Acta Biologica Szeged. *19* (1—4), pp. 3—11 (1973)

COMPARATIVE WEED INVESTIGATIONS IN WHEAT AND MAIZE CROPS CULTIVATED TRADITIONALLY AND TREATED WITH WEEDICIDES I. CHANGES IN THE WEED VEGETATION OF WHEAT CROPS

RÓZSA FEKETE

Department of Botany, Attila József University, Szeged

(Received January 17, 1972)

Introduction

Coenological recordings in 1961 proved that as a result of the up-to-date large-scale agricultural techniques applied in the socialistic reorganization of agriculture very considerable changes took place in the weed vegetation as compared to the recordings in 1947–1953. Their cover decreased considerably in every case, and particularly for weeds perennating in the soil (G), while at the same time the number of species increased in the majority of cases (FEKETE, 1963); that is to say, the weed conditions at present differ completely from those at the time of the national weed recordings.

After this favourable change was established in the weed vegetation of wheat and maize crops under traditional agricultural conditions, it was later considered necessary to extend the investigations to the areas treated with chemical weed-killers as the development of weeds under these agrotechnical conditions was considerably influenced by the increasingly general application of the various herbicides (2,4–D, aminotriazines). It was therefore considered justified to establish the roles of the developed large-scale agrotechnology and the various systematically applied chemical weed-killers in the change in weed vegetation, as compared to the conditions in 1949–1950.

In this way, from 1963 a study was made on fixed investigation sites with regard to the qualitative and quantitative conditions of the weed vegetation of (i) wheat crops; untreated cultures and those treated with Dikonirt or under the after-effect of Simazin and (ii) maize crops; cultured traditionally, sprayed first with Hungazin PK, treated with HPK for several years and for two-three years under the after-effect of being sprayed with HPK.

To establish the changes in the weeds during the last decade, the results of the investigations were compared with the data of ÚJVÁROSI (1950, 1961), for the same places.

I made my paper in the spring of 1964 from the coenological results of the first investigations (1963) and from those concerning the weedicides of the soil, but it could not be published. In 1967, I elaborated the manuscript again, to meet the requirements of a doctoral dissertation, completing it with the results of my investigations on the weed-seed content of the soils. The present paper is containing the part of the old manuscript, resp. of the doctoral disser-

tation elaborated out of that, concerning the weed vegetation of wheat crops. The work was carried out in the Botanical Research Institute of the Hungarian Academy of Sciences at Vácrátót.

Places and methods of investigations

Except for a farm at Enying, the investigation sites were chosen so as to belong to the areas examined in detail on the occasion of the national weed recording. The investigations were carried out on state Farms at Fehérgyarmat, Mezőnagymihály, Mezőhék, Enying, Lábod and Kaposvár. In some of these farms several units were recorded. From among the national weed recording data those of Mezőkövesd were used for a comparison with the weed conditions at Mezőnagymihály, those of Mezőtúr with those of Mezőhék, and those of Kadarkút with Lábod. The areas recorded in 1949—1950 belong at present to the farms mentioned above. In the case of the State Farms and Fehérgyarmat and Kaposvár there has been no change in name.

The wheat received the necessary agrotechnical treatment on every farm and in a suitable quality during the preparation for the sowing and later too. The wheat treated with Dikonirt was sprayed by the farms May 5 to 10, with doses of 1.2—1.3 kg per cadastral yoke. The wheat areas examined for the "after-effect" were sprayed with 7 kg Simazin per cad. yoke at Mezőnagymihály in the spring of 1961. In one of the areas investigated at Enying 5 kg Simazin per cad. yoke was applied in the autumn of 1960, and in another area in the spring of 1961. The herbicides were administered by aeroplane in all cases, except for the single area of autumn spraying at Enying, where a land machine was used. The recording was carried out with the coenological method of BALÁZS (1944). In every investigation site separate recording series were made for the traditional wheat, that with Dikonirt, and that with the Simazin after-effect. Ten recordings were performed for each treatment on every site, and twenty in the case of areas larger than 300 cad. yokes. The recording sites were distributed proportionately to the number of wheat-fields, with in general two recordings per field. (As the farm units were specialized and put in blocks, the fields investigated were everywhere localized beside or close to one another.) Both the earlier recording and those in 1963 were carried out in June. The recording series in every investigation site were evaluated separately, according to the treatment. The results cannot be reported here owing to the limited size of this publication, however desirable it would be from the point of view of the protection against weeds to give information about the mass relations of at least the more important species in every field separately. These data are contained, however, in a doctoral dissertation (FEKETE, 1967, defended in 1972). In the framework of the present publication it is possible only to list those weed species (Table 1), which cover an area of larger than 1% on an overall average for the treatment in each of the different investigation sites.

Table 1. Major weed species of wheat crops and their covering percentages ofter various treatments, on the basis of the summarized data for the sites investigated

Treatment	Traditional	Traditional	With Dikonirt	Simazin after-effect
Year of recording	1950	1963	1963	1963

The recordings were carried out in accordance with the investigations of the Geological and Agrochemical Research Institute of the Hungarian Academy of Sciences, at Fehérgyarmat in soil of clayey adobe, and to a smaller extent of sandy adobe. On the State Farm of Mezőnagymihály the recording of wheat took place in strongly bound adobe and clayey adobe soils, at Mezőhék and Enying in open country adobe, at Lábod in sandy adobe and adobe, and at Kaposvár in harder and lighter adobe soils.

It is characteristic of the precipitation conditions that at the time of the national recording (1949—1950) in some of the places investigated there was much drier weather than the 40 years' average.

In 1963, the precipitation totals corresponded to the many-year averages characteristic of the areas, but at Mezőhék it was higher than this. At Lábod and Kaposvár there was only very little rain in April 12 and 13 mm respectively.

Results of the investigations and their evaluation

The most important weeds of wheat crops and the number of species and cover values for the individual life forms (ÚJVÁROSI, 1952) are given in Tables 1 and 2, on the basis of the overall data of the investigation sites and treat-

Table 2. Numbers and covering percentages of the weed species belonging to the individual life forms, as averages of the areas investigated, according to the results of the recordings in 1949—1950 and 1963.

Treatment	Traditional		Traditional		With Dikonirt		Simazin after-effect	
Number of species and cover percentage	1	2	1	2	1	2	1	2
Life forms:								
T_1	16	0.81	15	0.71	5	0.05	2	0.02
T_2	31	11.98	25	1.58	15	1.28	5	0.14
T_3	11	5.15	13	2.30	8	2.52	6	1.33
T_4	30	7.32	42	7.63	37	3.50	28	16.25
Total T	88	25.26	95	12.22	65	7.35	41	17.74
HT	1	0.01	1	0.01	2	0.01		
H_3	5	0.19	4	0.01	3	0.01	3	0.03
H_5			3	0.10	3	0.01		
Total H	5	0.24	8	0.11	8	0.02	3	0.03
G_1	6	6.85	8	1.20	4	1.58	3	1.06
G_2	1	0.02			1	0.01		
G_3	9	10.40	7	5.25	7	4.29	4	9.63
G_4	3	0.03	2	0.02	2	0.01	1	0.01
Total G	19	17.35	17	6.47	14	5.89	8	10.70
Number and covering percentage of the total weed species	113	42.86	120	18.13	87	13.27	52	28.47

1 : Number of species
2 : Percentage of covering
T_1: Wintering one-year old weeds in early spring
T_2: Early-summer one-year old weeds shooting in autumn
T_3: Early-summer weeds shooting in spring
T_4: Late-summer one-year old weeds
H_3: Tap-rooted weeds
H_5: Weeds with inclined rhizome
G_1: Creeping bent grass (Couch-grass)
G_2: Tuber crops
G_3: Weeds with couch-grass-like roots

ments. The Tables contain the data of the weed recordings from 1949–1950, too, (Újvárosi, 1950; 1961) for purposes of comparison. These and Figs. 1–3 indicate the extent of the changes in the weeds of wheat crops since the national recordings, due partly to the traditional cultivation, and partly to chem-

ical weed-killers, and the group or groups of life-forms among these which were most affected by these changes.

1. Effect of the agrotechnology in large-scale farming of the development og weeds in wheat crops

In the wheat crops of the farms chosen as the investigation sites, 113 weed species occurred in the recordings of 1949–1950, with an average cover of 42.86%. In 1963, according to the overall data, 120 species were found in the traditionally cultivated wheat crops, with an average cover of 18.81%. During 13 years, therefore, the weed cover of the wheat crops decreased by more than half as a result of the more up-to-date agricultural techniques in the large-scale farming (Table 2).

Comparing the weeds according to life forms, the following changes are found:

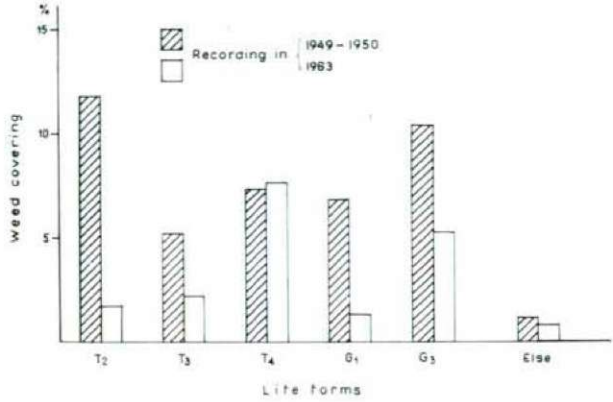

Fig. 1. Influence of the agrotechnology in large-scale farming on the formation of weeds in wheat crops, according to life forms.

As indicated in Fig. 1 and Table 2, the early summer weeds shooting in autumn (T_2) have completely lost their earlier importance, for their cover is reduced to nearly a tenth of the old value (from 11.98 to 1.58%) and the number of species too is appreciably lower than before (25 instead of 31). Some spiked weeds of frequent occurrence, belonging to group T_2, such as *Centaurea cyanus, Consolida orientalis* and *Vicia* species, have fallen completely into the background (Table 1).

The early summer weeds shooting in spring (T_2) have similarly decreased in quantity, to be about half the old cover (from 5.15 to 2.3%), primarily as a result of the reduction of Sinapis arvensis and Scleranthus annuus.

For those from the late summer (T_4), however, it is observed that their cover has risen somewhat compared with those in 1949–1950 (from 7.32 to 7.63%). The explanation of the unchanged, or slightly increased amount of those belonging to group T_4 is mainly that the winter of 1962/63 was extremely hard, and unfavourable to the crops in standing the winter; in addition the Italian wheat species known to be much more sensitive to cold were also sporadically recorded. These crops were therefore much thinner than the others, and this weed group could easily prevail in them. Although the amount

of those from the late summer remained essentially unchanged, the cover values of a large proportion of the weed species belonging here are changed. For example, *Ambrosia elatior Polygonum aviculare* and *P. convolvulus* are now to be found to a considerably lower extent. At the same time, some species have counteracted the decrease of the above species with their rapid propagation. The number of species of life form T_4 has also increased, similarly to the cover, from 20 to 42. A lesser pushing forward of the thermophilous late summer weeds seems to support the earlier findings (UBRIZSY, 1954; TIMÁR–UBRIZSY, 1957).

Wheat overgrown with perennial radiciform couch-grass (G_3) occurred with 10.4% in the investigation sites in 1949–1950. It is noteworthy that the cover of the weed group decreased in the 13 years to 5.25%, about half the old cover. Although they can still be found sporadically in considerable amount (e. g. at Fehérgyarmat), on the majority of farms they are on longer considerable. Similarly to the results of investigations in 1961 (FEKETE, 1963), the highest decrease in the group is for *Convolvulus arvensis,* which occurs nationally in the greatest quantity, but here its cover has fallen from 6.67 to 2.44% (Table 1). A similar change, but to a still higher degree, may be observed in the case of couch-grasses (G_1). The cover of this weed group in 1949–1950 was 6.85% in the overall average of the investigated sites. The present cover of couch-grasses, however, is only 1.2% (Table 2). Of the weeds belonging here, *Equisetum arvense* has decreased significantly, in spite of its still being considerable at Lábod.

Compared to the weed groups discussed so far, weeds belonging to other life forms are negligible in both investigations, and are therefore not discussed in detail.

2. Effect of Dikonirt spraying on the formation of weeds in wheat crops

Dikonirt-treated wheat-fields were recorded at Fehérgyarmat, Mezőnagymihály, Mezőhék and Lábod.

Comparing the wheat crops of the present traditional cultivation with Dikonirt-sprayed ones, an additional 27% decrease occurred in the weed cover as a result of the herbicide (Table 2). As the average for the four farms, the weed cover of the wheat with Dikonirt is 13.27%, which can be regarded as still fairly high after the chemical weed control.

Investigation of the effect of chemical treatment upon the covers of the weeds belonging to the individual life forms leads to the following findings (Fig. 2).

The cover of groups T_2 and T_3 has hardly changed in essence as a result of Dikonirt. In the case of these two life forms, therefore, the major decrease compared to the cover in 1950 was a result not of Dikonirt but primarily of the better agrotechnology applied. The use of herbicides proved effectual to various extents for every weed species except two. The somewhat larger cover of T_3 was caused by the propagation of *Fumaria* in the Dikonirt wheat at Mezőnagymihály and Mezőhék. *Galium aparine,* belonging to T_2, similarly increased.

An appreciable decrease as a result of Dikonirt can be demonstrated in the covers of the one-year old weeds from *late summer* (T_4): 3.50% on average

for the sites investigated in the chemically treated wheat, and 7.63% in that traditionally cultivated. The most sensitive response to the Dikonirt spraying was given by *Stachys annua* and *Ambrosia elatior,* but some effect can be dem-

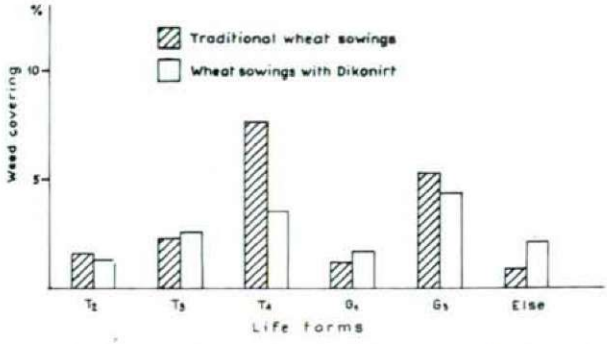

Fig. 2. Influence of Dikonirt spraying on the formation of weeds in wheat crops, according to life forms.

onstrated on nearly every T_4 weed species. The larger amount of *Chenopodium* can be explained by its propagation among the Italian wheat at Mezőhék. It is obvious from the Figure and Tables that the weed-killing effect of Dikonirt was the most efficient in the case of this life form.

It is known that the late summer weeds (T_4) shoot en masse in densely growing wheat in May and June, and even earlier in thinly growing wheat.

Spraying of wheat with Dikonirt is usually carried out from the middle of April till the middle of May; on the farms investigated for instance, it was performed everywhere between May 5 and 10. As the effect of Dikonirt spraying lasts for about 4–5 weeks, the influence of the herbicide extends to the period when the late summer weeds sprout; these therefore come into contact with the weedicide in just that stage when they are biologically the most sensitive to it. In contrast to earlier findings (UBRIZSY, 1958a,b), this is the explanation for the very sensitive reaction of the late summer weeds (T_4) to Dikonirt spraying. At the same time, the cause of the low effect of herbicides on the life forms T_2 and T_3 may be that at the time of their being sprayed some of the species belonging to these weed groups are already over the period of being sensitive to herbicides.

Of the perennial weeds wintering in the soil, the cover of couch-grasses (G_1) was not decreased by Dikonirt. In the case of the radiciform couch-grasses (G_3), however, a decrease of about 20% could be observed (from 5.25 to 4.29%). It is true that *Convolvulus arvensis* has a somewhat larger cover value among wheats with Dikonirt, but the explanation of this may presumably be that the cover there was originally larger than in untreated crops (Table 1).

3. Development of weeds in wheat crops exposed to Simazin after-effect

Wheat crops with Simazin after-effect were recorded at Mezőnagymihály and Enying. At Mezőnagymihály, the crop-field was treated with 7 kg Simazin per cad. yoke in the spring of 1961. At Enying, some of the fields investigated were sprayed with 5 kg Simazin per cad. yoke in the autumn of 1960, and

the rest in the spring of 1961. In these two areas, the extents of the damage and the weed cover of the wheat were different, and thus separate recording series were made for them.

At Mezőnagymihály, and in the field sprayed in the autumn of 1961 at Enying, the crop began to turn yellow in April and May of 1963 and, owing to the after-effect, about 15–20% of the wheat perished. Empty spots developed sporadically, but the whole crop became thinner, and the place of the destroyed crop was partly occupied by weeds, correspondingly, in contrast to the 18.81% weed cover of the traditional wheat crops, the weed pollution of the fields under after-effect increased to 28.47% (Table 2).

In the wheat crops with Simazin after-effect, two weed groups in particular were found in large numbers: the one-year old weeds from the late summer (T_4) and the perennial radiciform couch-grasses wintering in the soil (Fig. 3).

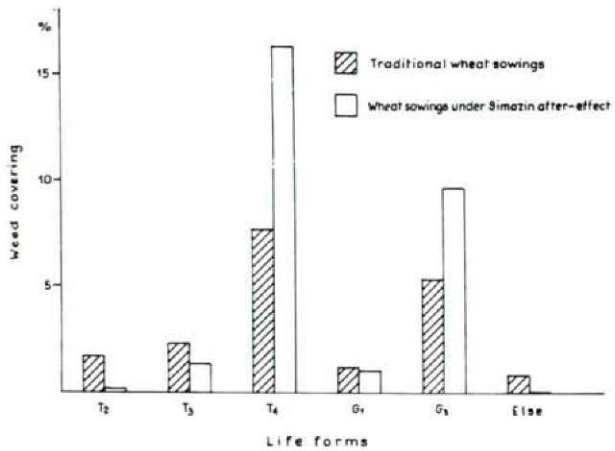

Fig. 3. Development of weeds in the wheat crops with Simazin after-effect, according to life forms.

The average cover of the late summer weeds (T_4) in the sites investigated proved to be 16.25%, their presence being more than twice as frequent as in the crops cultivated in the traditional way. Life from T_4 occurred in extremely high numbers, with 23.29%, at Mezőnagymihály where *Echinochloa crus-galli* propagated itself to an incredible degree (16.66%).

According to the investigations of Újvárosi, (1951), densely growing cereals, including wheat, exert an effect on the development of weeds shooting among them. Here, however, the crop became thin due to the after-effect and the weed-suppressing influence could no longer prevail in a suitable way from the beginning of May, this resulting in the mass propagation of the late summer weeds.

Of the perennials, the advance of the radiciform couch-grasses (G_3) could be observed, their average cover being 9.63% in the wheat with Simazin after-effect, compared to 5.25% in the non-chemically treated fields. In the groups, mainly *Rubus caesius* prevailed with its large mass.

The Simazin after-effect, and the consequent overgrowth with weed, manifested itself in the crop results, too, for in the fields affected 15–25% less wheat grew than in the untreated ones.

Summary

In 1963, weed recordings were carried out in fields the weed conditions of which had been elaborated in detail by ÚJVÁROSI in 1949–1950. Traditional wheat crops and those treated with Dikonirt or under Simazin after-effect were investigated to establish the roles of the individual factors in the development of the weeds.

The recording results can be summed up as follows:

1. The agrotechnology of large-scale farming makes its effect felt in a definitely positive way on weeds in wheat crops. In the traditional cultivation the weed cover of the wheat crops investigated decreased 56% as compared to those in 1949–1950, that is to less than half the previous cover, merely as a result of more up-to-date agrotechnical processes. Within this favourable change in the total cover the differences for the single life forms are of various extents. The amount of one-vear old weeds (T) decreased to be about half year the old value. The early summer weeds (T_2) shooting in autumn, and occurring in large numbers in the old wheat crops, lost their earlier importance both as to the number of species and to the cover. The decrease in early summer weeds shooting in spring (T_3) was 50% or so. The number of species and the cover of those from late summer (T_4), however, somewhat increased. The increase in the latter can be explained mainly by their propagation among the thinly growing Italian wheats where this weed group could easily prevail. The weeds wintering in the soil (G) were forced back to one-third of the control value during the 13 years. The decrease in couch-grasses (G_1) was higher (80%) than that in the radiciform couch-grasses (47%). As in the earlier investigations the weed-decreasing the effect of the agrotechnology of large-scale farming is therefore definitely proved.

2. Spraying with Dikonirt resulted in a further 27% decrease in the total weed-cover of the wheat crops. The reactions of the individual weed groups to the hormone-based herbicides, however, were different. Of the one-year olds, the cover of T_2 hardly changed as a result of 2,4–D. The cover of group T_3 grew a little, but there was a very considerable decrease (50%) in that of T_4. The herbicide effect of Dikonirt, therefore proved to be most effective with this life form. Of those wintering in the soil, group G_1 was not affected at all by Dikonirt; a 20% decrease was induced in the amount of G_3, however.

3. In areas treated with Simazin, about 15–20% of the wheat perished in the third year after being sprayed, due to the after-effect. This resulted in 60% more weed cover as compared to the control. In crops becoming thinner as a consequence of the after-effect, particularly some members of weed groups T_4 and G_3 propagated themselves in large quantities. As a result of all these factors the crop of those areas decreased by 20–25%. The data from the investigations therefore suggest the more careful agricultural administration of the areas under Simazin after-effect.

References

BALÁZS, F. (1944): A növénycönológiai felvételek készítésének újabb módjai (New methods of carrying out plant coenological recordings). — Bot. Közl. *41*, 18—33.

FEKETE, R. (1963): Változások a szántóföldi gyomnövényzetben (Changes in field-weed vegetation). — Hung. Acad. of Sci. Publ. of the Dept. of Agr. Sci. *22*, 377—393.

FEKETE, R. (1964): Összehasonlító gyomvizsgálatok hagyományos művelésű és vegyszeresen kezelt búza- és kukoricavetésekben (Comparative weed-investigations in wheat and maize crops cultivated traditionally and treated with chemical herbicides. Manuscript, elaborated in the form of Doct. Diss., 1967; defence of the thesis 1972).

I'SÓ, J. (1962): Utóhatás-kísérlet őszi búzában klóraminotriazinokkal kezelt kukorica után. Kukoricatermesztési kísérletek 1958—1960 (After-effect experiment in winter wheat, after maize treated with chloraminotriazines. Experiments in maize growing. 1958—1960). 363—369.

I'SÓ, J. (1963): A Hungazin, Simazin, Atrazin utóhatásáról (The after-effects of Hungazin, Simazin and Atrazin). — Magyar Mezőg. *12*, 10—11.

TIMÁR, L.—UBRIZSY, G. (1957): Die Ackerunkräuter Ungarns mit besonderer Rücksicht auf die chemische Unkrautbekämpfung. — Acta Agron. Acad. Sci. Hung. *7*, 123—150.

UBRIZSY, G. (1954): Vizsgálatok őszi búzavetés agrofitocönózisában (Investigations into the agrophytocoenosis of winter wheat). — Növénytermesztés *4*, 281—300.

UBRIZSY, G. (1958a): Cönológiai kutatások agrárterületek gyomtársulásain, különös tekintettel a vegyszeres gyomirtás flóraátalakító hatására (Coenological investigations of the weed coenoses of agricultural areas, with particular regard to the flora-transformative effects of chemical weed-killers). — Biol. Group, Hung. Acad. of Sci. *2*, 65—78.

UBRIZSY, G. (1958b): Vegyszeres gyomirtás gabonavetésekben (Chemical weed-killing in corn crops). — Dept. of Agr. Sci., Hung. Acad. of Sci. *14*, 339—418.

UBRIZSY, G. (1962): Vegyszeres gyomirtás (Chemical weed-killing). — Agr. Publ. House, Budapest.

ÚJVÁROSI, M. (1950): Hol milyen gyomok ellen védekezzünk? (Where and against which weeds should we protect?) — Yearbook of the Agric. Res. Inst. in Debrecen, *1*, 27—105.

ÚJVÁROSI, M. (1951): Szántóföldi kísérletek a különböző gabonavetések gyomirtó hatásának vizsgálatára (Field experiments to investigate the weed-killing effects of various field crops). — Biol. and Agr. Dept. of the Hung. Acad. of Sci. *2*, 145—149.

ÚJVÁROSI, M. (1952): Szántóföldjeink gyomnövényfajai és életformaanalízisük (Weed species on cultivated land in Hungary and analysis of their life forms). — Növénytermesztés *1*, 27—50.

ÚJVÁROSI, M. (1957): Gyomnövények, gyomirtás (Weed plants and weed-killing). — Agricult. Publishing House. Budapest.

ÚJVÁROSI, M. (1961): A búzavetések gyomnövényzete. Búzatermesztési kísérletek 1952—1956 (Weeds in wheat crops. Experiments in wheat-growing, 1952—1956). — Publ. House of the Hung. Acad. of Sci. Budapest.

ÚJVÁROSI, M. (1966): A gyomnövényzet változása a szántóföldeken az elmúlt évtizedben (Changes in ploughland weeds in the past decade). — Agr. Dept., Hung. Acad. of Sci. *25*, 275—289.

Address of the author:
Dr. RÓZSA FEKETE
Department of Botany,
A. J. University, H—6701 Szeged
P. O. Box 428, Hungary