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COMPARATIVE WEED-INVESTIGATIONS IN TRADITIONALLY-CULTIVATED AND CHEMICALLY-TREATED WHEAT AND MAIZE CROPS. IV. STUDY OF THE WEED-SEED CONTENTS OF THE SOILS OF MAIZE CROPS

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Abstract

Weed-seed content investigation of the soils of maize plots of four farms, cultivated traditionally or treated with Hungazin PK for various periods and under the first- or second-year after-effect, led to the collowing findings:

a The weed-seed reserves of the 0—40 cm layers of the soils examined decreased very considerably during 10 years of traditional cultivation. A decisive role is played in the improvement of the soils by the more modern large-scale agrotechnology.

b The effect of the aminotriazines leading to a decrease in the weed-seed content depends appreciably on the type of the soil.

On Mezőség soils, compared to the traditionally-cultivated areas the weed-seeed reserves did not decrease, or did so to only a small extent ,as a result of chemical treatment for 1—3 years. This is understable, because of the slow and protracted germination of the majority of the weed seeds. In addition, the partial recontamination with weed seeds occurs on these soils, since the herbicide does not ensure complete elimination of the weeds.

The effect of the use of aminotriazines on reducing the weed-seed reserves is manifested better and more quickly on the lighter soils. In accoradance with this, a decrease of about 30—35 p. c. in the weed-seed contamination can be observed on sandy adobe and sandy soils following chemical exspraying for several years.

c As regards the overall evaluation of the data relating to soils of crops under Hungazin after-effect, it can be said that chemical treatment on one occasion has no, or only a very slight positive effect on the development of the weed-seed content in the following year. On areas under such an after-effect, therefore, the decrease of the weed-seed contamination is not to be expected; indeed, an increase can be reckoned with, particularly if *Echinochola crus-galli* and the panic grasses are predominant.

As regards protection against weeds, it is extremely important to know not only the weed cover, but also the weed-seed content of soils. The most significant surveys of the weed-seed reserves of agriculturally-cultivated soils in Hungary have been carried out by BENCZE (1954, 1958). His investigations revealed that as a consequence of the incorrect agrotechnology soils in Hungary were saturated with weed seeds: in the upper 0—20 cm soil layers he found 33,000—241,000 weed seeds per square metre, this concentration being much in excess of equivalent data published abroad (KORSMO, 1930; WEHSARG, 1954).

With one exception (the study by MÁTHÉ—PRÉCSÉNYI (1968) in 1967), Hungarian weed researches have been characterized by the fact that the weed covers of the crops and the weed-seed reserves of the soils have been examined completely independently of one another, whereas in the interest of the correct organization of protection against weeds it would be desirable to examine the two together.

During weed coenological surveys in 1961, the present author also carried out simultaneous examinations of the weed-seed contents, but the results were not published at that time. This research was continued in 1963, and for several years extended not only to the traditional cultivation, but also to the changes in the weed-seed reserves of maize soils as a result of large-scale agrotechnology. In addition, studies were also made of the effects of the very intensively active Hungazin on the weed-seed reserves of the soils, for in this respect concrete research results were not available in either the Hungarian or the foreign literature up to the beginning of the experiments (1963).

The present paper contains the results of the examinations in 1963; these were prepared as part of a doctoral dissertation in 1967, but have not yet been published. Similarly to earlier papers dealing with weed coenology, this work was done at Vácrátót.

Investigation sites and methods

Since examinations of weed-seed contents demand very much work and time, the surveys were not carried out on every farm where coenological recordings were made, but only on those which seemed suitable as constant investigation sites for a prolonged period, or where in part comparison too was possible (e.g. Mezőhék). The examinations of the weed-seed reserves extended to the soils of maize crops on the State Farms at Mezőnagymihály, Mezőhék, Enying and Lábod; these crops had been cultivated traditionally, had been treated for 1—3 years with Hungazin PK (Atrazin), and were in the first or second year of the after-effect. From every area examined on each of these farms, 10 samples were taken at each depth, from depths ranging from 0 to 40 cm, at 10 cm interavals, i.e. a total of 40 samples each from every treatment, and all of these samples were analyzed. Examinations to such depths appeared necessary bacause, with the increase of the mechanization, deeper soil cultivation is applied increasingly more often. The borer used to take samples had a base area of 19.625 cm^2. The soil samples were taken everwhere on the second weed survey of the maize crops (in the second half of August and the first week of September).

In the examinations of the weed-seed reserves of the soils the $ZnCl_2$ solution separation method used by BENCZE (1954, 1958) was employed.

The degree of weed-seed contamination is given per square metre. Average values for each species were calculated from the results, for the various soils (Mezőnagymihály, Mezőhék, Enying), treatments and depths, and are tabulated for 25 weed species: in general those from which more than 100 seeds per square metre were found from 0 to 40 cm. The results for the Lábod State Farm are given separately (Table 4), because of the adobe or partially sandy soil. The numbers of seeds per square metre for the late-summer annuals (T_4) are given at the foot of the Tables for every treatment and depth, since these occur in the greatest amount from all the life-form groups; also given are the numbers of seeds of the total annuals, and the perennials (H+G), and the numbers of species of weed seeds found (Tables 1—4). (For every treatment the total number of weed seeds is also discussed in the text; in the majority of cases this is the sum of the total T and H+G.)

The weed seeds were determined on the basis of the handbook of UJVÁROSI (1957), the weed-seed collections of the present author and of Ujvárosi, and the handbook of BRONWER—STÖHLIN (1955). Those weed seeds which could not be identified on this basis were identified by means of the seed collection of the Országos Vetőmag Felügyelőség (National Seed Inspectorate), to whom the author expresses her grateful thanks.

The agrotechnological data relating to the investigation sites, and the details of the chemical treatments applied, are reported in the papers containing the weed-coenological examination results obtained from the same sites (FEKETE, 1964; published 1974a, b).

Results and discussion

A. Examinations of weed-seed reserves on Mezőség soils

1. Weed-seed reserves of traditionally-cultivated maize soils

The most frequent weed seeds in traditionally-cultivated maize crops on Mezőség soils are given in the first part of Table 1, referred to 1 m². The examinations indicated that the number of weed seeds in the 0—40 cm traditional maize soils of the three State Farms (Mezőnagymihály, Mezőhék, Enying) varied between 5,503 and 14,908, and the average weed-seed contamination was 10,932 per m². A study of the distribution of the weed seeds according to depth showed that in all sites the 10—20 cm level of the soils contained the most weed seeds (2,089—5,841, and on average 4,240 per m²). As can be seen from Table 1, the 0—10 and 20—30 cm layers exhibit roughly the same degree of contamination (2,955 and 2,870, respectively) on average for the three investigation sites, while the fewest weed seeds are to be found in the 30—40 cm layer (866 per m²). Naturally there were various differences between the individual farms: the highest weed-seed contamination occurred in the Mezőnagymihály soils (14,908), and the lowest in those at Mezőhék (5,503). From the data at the foot of the Table it can be seen that the seeds of the late-summer annuals (T) are found in the greatest amount in the soils (mainly *Stachys annua, Chenopodium album, Amaranthus retroflexus* and *Echinochloa crus-galli)*, and in comparison with these the other life-form groups are insignificant. This is understandable, since the data of the coenological surveys too indicate that the T life-form, and to a smaller extent the perennial root-like couch-grasses (G_3), predominate in cultivated land in Hungary (FEKETE, 1963, 1964, published 1974; UJVÁROSI, 1966). The tremendous seed yield of the former is well-known, while it is also known of the latter that primarily vegetative multiplication is decisive in their group, although the seed is also ripened on areas treated with aminotriazine (second half of Tables 1 and 2).

If the results obtained are compared with the weed-seed examination data of BENCZE (1954), obtained in part from the same sites and in part from different sites, but similarly in Mezőség soils, it is observed that compared to the earlier weed-seed concentrations of 33,596—54,094 per m² found in 1952 (the year immeidiately following the reorganization) in the 0—20 cm levels at Iregszemcse, Pusztapó and Bánkút, there was a significant improvement of the soils in the following 10 years. Thus, if the same levels (0—20 cm) are considered, it can be stated that at present the weed-seed reserves of the soils are only a quarter, or less, compared to the earlier values. This positive change is particularly striking in the case of Mezőhék—Kétpó (earlier known as Pusztapó), where the previous contamination 33,596 per m² for 0—20 cm (BENCZE, 1954) has decreased by a factor of more than ten (3,006 for the same level). At this latter site a large role in the improvement of the soils has been payed by the correct agrotechnology applied on the farm (UNGÁR, 1959), which is otherwise well reflected by the data of weed-coenological surveys here (FEKETE, 1964, published 1974a, b).

2. Weed-seed reserves of first-year Hungazin-treated maize soils

On average for the three farms, the first-year Hungazin-treated maize soils containe about 70 per cent more weed seeds (18,548 per m^2) than those cultivated traditionally (second half of Table 1) (10,932 per m^2). In corresponding soils at Mezőnagymihály about three times as many seeds (32,533 per m^2) were found as in the traditionally-cultivated soils; at Enying and Mezőhék increases of about 40 per cent and 10 per cent, respectively, were observed compared to the control. Naturally, this did noe occur as a result of the chemical treatment, since up to the time of sampling (the second survey of the maize crops, in the second half of August and the beginning of September in 1963) the weed-seed yield for that year had not yet entered the soil, or only in part, either in the traditionally-cultivated, or in the chemically-treated areas. The large differences in the weed-seed contents in the individual investigation rates can be explained by the different plant-pyrdicotions and soil-operations, and by the unsatisfactory care of the plants. (Thus, because of the presence of the hybrid-section in this farm-unit of the Mezőnagymihály State Farm, maize is almost always grown on these plots, so far in the traditional way, or at least with a herbicide not possessing such a lasting action as that of Hungazin PK. The hoeing monocultures favour the multiplication of just the late-summer species (T_4). On the first-year sprayed maize area at Enying lucerne had been grown for the previous three years, and this is why it was more contaminated.)

From an examination of the distribution of the weed-seeds according to depth it can be stated that the excess compared to the traditional soils is contained primarily in the uppermost two layers, and here too, compared to the control, the 10—20 cm layer is the most contaminated (second half of Table 1).

Analysis according to life-form indicates that the predominant seeds in the first-year Hungazin-treated maize soils too are those of the late-summer species (T_4), mainly *Amaranthus retroflexus, Chenopodium album* and *Stachys annua.*

3. Weed-seed reserves of maize soils treated with Hungazin for several years

Mezőség soil areas systematically treated with Hungazin or Atrazin for several years were examined only at Enying. As already reported in the coenological studies (FEKETE, 1964, published 1974a, b), in this farm all of the chemically-treated maizes were hoed, the number of hoeings on these plots being exactly the same as on those cultivated traditionally. Accordingly, apart from the herbicide effect, the ecological conditions of germination of the weed seeds were the same for all of the maize crops on the farm during the growing period. Although the aminotriazine agents do not act directly on the germination of the seeds, they can affect it indirectly as superselective herbicides.

If the results of weed-seed investigations on the plots of this farm which had been treated chemically are considered, it is surprising that their soils contain almost the same weed-seeds as those of traditionally-cultivated crops, and therefore these results are not given separetely. In crops treated chemically for 3 years a decrease of only 15 p. c. was observed (Table 2). Comparison of the contaminations of the

Table 1. More frequent weed seeds in maize crops on Mezőség soils (number per m²) (overall data)

Treatment	Traditionally cultivatet					Hungazin (first-year treatment)				
Depth (cm)	0–10	10–20	20–30	30–40	0–40	0–10	10–20	20–30	30–40	0–40
Trifolium arvense	33.9	50.9	67.9	17.0	169.7	76.9	91.1	82.3	47.0	297.6
Hibiscus trionum	67.9	254.7	288.7	33.9	645.2	81.0	101.9	67.9	33.9	284.7
Convolvulus arvensis	33.9		50.9	33.9	118.7		26.1	60.1	17.0	103.2
Heliotropium europaeum	33.9				33.9	101.9	13.1		17.0	132.0
Ajuga chamaepitys	135.8	101.8	67.9		305.5	118.9	73.6	101.9	50.9	345.3
Stachys annua	305.7	526.5	305.7	254.8	1392.5	286.1	762.8	469.0	365.7	1883.6
Veronica triphyllos						78.4	209.0	145.7		433.1
V. hederifolia	17.0	17.0			34.0	163.3	256.9	90.1		510.3
Plantago major		17.0	17.0		34.0	84.9	113.2	135.8	50.9	384.8
Sinapis arvensis	50.9	50.9	17.0	33.9	152.7	50.9	50.9	43.1	111.0	255.9
Diplotaxis muralis	17.0	67.9	33.9		118.8	17.0	37.7	67.9	17.0	139.6
Capsella bursa-pastoris	17.0	17.0			34.0	33.9	80.8	47.0		161.7
Ambrosia elatior	67.9	50.9	17.0	17.0	152.8	101.9	150.9	101.9		354.7
Arenaria serpyllifolia	169.8	305.7	220.8	67.9	764.2	50.9	226.5	50.9	33.9	211.2
Chenopodium album	475.6	645.4	237.7	84.9	1443.6	330.5	700.6	471.6	98.0	1600.7
Amaratnhus retroflexus	288.7	475.8	169.8	34.0	968.3	2799.9	3509.3	670.2	52.2	7031.6
A. albus	17.0	34.0	51.0		102.0	143.7	199.9	65.3	13.1	422.0
Anagallis arvensis	17.0	186.8	118.9	1 7.0	339.7	101.9	188.7	301.8	101.9	694.3
Polygonum lapathifolium	17.0	33.9	33.9	33.9	118.7		50.9	30.0		80.9
P. aviculare	50.9	33.9	17.0	34.0	135.8	43.1	31.9			75.0
Bilderdykia convolvulus	101.9	50.9	67.9	34.0	254.7	98.0	126.3	118.9		343.2
Digitaria sanquinalis	220.8	84.9	50.9		356.6					
Echinochloa crus-galli	237.8	407.8	458.6	84.9	1189.1	582.7	323.8	26.1	95.4	1028.0
Setaria glauca	169.8	220.8	236.6		627.2	52.3	121.5	90.1	13.0	277.0
S. viridis	152,8	305.7	220.8	17.0	696.3	167.2	198.4	120.2	47.0	532.8
Total late-summer species (T_4)	2476.8	3662.6	2513.0	730.5	9382.9	5155.7	6851.1	2543.9	965.6	15516.3
Total annuals (T)	2870.7	4155.3	2801.7	832.4	10 660.1	5567.3	7653.8	3318.8	1101.5	17 641.4
Total perennials (H, G)	84.9	84.9	84.9	33.9	288.6	219.7	328.0	290.0	81.0	931.9
Number of weed species	36	34	28	18	44	31	38	34	20	47

Table 2. More frequent weed seeds)per m²) in maize soils on the Enying State Farm

Treatment	Traditionally cultivated					Treated with Atrazin for 3 years				
Depth (cm)	0—10	10—20	20—30	30—40	0—40	0—10	10—20	20—30	30—40	0—40
Trifolium arvense	101.9		101.9	51.0	254.8					
Hibiscus trionum	51.0	51.0		51.0	153.0	101.9		51.0		152.9
Euphorbia falcata	51.0	101.9	51.0	51.0	254.8	101.9		51.0		152.9
Convolvulus arvensis						101.9	101.9			203.8
Heliotropium europaeum	51.0	51.0			102.0	152.9	203.8		51.0	407.7
Verbena officinalis	51.0	51.0			102.0				51.0	51.0
Ajuga chamaepitys	253.7	203.9	152.9		611.5	305.7	254.8	101.9	101.9	764.3
Stachys annua	713.4	713.4	611.5	509.6	2547.8	305.7	407.6	152.9		866.2
Veronica hederifolia	51.0	51.0			102.0			101.9		101.9
Plantago major		51.0			51.0				152.9	152.9
Diplotayis muralis		203.8			203.8		51.0	101.9		152.9
Camelina microcarpa	101.9		51.0		152.9		51.0			51.0
Ambrosia elatior	203.8	152.9	51.0	51.0	458.7	356.6	407.6	305.7		1070.1
Arenaria serpyllifolia	509.6	917.2	662.4	203.8	2293.0		101.9	152.9		254.8
Chenopodium album	815.3	764.3	305.7	101.9	1987.1	866.2	764.3	509.6	152.9	2293.0
Amaranthus retroflexus	152.9	203.9	51.0	51.0	458.8	152.9	354.8	254.8		663.4
Anagallis arvensis		509.6	305.7		815.3	51.0	305.7	356.6	101.9	815.2
Polygonum lapathifolium	51.0	51.0	51.0		153.0	101.9		101.9	51.0	254.8
Bilderdykia convolvulus	203.8	101.9	51.0	51.0	407.7		101.9			101.9
Sorgum halepense						51.0		51.0		102.0
Agropyron repens	101.9	152.9	51.0		305.8	51.0				51.0
Eragrostis poaeoides	51.0	51.0			102.0					
Echinochloa crus-galli						101.9	203.8	152.9		458.6
Setaria glauca							101.9	51.0		152.9
S. viridis		51.0		51.0	102.0	203.8	152.9	101.9		713.4
Total late-summer species (T4)	2802.7	3363.5	1834.7	1019.5	9020.4	2904.4	3260.0	2294.0	560.6	9019.0
Total annuals (T)	3618.2	4484.6	2548.1	1223.3	11874.2	2955.4	3412.9	2650.7	560.6	9579.6
Total perennials (H, G)	152.9	254.9	51.0		458.8	305.9	254.8	51.0	203.9	611.5
Number of weed species	19	23	15	10	30	19	20	17	7	34

individual soil levels did not reveal an essential difference either; thus, the positive effect of chemical treatment for 2 or 3 years develops more slowly on the Mezőség soil than on lighter soils, for instance, as will be seen later. The resistance of the weed-seeds was proved by the fact that the soil could be shown to contain the seeds of weed species which had certainly not occurred since chemical treatment (as demonstrated by the coenological surveys) in crops on areas treated with the same dose of aminotriazine. A decisive role in the slow purification of the soils from the weed seeds is played by the resting state of the seeds, which can be induced by several factors (PETERSEN, 1951; WEHSARG, 1954; CORCKER—BARTON, 1957; THURSTON, 1960; NÍKOLAYEVA, 1967). In some of the weed seeds (e.g. *Convolvulus arvensis, Hibiscus trionum)* the resting state is brought about by the "hard covering" of the seeds (SRIPLENG—SMIITH, 1960; CZIMBER—REISINGER, 1968). Since such hard-skinned seeds are in dormancy they resist chemical herbicides and again give rise to weed cover on germinating after cessation of the herbicide effect, as shown by the data of late-summer (II) weed surveys on maize crops under the after-effect of aminotriazine (FEKETE, 1964; published 1974a, b). In addition to what has already been said, another cause of the slow purification of the soils may be that partial recontamination with weed seeds occurs on areas treated with chloraminotriazine, for this herbicide does not ensure total elimination of weeds.

4. Weed-seed contents of maize soils under after-effect of Hungazin PK

It was mentioned above that the tratment of the maize plots under the after-effect at Enying and Mezőhék was exactly the same as that on those cultivated traditionally there, apart from the herbicide. At Mezőnagymihály the crops were hoed mechanically twice and by hand once, in contrast with the maize cultivated traditionally, where second serial hoeing too was carried out.

From the overall data from the investigations on areas under first-year Hungazin after-effect, the 0—40 cm cultivated layer contains 12,548 weed seeds per m^2; the average is thus about 10—12 p. c. worse than for the traditionally-cultivated areas. If the average results are broken down for the individual farms, it can be established that the weed-seed content in the soils of the Enying plots has decreased a little compared to the control. At Mezőnagymihály and Mezőhék, on the other hand, an increase can be observed. The overwhelming proportion of the weed-seed increase is contained in the 10—20 cm layer (first part of Table 3).

As reported in the paper dealing with the results of the weed coenological investigations (FEKETE, 1964, published 1974a, b), a huge weed-mass, mainly *Echinochloa* and Setaria, lived in places on the areas under the first-year Hungazin after-effect (including Mezőnagymihály too). Up to the time of the sampling, however, these had only partially shed their seeds. The conciderable seed-rotation occurred in the period after the survey and the sampling, and could be demonstrated only in samples of soil taken in the following year (1964). But even then not entirely, for an appreciable part of the weed seeds entering the soil (mainly *Echinichloa cruss-galli* and panic grasses) germinated during the growing time, as proved by the coenological surveys in 1964. Weed seed germination experiments from 1961 also confirm that *Echinochloa crus-galli* and the panic grasses *(Setaria viridis, S. glauca)* had already shed their seeds at the end of summer; these entered the soil and germinated in a fairly high proportion in the following year.

Weed-seed contents of plots under second-year Hungazin after-effect were studied only at Mezőhék, and these results are given in the second half of Table 3. These data are almost the same as those of the control there.

B. Weed-seed content investigations on sandy adobe — sandy soil

The Lábod State Farm is situated on sandy adobe, and partly on sandy soil. Here examinations were made on the weed-seed reserves of soils of maize crops cultivated traditionally or treated with aminotriazine for three years. These examinations revealed the very extensive contamination of the soil on this farm (Table 4). The Table contains weed-seed data on only 25 species, but of the seeds of the 51 weed species found in these two types of soil sample only three did not attain a concentration of 100 per m^2.

From the soil of maize cultivated traditionally 176,878 weed seeds were found per m^2 from the 0—40 cm layers, the bulk of which were late-summer annuals (T_4) (142,895 per m^2). BENCZE (1958) demonstrated such a huge weed-seed contamination only on the sandy soils at Nyíregyháza, where he counted 110,250—241,375 weed seeds per m^2 in the 0—20 cm layers in the various hoeing cultures. (In the same layers at Lábod there were 117,715 seeds per m^2.)

This extremely extensive contamination of the traditional maize soils at Lábod is attributed to a certain degree to the fact that on the occasion of the national weed coenological survey in 1949—50 this was the most densely weed-populated area of the country, and such a state cannot be changed from one day to another. In addition, another fact which undoubtedly contributed to such a mass presence of late-summer seeds, however, was that only maize has been grown on this area since 1961, and it is well known that the main multiplication sites of the late-summer varieties are monoculture maize crops.

Examination of the distribution of the weed seeds according to depth reveals that they progressively decrease in number on passing downwards from the surface, but there is no appreciable difference between the contaminations of the individual soil layers from 0 to 30 cm. In the 30—40 cm layer, however, the number of weed seeds exhibits a sudden considerable decrease (first part of Table 4).

The number of weed seeds in soil of maize which had been treated chemically systematically for three years was about 30—35% lower than in the tradition-cultivated areas serving as control, but even then the number was very high: 112,153 per m^2. 75—80% of these weed seeds similarly belonged to the late-summer annual life-form (T^2).

If the weed-seed reserves of the individual soil levels are compared with those for traditionally-cultivated maize, it is observed that purification from the weed seeds as a result of the 3 years' chemical treatment occured over the total depth of soil examined. Although the number of weed seeds, including the late-summer species too, decreased, attention must be drawn to an unfavourable phenomenon. In these areas not only the coverage of *Echinochloa crus-galli* increasedt but also the number of its seeds in the soil. At the same time it is encouraging that during this time the seeds of *Amaranthus retroflexus* and *Chenopodium album* practically disappeared from the soil, as is otherwise confirmed by the data of germination experiments with the seeds of these latter two species in sandy soil.

Table 3. More frequent weed seeds (per m²) in Mezőség maize soils under Hungazin after-effect (overall data)

Treatment	Areas under first-year Hungazin after-effect					*Areas under second-yer aminotrizaine after-effect				
Depth (cm)	0–10	10–20	20–30	30–40	0–40	0–10	10–20	20–30	30–40	0–40
Trifolium arvense	38.2	101.9	63.7	12.7	216.5					
Malva neglecta	25.4	76.4	76.4		178.2					
Hibiscus trionum	38.2	38.2	76.4	25.4	178.2		254.8	101.9	51.0	407.7
Convolvulus arvensis	76.4	114.6	50.9	25.5	267.4				51.0	51.0
Heliotropium europaeum	25.4	51.4	12.7	50.9	178.7					
Ajuga chamaepitys	76.4	89.1	76.4	25.4	267.3		101.9		51.0	152.9
Stachys annua	356.2	853.5	496.8	178.4	1184.9	203.8	815.3	254.8	305.7	1579.6
Veronica hederifolia	12.7				12.7	51.0			51.0	102.0
Fumaria schleicheri	12.7	63.7	12.7		89.1	51.0	51.0			102.0
Sinapis arvensis		25.4	12.7		38.3	305.7	152.9	254.8	458.6	1172.0
Diplotaxis muralis		12.7	63.7	38.2	114.6			51.0		51.0
Thlaspi arvense			25.4		25.4	51.0		101.9	152.9	305.8
Capsella bursa-pastoris	24.5	63.7	25.4		114.5					
Ambrosia elatior	76.4	89.1	76.4	5.90	292.8					
Arenaria serpyllifolia	25.4	50.9	38.2		113.6					
Polycnemum arvense		127.4	38.2	25.4	191.0					
Chenopodium album	394.9	700.6	726.1	229.3	2050.9	356.7	51.0		407.6	815.3
Amaranthus retroflexus	76.4	165.7	114.6	50.9	407.6		51.0		51.0	102.0
A. albus		50.9	50.9		101.8					
Polygonum aviculare	50.9	89.1	76.4	12.7	229.1					
Bilderdykia convolvulus	24.5	152.8	216.5	25.5	419.3					
Digitaria sanquinalis	127.4	127.4	12.7		267.5			152.9		152.9
Echinochloa crus-galli	331.2	280.2	191.2	38.2	840.8	101.9	51.0	51.0	101.9	305.8
Setaria glauca	114.6	216.5	318.4	101.9	751.4	51.0	51.0			102.0
S. viridis	560.6	1184.7	560.5	420.4	2726.1	152.9	51.0	51.0	203.8	458.7
Total late-summer species (T4)	2344.0	4547.9	3324.9	1324.9	11541.7	917.3	1477.9	662.6	1223.0	4280.8
Total annuals (T)	2446.0	4879.2	3477.8	1363.1	12166.1	1376.0	1681.8	1019.3	1885.5	5962.6
Total perennials (H, G)	101.8	152.8	89.1	35.2	381.9				51.0	51.0
Number of weed species	26	38	33	22	49	10	10	8	11	17

* Refers only to Mezőhék.

Table 4. More frequent weed seeds in the maize soils on the Lábod State Farm (number per m²)

Treatment	Traditionally cultivated					Treated with Atrazin for 3 years				
Depth (cm)	0–10	10–20	20–30	30–40	0–40	0–10	10–20	20–30	30–40	0–40
Ranunculus sardous	254.8	622.8	283.1		1160.7	305.7	866.2	256.7	51.0	1579.6
Aphanes arvensis	636.9	452.9	736.0	169.9	1995.7	1019.1	407.6	305.7		1732.4
Myosotys arvensis	2866.2	2321.3	4246.3	169.9	9603.7	866.2	305.7	407.6		1579.5
Plantago major	700.6	396.3	169.9		1266.8	611.5			51.0	662.5
Arabidopsis thaliana	1592.3	1472.0	2264.6	56.0	5385.5	866.2	152.9	560.5	51.0	1630.6
Viola arvensis	955.4	452.9	1981.6	113.2	3503.1		51.0			51.0
Ambrosia elatior	828.0	1245.6	962.5		3036.1	203.8	458.6	611.5	51.0	1324.9
Anthemis arvensis			396.3		396.3					
Gypsophila muralis	3694.2	2094.8	2547.8	339.7	8676.5	1426.7	1273.9	1528.7	356.7	4586.0
Stellaria media	382.2	396.3	113.2	56.6	948.3		51.0	203.8	51.0	305.8
Cerastium fontanum	254.8		1358.8		1613.6	407.6	51.0			458.6
Scleranthus annuus	1528.6	1188.9	1188.9	169.9	4076.4	1885.3	1228.7	713.4	51.0	4178.4
Spergularia rubra	63.7	56.6	226.5		346.8	305.7		152.9		458.6
Herniaria hirsuta	573.2	906.9	566.1		2045.2	254.8		764.3	152.9	1172.0
Chenopodium album	509.6	226.5	226.5	56.6	1019.2	101.9				101.9
Amaranthus retroflexus	254.8				254.8	101.9				101.9
Anagallis arvensis	636.9	339.7	905.9		1882.5	254.88	101.9	356.7	51.0	764.4
Centenculus minimus	1273.9	849.3	679.4		2802.6	866.2	1375.8	968.2	51.0	3261.2
Polygonum lapathifolium	509.6	452.9	396.3	56.6	1415.4	254.8	305.7	152.9	51.0	764.6
P. persicaria	191.1	452.9	226.5	113.2	983.7	152.9	611.5			764.4
P. aviculare	318.5	56.6	56.6		431.7	866.2	254.8			1121.0
Juncus bufonius	42544.6	39176.5	31705.1	3679.9	117106.1	27057.1	24152.8	17936.2	3566.9	72713.0
Digitaria sanquinalis	191.1	56.6	169.9		416.7	1579.6		152.9		1732.5
Echinochloa crus-galli	509.6	1132.3	1075.7	339.7	3057.3	2343.9	2140.1	4381.1	254.8	9120.9
Setaria glauca	445.9	339.7	452.9		1238.5					
Total late-summer species (T4)	51861.9	47159.4	39688.1	4587.7	142895.1	35159.0	29605.0	26853.5	4535.3	96152.8
Total annuals (T)	61461.8	54632.6	53502.5	5321.8	174918.7	41783.0	33834.5	30471.4	4892.2	110879.2
Species wintering at the soil level (H)	828.0	736.0	283.1		1847.1	815.3	51.0	51.0	102.0	1019.3
Species witering in the soil (G)		56.6	56.6		113.2	51.0	51.0	203.9	51.0	356.9
Number of weed species	28	29	33	12	41	30	23	25	17	42

The surprising resistance of the weed seeds is indicated by the fact that the seeds of many more weed species (altogether 51 from the two types of cultivated area) could be detected in the soil at Lábod than suggested by the data of the coenological surveys here. The seeds were found of species which were not observed at all in the course of the weed coenological surveys in 1963—1965. A few of these species (*Centaurea pannonica, Cerastium* fajolo, etc.) were contained in the 1949—50 weed list. At the same time a few weed species and their seeds were now detected sporadically which can be regarded as new data for the area (*Alopecurus myosuroides, Holcus, Galeopsis, Matricaria inodora* etc.).

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