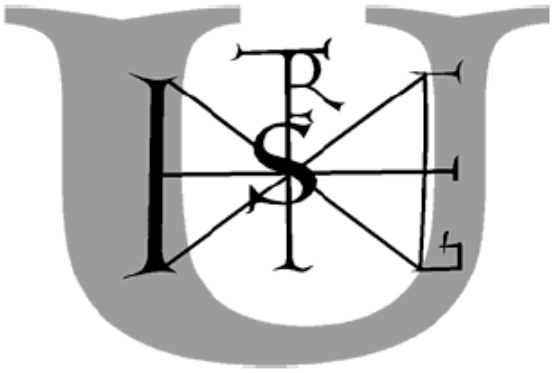

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SOIL MANAGEMENT AND TILLAGE POSSIBILITIES IN WEED CONTROL

Gödöllő
2004

Ph.D. School: Plant Sciences

Scientific Code: 4. Agricultural Sciences

4.1. Agronomy and Horticulture

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BACKGROUND AND OBJECTIVES OF THE RESEARCH

The analysis of traditional tillage systems has a significant place among crop production reserach topics. In the past 20 years several essays were published on the effect of low tillage and no-till sytems on cultivation factors, mainly overboard. The actuality of the analyses is justified by the different cost demand, the necessity and difficulty of creating harmony between the inputs and the more exact knowledge of the plant protection effects of certain sytems. In different soil tillage systems tillage influences physical condition and weediness just like crop rotation order and other elements of cropping practices.

One of the unfavourable effects of tillage is soil compaction that presents production risk on 1.4 million hectares in our country. Tillage originated compaction can be meliorated by mechanical (loosening) and biological (plants having favourable effect on soil condition) methods.

Weediness is related to soil utilization, tillage and the professionality of plant protection. The yield losses due to weeds can each or exceed the 30% of the total loss. Due to the damage of weeds the protection against them is inevitable.

As a consequence of structural and financing problems the cultural condition of the soils deteriorated and weeds proliferated, many species are hard to kill. The problem is not new. As a result of the herbicide utilization of the previous years resistant biotypes gained prevalence and the tolerance against chemicals increased.

The realization that herbicides have a negative effect on environment and food safety influenced the weed control practice positively. One sign is the ambition to keep the weed coverage under the harmful limit. The result is the reducing of herbicide utilization to reasonable levels, that is also eligible according to the EU and international regulations. The application of weed control measures can be aided by the requirements of agricultural-environmental programmes and subsidies, the weed controlling effect of soil tillage, the expansion of reduced crop rotation wth catch-crops with a beneficial effect on soil condition and weed control.

The reasons and factors mentioned above make the comparing analysis of different soil tillage sytems useful.

According to this, the objectives of the research are

1. analysis of weediness changing as a result of different cultivation methods, with attention to the various nutrition levels;
2. analysis of the effect of soil condition forming and changing as a result of various tillage methods on the weediness, with new analytical methods;
3. determining whether the low tillage can be complied with the appropriate control of weeds;
4. reaction of some important weed species to the treatments;
5. conclusion on the basis of the results and phrasing the recommendations that can be used in practice.

MATERIAL AND METHOD

On the Experimental Station of the predecessor of title of the Szent István University (GATE) several different cultivation treatments were compared in a soil tillage trial on the basis of their effects on soil condition, yield and weediness. The significance of the examinations is increased by the judgement of the effects of tillage and fertilization and the introduction of catch-crops into the crop order.

The experimental field is in the Gödöllő hills. The soil (liable to sedimentation, sandy loam) and the precipitation conditions make the yield safety fluctuant, and the number of crops that can be cultivated economically is low. The year 2000 and 2002 were drier than the average, the years 1999 and 2001, on the ther hand, had more rain.

In the two factorial, strip small plot trial with four replications (a) signifies the soil tillage methods, (b) the fertilization treatments. Plot sized are 5x20 m= 100m^2. The order of crops is: white mustard in 1999, followed by winter wheat, after the harvest of wheat oil radish, maize in 2001, spring barley in 2002. The date of weed surveys is shown in Table 1. Table 2. includes the agricultural technological data of the trial.

Table 1.: Dates of weed surveys (Gödöllő, D trial)

Year	Crop	Date of weed survey		
		1	2	3
1999	white mustard	05. 27.	08. 22. (stubble)	
2000	winter wheat	04. 20.	05. 16.	06. 16.
2000	oil radish	08. 24.		
2001	corn	06. 06	08. 20	09. 27
2002	spring barley	04. 16.	05. 27.	07. 08

Treatments employed in the trial and their levels:

Soil tillage:

a_1: Ploughing (22-25cm): traditional system with several turns

a_2: Loosening (35-40cm) + disking (16-20cm): soil condition improving system

a_3: Tilage system based on heavy cultivator (16-20cm), low-till and low cost system

a_4: Direct drill: no-till, soil condition maintaining system

Fertilization in the autumn:

b_1: 80 kg N + 60 kg P_2O_5 + 60 kg K_2O /ha active agent (low dose according to the soil supply),

b_2: 160 kg N + 120 kg P_2O_5 + 120 kg K_2O /ha active agent (optimal dose according to the soil supply).

Methods of examination

Method of weed seed content analysis: On the stubble of the white mustard the upper 10 cm layer of the soil was analysed on the basis of ten 200 cm^3 samples. Weed seeds were isolated with $ZnCl_2$ flotation method. The size of the seed-bank determining the potential infection was determined for 1 m^2.

Method of weed survey: Weed covering examinations were carried out with the 1 square meter (modified Balázs-Ujvárosi-type) quadrat method. In white mustard and its stubble coverage percentage was measured at ten places each time. Measurements were taken three times in winter wheat, maize and spring barley, and once in oil radish. Evaluation was carried out by variance analysis.

Method of yield evaluation: The yield data from the plots was calculated for one hectare. Data was evaluated by variance analysis.

Method of soil condition analysis: To measure soil resistance the Daróczi-Lelkes-type PENETRONIK penetrometer was used. The resistance of the upper 40 cm layer of the soil was measured every 5 cm, together with humidity.

***Evaluation of the reaction of* Ambrosia artemisiifolia *L.*:** The different tillage methods were evaluated and placed in order on the basis of their *Ambrosia artemisiifolia* controlling effect.

Demonstration of the direct effect of soil resistance on weediness: The direct effect of soil resistance on weediness was demonstrated by rank correlation. Rank correlation was carried out according to the steps given by SVÁB (1981).

The agrotechnical data are in Table 2.

Table 2.: Agrotechnical data of D trial (Gödöllő 1998-2002)

Term	1999	2000	2000	2001	2002
Crop	White mustard	Winter wheat	Oil radish	Maize	Spring barley
Objective	Mulch	Grain	Mulch	Grain	Grain
Species	mixed	Mv MAGVAS	mixed	PR36R10	Amulet
Sowing time	04. 12	'99. 10. 28.	08. 04.	2001.05. 04.	2002.03. 22.
Harvest time	06. 29. (stem.)	07. 13.	frozen (Oct) mulch	2000. 10. 15.	2002. 07. 03
Vegetation period, days	79	258	89	143	104
Preceding crop	winter wheat	white mustard	winter wheat	oil radish	maize
Tillage method	Ploughing	4 treatments	Disking	3 treatments	2 treatments
Date of tillage	1998. 10. 28.	1999. 09. 28-29.	2000. 07. 17.	2000 10.31.	2002. 03. 16-19.
Seedbed preparation	04. 10.	10. 08.	08. 04.	2000.05.14	2002. 03. 21
Top-dressing		2000. 03. 23.	-	2001. 05. 18.	2002.04. 12.
Plant protection (weed	-	2000. 04. 24. Segal 65 WG	-	Post: Titus plus	-
control)	-	-	-	-	-
Pests, diseases		-		-	
Number of plants/m^2 a_1 b_1	165	460	102	64.300/ha	180
a_1 b_2	162	566	111	64.600	220
a_2 b_1	160	504	110	64.800	210
a_2 b_2	156	575	120	64.880	240
a_3 b_1	158	480	110	65.200	200
a_3 b_2	162	570	116	65.300	210
a_4 b_1	160	310	102	63.600	150
a_4 b_2	162	390	112	63.900	190
Plot m^2 5x20 = 100	100	100	100	100	100
Appearance of shoots	1999. 04. 16.	1999 11. 20.	2000.08.10-15. residue	2001.05.12.	
Other:	Without fertilization	Fertilization according to treatment 09. 18.	nutrients	fertilization according to treatments 2000. 10.31.	Residue nutrients

RESULTS

1. Result of the seed content analysis

From the samples taken from the stubble of white mustard it was seen that the area is infected mainly by annual weeds. The composition of the seed-bank consisted mainly of T_4-type species. Less seeds belonged to other annual and perennial species. Late summer annuals contribute to a diverse seed-bank in the soil (Table 3.). On the basis of the 20 species the soil is not considered rich in weeds. This tendency is apparent also on the field. The tillage systems, the simplified crop rotation and the employed agrotechnology (chemical plant protection) all contribute to the decrease of weed diversity. As for the life form of seed-bank species, the predominance of warm demanding species is obvious. Weed seed content per 1 m^2 was 38250, infection is considered low.

Table 3.: Seed-bank of the soil, Gödöllő, 1999

Life form	Number of species	Number of seeds	%
G_1	1	3	0,39
G_3	1	1	0,13
H_3	2	4	0,52
H_4	1	1	0,13
perennials	**5**	**9**	**1,18**
T_1	2	28	3,66
T_3	1	1	0,13
T_4	12	727	95,04
annuals	**15**	**756**	**98,82**
total	*20*	*765*	*100*

2. Results of the weed surveys

In **white mustard** total coverage was average in May (9.31%). The developments of the species of the first aspect (7.14%) were aided by the precipitation. T_4 life form species that were characteristic of the area had many germinated plants, but their total coverage is low (1.66%). Annuals contributed to the 98% of the total weed coverage.

On the **stubble of mustard** weed coverage was much higher (71.02%) compared to the spring results. Germination of the mustard after harvest was significant with its 8.1%, and was the fourth in the order. This means that the time of mulching of the protective crop and the tillage for the following crop has to be chosen more carefully in case of wet weather than in an average vegetation period. The development of T_4 species forming the third aspect (58.71%) was aided by high precipitation and high temperature.

There were three monocotyledonous weeds present (*Digitaria sanguinalis*, *Echinochloa crus-galli*, *Elymus repens*). Their total coverage is 9.23%, from which perennials presented 1.32%. The proportion of monocotylednonous plants in the total coverage increased from the initial 2.15% to 13%, with *Digitaria sanguinalis* and *Echinochloa crus-galli* playing a significant role. The number of species was 19 and 28 at the two dates.

In April in **winter wheat** the weeds of the T_1 group dominated in accordance with the date of the survey. The formerly typical cereal weeds had a low cover percentage. Due to the favourable weather conditions, the lack of many competitors, and the slower development of the wheat, many germinated T_4 plants were found. From among monocotyledonous weeds, *Echinochloa crus-galli* was significant. The scope of the presence of T_4 weeds is in accordance with the other experiences in the country, and warns about the tendency and the necessity of creating a proper crop rotation. In case plant protection was not effective against these species, in next year's intertilled crop the weed problem may increase.

Since total coverage consisted in large part of species sensitive to the applied active agents, the sensitive and early annuals thinned or disappeared by May.

By June perennials – especially *Elymus repens* – had the highest coverage, but differently at the two nutrient levels. Their role in total coverage and in determining the differences between tillage methods is similar to the role of annuals in April.

Considering the June data it can be said that if nutrition is unfavourable, tillage methods without soil-turning may prove to be weed-promoting. On the other hand, if nutrition is appropriate, the disadvantage of these tillage methods disappears. The effect of direct drill is antinomic, according to the literature, because both its weed controlling and weed promoting effect was seen.

It is favourable that the coverage of perennials is not too high and their upsurgence in maize is less expected. Within total coverage the proportion of monocotyledonous plants was rising.

Because of the dry vegetation period wheat did not tiller properly, and therfore its weed-limiting effect was less. It is probable that this was the reason why the weed-controlling effect of ploughing could not manifest.

On the basis of the survey taken in **oil radish** the predominance of *E. crus-galli* was obvious compared to annuals and the total coverage, at optimal nutrition level. In the average of the four treatments annual monocotyledonous plants contributed to 74.99% of the total coverage. *E. crus-galli* has a special significance, because maize was following oil radish.

In **maize** *Echinochloa crus-galli* had a high coverage at the time of the first survey; compared to the others, with the exception of cultivator treatment on low nutrition level where the coverage of *Elymus repens* was close to 4%. Because of the late survey, in the case of the other species more T_4 weeds appeared.

At the time of the second survey the coverage was tenfold. *E. crus-galli* was again the first. The *Digitaria sanguinalis,* which was missing in June, climbed to the second place. The coverage of *Ambrosia artemisiifolia* also increased, just like the cover percentage of *E. repens* and *Convolvulus arvensis*.

By September the weed coverage decreased. Many weeds finished their life activity and the shadowing of the maize was also acceptable. *E. crus-galli* still had a high coverage, but shared its place with the formerly indignificant *Solanum nigrum* and *A. artemisiifolia.*

The **spring barley** was lacking weeds, which was caused probably by the low precipitation and the coverage of barley. At the time of the late survey mainly perennials (*E. repens*) and T_1 species were present, with *S. media* as the most characteristic. The adaptability of *A. artemisiifolia* is obvious, since young plants were seen even at this date.

By the time of the second survey the field still had a low weed coverage, with the exception of direct drill treatment with higher nutrition level. T_4 life froms gained prevalence, with *E. crus-galli* having the highest coverage. *A. artemisiifolia* had an almost similar coverage in the cultivator treatment at optimal nutrition level.

In July after the harvest the coverage was obviously low, but *E. crus-galli* still had the highest coverage.

It can be stated that in the weed population that is poor in species T_4 weeds had the highest significance. This is probably the result of the cultvation practice of the previous years.

As a result of the weed condition after white mustard sown as an adjusting crop, the effect of the treatments can be evaluated reliably in winter wheat. In April and June the interaction of the two factors was apparent, so nutrition influenced the weed limiting or promoting effect of the cultivation treatments.

At the first date the disking + loosening combination limited the development of annuals better than cultivator treatment at low nutrition level. Since total coverage was determined by annuals this was also true for total coverage. In case of higher nutrition level weed coverage was higher in treatments without soil turn, but the difference is not significant, which means nutrition had a balancing effect.

Weed condition in May was influenced by herbicide treatment to such an extent that the interacion of treatments and the weed-promoting effect cannot be demonstrated.

According to the results in June the weed limiting effect of ploughing is just tendential at minimal nutrition level. Nutrition modifies this and in case of optimal fertilizer level the other treatments curb weeds more than direct drill.

Tillage preceding the sowing of oil radish and the development of oil radish balanced the weed condition. The weed limiting effect of ploughing was obvious at both nutrition levels. The tillage accompanying the sowing of oil radish had an effect on weediness also later.

In maize the interaction of the tillage and fertilizer treatments could not be demonstrated. It is obvious that the weed limiting effect of ploughing could be demonstrated in the average of the three dates. The other treatments had a different effect depending on the level of nutrition but statistically this effect is not authentic.

In barley the weed limiting effect of ploughing and the weed promoting effect of driect drill is showing a tendency.

The most significant weed of our days, *Ambrosia artemisiifolia* L. was evalauetd separately. Its coverage was considerable at both nutrition levels. In winter wheat and maize it had tendentially higher coverage on soils with proper nutrition supply. On the other hand, depending on the year, it utilized low level nutrients better than competitive weeds and the crop. This shows that *A. artemisiifolia* can be limited by approriate fertilization and the cultivation of weed limiting crops. This is in accordance with the demand for harmony between resources.

Between the different tillage treatments the favourable or anfavourable effect on the weed cannot be determined. In the order of treatments the ploughed soil was the most favourable for *A. artemisiifolia*. This means that on the weed-infected field the weed-bank of the soil also aids the proliferation of the weed through annual ploughing.

3. Yield results

Examinations were carried out in biologically favourable crop rotation system. The crop order of the trial is not typical because of the introduction of oil radish. Therefore the results can be used also from the viewpoint of sustainable crop production and integrated technologies.

The yield was the best in case of soil loosened favourably 35-45 cm deep, independently from the weather of the year. Somewhat lower yield was harvested from soil tilled with cultivator, and ploughing was the third in order. In every case the yield was lowest in direct drill treatment. On similar soils, where direct drill can be favourable because of its soil protecting function, the lower yield and its effect of weediness calls for careful consideration. In case of professional and continuous chemical protection weedness can be reduced, and this may have environmental cosequences. The weed limiting effect of loosening is not satisfactory, with the exception of perennial weeds, but its favourable effect on the soil provides an economic advantage of ploughing, that has otherwise a better weed limiting effect.

In winter wheat and spring barley the interaction of the two factors is not apparent, but fertilization had yield increasing effect in all treatments, most strongly in loosening + disking treatment. The drough damage lessening effect of fertilization was demonstrated in accordance with literature.

The undisturbed soil condition characteristic of direct drill did not limit the favourable utilization of fertilizers in case of maize, in a year with average precipitation. It can be stated that the yield limiting effect of compacted or sedimented soil condition can be reduced.

4. Effect of introducing a catch crop between the main crops

The favourable biological effect of crop rotation was increased both by white mustard and oil radish. Favourable effect was shown in the better cultivability of the soil. On given soil that is susceptibel to sedimentation the duration of soil loosening is short and the effect can be lengthened by crops with a loosening effect.

5. Change of soil condition

A compacted layer forms under the layer of annual ploughing, which can extend also towards the upper layers. The loosening effect of oil radish improved the soil condition, and this effect was shown also in the deeper layers. Under the depth of the basic tillage for the next crop (maize) the penetration values were higher but the thickness of the plough-sole decreased.

The flaws of the previous years were demonstrated mainly in the shallow tillage treatments. The 35-45 cm deep loosening of the soil alleviated this problem, and no soil resistance above 3 MPa (critical value) was measured. The loosening effect of oil radish was reduced somewhat by the disking following loosening.

In soil tilled with cultivator a more compacted layer formed under the layer in question. The loosening effect of oil radish could be shown down to 25 cm depth.

In direct drill plough-sole shows the previous soil-turning tillages. In the second year the soil is compacted under the sowing, in the upper 10 cm of the soil. The loosening effect of oil radish was demonstrated only in the upper 15 cm layer but this effect disappeared in the next year. It is important that weeds endure compacted soil condition while in case of cultivated crops the yield is depressed because of the competition and the limiting effect on rooting.

6. Results of rank correlation

The basic hypothesis of my work was that the soil condition influences the development of the weeds and plant organisms directly. It was assumed that in a certain depth soil condition affects weediness. If treatments are put in order on the basis of MPa values measurd in acertain depth, weediness is related to this order. According to the calculated values of the rank correlation the connection of the two orders of the treatments can be demonstrated only in a few cases. This can be due to the fact that treatments change the looseness of the soil in different depths and extents and in a crop the different plant populations are presented in different proportions, thus affecting the order and rank correlation also. On this basis the analysis of pure stands with different tillage methods is recommended.

Examining the rank correlation in function with the depth certain laws can be observed. To determine mathematical relationship a dot diagram was created, fitting the sixth degree polinom of EXCEL as a trend line. Different R^2 values were calculated for the different dates and weed groups, but those show the strong fit of the polinom. The example is shown on the weed and soil conditions of winter wheat in Table 4.

Table 4.: Rank correlation depending on sample depth, Gödöllő

		R^2		
Winter wheat	2000	April	May	June
rankcor$_1$*	Annual	*0,93*	*0,36*	*0,78*
rankcor$_2$**		*0,82*	*0,91*	*0,98*
rankcor$_1$	Perennial	*0,89*	*0,91*	*0,91*
rankcor$_2$		*0,83*	*0,91*	*0,63*
rankcor$_1$	Total	*0,75*	*0,86*	*0,97*
rankcor$_2$		*0,88*	*0,83*	*0,63*

Key:* at minimal nutrition level, **at optimal nutrition level

It can be seen in Table 4. that the value calculated on the basis of the coverage of annual weeds in winter wheat in May is low. This is in accordance with the fact that because of the chemical plant protection annuals are almost gone from the field. Among “unnatural” conditions this law does not manifest. In June the value of perenniels and total coverage is average, this is probably due to the fact that the role perennials played in total coverage is different in each treatment.

The results justify the necessity of other, similar examinations, despite the difficulties.

7. New scientific results

On the basis of the analyses of tillage, soil condition and weediness the following new scientific results were determined.

1. On Gödöllő brown soil the relationship between the favourable loosening of the root zone and the yield was obvious in dry year. The soil condition created by ploughing ensures average yield.
2. On soil that is prone to sedimantation the yield reducing effect of direct drill in winter wheat, maize and spring barley was caused by bad soil condition and the higher coverage of less susceptible weeds.
3. Tillage methods were put into order according to their weed-limiting effect. The weed promoting effect of direct drill and the weed limiting effect of regular soil-turning was proved together with the modifying effect of crop rotation order and nutrition level, especially in the case of tillage without soil-turning (loosening, cultivator treatment, disking).
4. On the basis of the decreasing coverage of *Ambrosia artemisiifolia* L. ploughing was put to the first rank as the most favourable tillage method for the development of the species. The great competetiveness of *A. artemisiifolia* had a tendency, especially among low nutrition conditions.
5. Analyses carried out during the 4 years of the experiment made rank correlation possible. It was determined that the method can be further improved by calculations per species. Since the competetion of species is seen among cultivation conditions, pure stands and more tillage methods can be taken into account.
6. The dependabce of rank correlation on tillage depth was proven by fitting a polinom. More analyses are necessary to justify or reject the accuracy of the method.

CONCLUSION, RECOMMENDATIONS

On the basis of the research done in the topic of interactions between tillage, soil condition and weediness, conclusions are listed in three main point and 18 sub-points.

a) Importance of favourable soil condition

1. The weather data of the region affirm the growing frequency of dry years and the tendency of weather extremes. This shows the necessity of tillage systems that increase the water absorbing and water retaining capacity of the soil. Tillage methods that improve and maintain soil condition may gain prominance. The cover of the soil between crops and the introduction of crops that have a beneficial effect on yield may become a necessity.
2. The effect of previous years can be shown by exact soil condition examinations, and on this basis the methods of improvement can be planned and implemented. The danger of plough-sole and disk-sole is present on the soil. The damage can be alleviated by technological and biological methods.
3. The disk-sole formed after the stubble-clearing of mustard confirmed the importance of consideration of the soil humidity. Tillage treatments were enough to break compacton close to the surface (with the exception of direct drill), which means that smaller damages can be alleviated.
4. The sowing and germination of oil radish may be influenced by the soil condition changed by the tillage method under the main crop. The soil loosening effect of the oil radish did not appear in case of direct drilling, which probably shows the sensitivity of the crop to the soil condition.

b) Evaluation of soil condition and nutrition level

1. The role of good soil condition and nutrition level in the reduction of drought damage was proven again in wheat, maize and spring barley.
2. The 35-45 cm deep loosened soil condition had the best influence on yield in the biologically favourable crop rotation system, which was achieved by loosening combined with disking. In dry vegetation period the beneficial effect of tillage methods sparing the soil structure (cultivator)is also obvious.
3. In winter wheat and maize the yield limiting effect of direct drill is explained by weediness and the hindrance of water movement on the soil of the experimental field, susceptible of sedimentation.
4. The yield of maize sown after oil radish was influenced by the loosening of soil and the nutrition level. While in winter wheat water retainment played a significant role in the whole of the vegetation period, in the year of maize there were druoghts only in spring. This shows that the yield of maize was influenced more by the water retaining effect of the soil condition influenced by tillage methods than the precipitation in the vegetation period.
5. The undisturbed soil condition characteristic of direct drill did not hinder the utilizaton of fertilizer in maize, in a year with average precipitation. It can be stated that in case of good nutrition level the yield-reducing effect of compacted or sedimented soil can be alleviated.

c) Evaluation of crop rotation order according to weediness

1. The introduction of mustard in the crop rotation is advantageous because of its weed-limiting, soil-covering and soil-improving effect. With mulching at an optimal date the weed-promoting effect of the catch-crop and the unnecessary water loss can be avoided.
2. On the stubble of mustard and winter wheat weeds characteristic of the area appeared. The higher weed coverage in summer – and thus the better timing of plant protection and the reduction of the seed-bank – was aided by the favourable loosening and humidity of the soil.
3. The soil loosening effect of oil radish was proven by penetration values. It can be used as a protecting crop in dry years if soil humidity loss is curbed during the sowing. The crop improved the cultivability of the soil and was proven to be a good green crop because of its good coverage, rooting and its weed limiting effect.
4. The good weed-limiting effect of the soil is proven, in accordance with the literature, which was further increased be the greater water loss of the soil. This makes the re-evaluaton of the role of ploughing necessary.
5. Tillage methods can be ranked according to their weed-promoting or weed-limiting effect. Among the same conditions direct drill has a weed-promoting, while regular soil-turning has a weed-limiting effect. The weed-promoting or limiting effect of tillage methods without soil turning (loosening, cultivator treatment, disking) is different in each crop and at each nutrition level. Loosening is good to curb the life activity of perennial crops.
6. The high proportion of *Echinochloa crus-galli* in the total coverage and its prominent rank in the order shows its adaptation to the different soil and nutrition conditions.
7. The disking under spring barley modified the morpho-biological spectrum. The coverage of the perennial *Elymus repens* increased, utilizing well the higher level of nutrients.
8. According to the coverage of *Ambrosia artemisiifolia* ploughing was put at first place in the order of tillage methods. The high number of seeds appearing after the turning of the soil showed greater infestation.
9. The competitiveness of *Ambrosia artemisiifolia* shows a tendency. On soils with low nutrient supply its more competitive than other weeds and crops. It reacted with higher coverage to the low nutrition level. In case of good nutrition level the weed-limiting effect of cultivated crops is higher, but the development of competing, less dangerous weeds is also better, against which plant protection is easier.

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