4.16	10.34	5.46	11.25
Cirsium arvense	1.10	0.42	0.02	2.56
Chenopodium album	5.97	10.03	0.18	1.39
Amaranthus retroflexus	2.91	9.01		0.01
Amaranthus blitoides	1.12	2.07		
Polygonum convolvulus	0.89	1.31	0.02	0.46
Setaria glauca		0.03	0.47	2.26
Setaria viridis	1.34	2.09	2.42	4.18

c) Weedicide contents of maize soils under the post-effect

16—18% of the *Sinapis alba* died in samples taken from the 0—10 cm soil layers at the end of the growing period in the year (1963) following the spraying, in the areas under the first-year post-effect of the application of 5—6 kg Hungazin PK (in 1962). The test plant did not die in the soil samples taken from the 10—20 cm layers, but the yellowing at the edges of the cotyledons indicated that this depth of soil does contain a small amount of weedicide.

On the application of doses of 9 kg per cadastral acre (the Klementina and Bagjas sub-units of the Mezőnagymihály State Farm), a 42—45% plant loss was observed in the 0—10 cm soil level; this points to a still considerable chemical content. Indeed, in the 10—20 cm level *Sinapis* losses of 20 and 34% were observed at Klementina and Bagjas, respectively. (At Klementina the chemical was applied in 2 parts: 6 kg in the autumn of 1961 and 3 kg in the spring of 1962, while at Bagjas the total amount was sprayed in one application, in the spring of 1962.)

The data thus show that an appreciable amount of the chemical remains in the cultivation layer even in the second year after the application of the weedicide, and under appropriate conditions this chemical content can result in a certain weedicidal effect. This is shown by the weed coenological surveys at Enying, at Mezőhék, and to a certain extent on the 100 sub-unit of the Fehérgyarmat State Farm at the beginning of the growing period. It is unfortunate that it was precisely on the Mezőnagymihály State Farm, where very large doses were used, that a weak weedicidal effect was exhibited in the second year.

Aminotriazine could not be detected from any of the soil levels examined by the biological method at the end of the growing period in 1963, on the areas under the second year (1961 spraying) post-effect. It seems that by the third year following the application of chloraminotriazine the chemical has already been consumed, decomposed or washed out of the cultivation layer. This conclusion is fully supported by the results of the studies relating to the weed cover.

As mentioned in the first paper (Fekete, 1973), a study prepared in the spring of 1964 (within the framework of one paper, following a treatment according to farms) contained the material of the three parts of the Hungarian Academy of Sciences at that time under the pressent title. but unfortunately could not then be published. For this reason. certain of the problems and results discussed in three papers must be considered in the light that nearelly a decade has passed since these were written,

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