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AGROTECHNICAL SYSTEMS TO CONSERVING WATER IN THE SOIL FOR WHEAT CROP

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Abstract

The ecological frame from the Transylvanian Plain is given by the existence of interaction among a great number of factors, of which two are very important for the agroechosystem: i) the first is the thermal background with high time variations and low rainfall, characteristics which impose significant restrictions for crop plants; ii) and the second is the hill orography, with slope fields. The purpose of the research made is to establish the influence of the soil tillage system (conventional and no-tillage), the fertilization system and the phytosanitary treatments applied, on the accumulation and water preservation in the soil, on the degree of weeds in the case of autumn wheat crop and the production. The restoration of water reserve in the soil in the no-tillage system is more reduced than in the conventional system, but also the loss of water in the conventional system is as rapid. This loss of water is due to a more intense water evaporation in the conventional system, without vegetal debris at the surface. The degree of weeds in the case of wheat in the conventional system (with plowing) during the experiment (2012-2016) is more reduced compared to the no-tillage system. The average production of wheat recorded in the no-tillage system during the five experiment years is 6234 kg/ha, compared to the average production obtained in the conventional system, that is 6162 kg/ha, which indicates the suitability of its cultivation in the no-tillage system.

Key words: *climate variability, conservative agrotechnique, no-tillage, wheat.*

INTRODUCTION

Research and agricultural practice have promoted, during the last years, several alternative variants of soil tillage, as solutions of conservative agriculture, with works adapted to concrete conditions regarding especially the type of soil, the climate conditions, the land orography and the available technical equipment. Expert literature cites, most frequently the following soil tillage systems (Dick et al., 1994; Rusu, 2014; Marin et al., 2015; Chetan et al., 2016): conventional system (with plowing), respectively no-tillage (direct sowing in unprocessed land). Between these extremes there are variants like: reduced works (rationalized conventional), minimum tillage (with covering under 30%), mulch tillage (with covering over 30%), ridge tillage, strip till, zone till, direct drill.
The reduction of the number of soil tillage modifies radically the technological approach regarding fighting against weeds, diseases and pests. Special attention in the case of these conservative soil tillage variants is imposed by the phytosanitary protection of crops where the preventive character must prevail. The failure of many attempts of applying conservative soil tillage systems is based on the adequate lack of control of weeds. Special attention must be paid to indirect methods: crop rotation, hidden crops, directed fertilization (Szajdak et al., 2003; Domuta et al., 2012). In the case of moldboard plowing weed seeds are spread in all arable layer, their germination being made in steps, and those buried deep lose their viability. In the case of minimum tillage and no-tillage, seeds are concentrated in the first 10 cm, they germinate explosively in the first year of application, determining excessive weeds, and subsequently the change of weed spectre.
During the last years there are more and more problems with drought, that is why it is necessary to preserve water in the soil, and the choice of the technological management system is the most important thing (Lal, 2007; Dixon

et al., 2010; Coyle et al., 2016; Lampurlanes et al., 2016). The limitation of drought effects can also be made by agrophytotechnical measures of accumulating, preserving and efficiently valuing water from rainfall (Halbac-Cotoara-Zamfir et al., 2015; Mu et al., 2015). In the case of conservative soil tillage systems by protecting the soil with vegetal debris (mulch), the loss of water is avoided by evaporation but also the suffocation of grown or upcoming weeds (Wozniak et al., 2014). In the conservative agricultural system, either we apply minimum tillage or no-tillage, the soil mulch (covering) with vegetal debris left after the harvest of the previous crop leads both to the improvement of humus content in the soil and to the water preserve.

The pedo-climate and ecological frame from the Transylvanian Depression is given by the existence of the interaction of a great number of factors, of which two are very important for the agroechosystem (Rusu et al., 2017); the first is the thermal background with high time variations, features which impose significant restrictions for thermophile plants like: corn, soy, sunflower and the second is the hill orography. The land degradation from the Transylvanian Depression and its effects must be regarded from the point of view of the local physical-geographical conditions, over which extreme climate conditions superpose. These conditions create, in general, a frame favorable for the development of morphogenetic processes caused by human activity, besides just like those caused by natural mechanisms, intensifying both the rhythm and their territorial extension. In this regard, we can notice first rainfall, which although under the aspect of the annual amount is lacking, it has a negative influence on the vegetal field by its regime. This is due to the fact that, on one hand, during March-November, when the soil through agro-technical works is always loosened, the quantity of rainfall which causes runoff on slopes is relatively high (40-50% of the total rainfall), and on the other, to torrential rain which has a strong rain aggressiveness. Together with rainfall, relief is also susceptible, by its increased degree of fragmentation and by the slope inclining, especially southern peaks, vegetation by the predominance of cultivated plants and by the advanced stage of land degradation, then lithology by the predominance of friable rocks (sands, bedrocks, freestones etc.). This climate characterization imposes special technological measures of preserving lands.

The interaction of environment factors in relation to the anthropic influence had an impact upon the field state, with a lot of soils degraded by erosion, which impose restrictions regarding the crop structure, the system of machines and tractors which ensure the mechanization of slope works.

The purpose of the research made is the study, under the pedoclimate conditions from the Transylvanian Depression, of the influence of the soil tillage system (conventional and no-tillage) on the accumulation and preserve of water in the soil, on the degree of weeds of wheat crop and of production. The novely of this research lies in the adaptation of an adequate phytosanitary protection system to the soil tillage system applied.

MATERIALS AND METHODS

The research presented in the paper was made at the Agricultural Research and Development Station Turda (ARDS Turda) during 2012-2016 and its purpose was testing two soil tillage systems: the conventional system (with autumn plowing, preparation of land, fertilizing and sowing), respectively no-tillage (direct sowing in the stubble of the pre-emerging crop). The research was made in a 3 years rotation crop (soy-wheat-corn), and for the technological optimization and particularization of the agrotechnical system applied, fertilization and the phytosanitary treatments applied were differentiated/adapted. Arieşan type of wheat was cultivated, which although it is not a very new type, it is productive and adapts easier to different agrotechnical systems (it has a slight genetic polymorphism).

The experiences were made on a vertic phaeosiom type of soil, with the following properties: pH 6.30-7.00, humus 2.21-2.94%, total nitrogen 0.162-0.124%, phosphorus 0.9-5.00 ppm, potassium 126-140 ppm. The experience made is polifactorial, with three repetitions, organized according to the method of subdivized parcels. The surface of an experimental parcel was 48 m^2 (4 m wide x 12 m long).

The experimental factors were:

Factor A - year: a_1 - 2012, a_2 - 2013, a_3 - 2014, a_4 - 15, a_5 - 2016.

Factor B - soil tillage system: b_1 - conventional system (CS), b_2 - no-tillage (NT).

Factor C - phytosanitary treatments: c_1 - without herbicides, c_2 - with herbicides (combinations of treatments presented in Table 1).

Sowing was made with Gaspardo Directa-400 sowing machine directly for the no-tillage variant. The sowing thickness was 550 germinable seeds/m^2, at 18 cm distance among lines and incorporating the seed 5cm deep (the pre-emerging plant is soy). The fertilization of the crop was made in two phases, with $N_{40}P_{40}$ kg active substance/ha in the autumn at the same time with sowing plus an additional fertilization with N_{40} kg active substance/ha in the spring when wheat retakes its vegetation.

The degree of weeds of the crop and the spectre of weeds presented was determined visually and by numbers with the help of the metric frame (0.25 m^2), then gravimetrically by extracting the seeds, separating them according to species, weighting and drying them in the oven. The production of the wheat crop was determined by weighting on the experimental parcels, after taking out the sides and transforming the production according to STAS moisture (14%). The set up of the soil moisture 0-100 cm deep was made according to the gravimetric method (taking soil samples with Theta drill and drying them in the oven). The experimental data was processed according to the variance analysis and by establishing the limit differences (5%, 1%, 0.1%).

Table 1. Products used for the control of vegetation and crop protection during 2012-2016

<table>
<tr><th rowspan="2">Variant of treatment</th><th colspan="4">Phenophase of application / dose</th></tr>
<tr><th colspan="2">End of twinning</th><th colspan="2">Skin</th></tr>
<tr><td rowspan="3">c_1-without herbicides</td><td>Polyfeed (foliar fertilizer: 19-19-19+1% Mg+ME)</td><td>2.5 kg/ha</td><td>Evolus (proquinazid 40 g/l + tebuconazol 160 g/l + procloraz 320 g/l)</td><td>1.0 l/ha</td></tr>
<tr><td>Calypso 480 SC (tiacloprid 480 g/l)</td><td>0.1 l/ha</td><td>Fastac 10 EC (alfacipermetrin 100 gr/l)</td><td>0.1 l/ha</td></tr>
<tr><td>Falcon 460 EC (167 g/l tebuconazol + 43 g/l triadimenol + 250 g/l spiroxamina)</td><td>0.6 l/ha</td><td>Trend 90 (900 g/l alcool isodecil etoxilat)</td><td>0.3 l/ha</td></tr>
<tr><td rowspan="4">c_2-with herbicides</td><td>Fastac 10 EC (alfacipermetrin 100 gr/l)</td><td>0.1 l/ha</td><td>Polyfeed (foliar fertilizer: 19-19-19+1% Mg+ME)</td><td>2.5 kg/ha</td></tr>
<tr><td>Sekator Progres OD (amidosulfuron 100 g/l+iodosulfuron-metil-Na 25 g/l+mefenpyr dietil 250 g/l) + DMA 6 (600g/l dimetil amina 2.4D)</td><td>0.15 l/ha + 0.6 l/ha</td><td>Evolus (proquinazid 40 g/l + tebuconazol 160 g/l + procloraz 320 g/l)</td><td>1.0 l/ha</td></tr>
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</table>

RESULTS AND DISCUSSIONS

The results obtained must be reported to the evolution of climate factors in order to identify the best agrotechnical measures to adapt to climate changes. In this regard, an analysis of the evolution of the thermal and rainfall regime at ARDS Turda (altitude of 427 m) is presented during the last 60 years, respectively since 1957, date when the station was set up and up to present (Figure 1 and Figure 2). The research area is characterized by a multiannual average temperature of 9.1°C and by multiannual average rainfall of 518.6 mm. But during the last 15 years one can notice a clear tendency of rising temperatures and a fall of the rainfall recorded. The climate changes recorded, as well as the unpredictible ones from the future impose the judicial choice of the biological material which is going to be cultivated and the application of certain agrotechnical systems adequate to the new climate conditions.

Specific for the five years taken into account in the study (2012-2016) was the unequal distribution of rainfall; there were periods of drought, with extended pedologic drought followed by torrential rain.

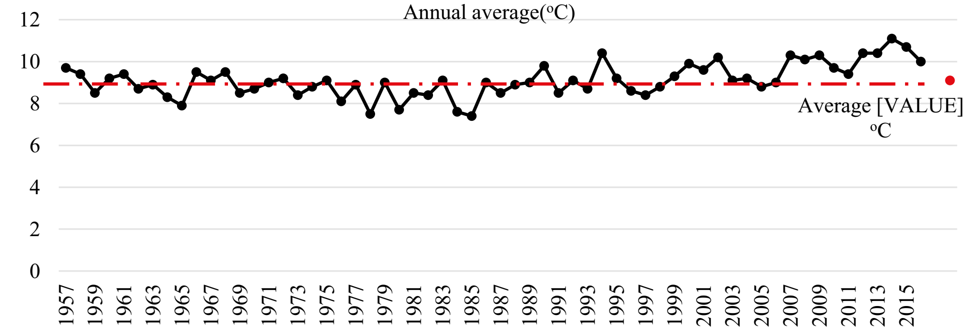


Figure 1. The thermal regime ARDS Turda, 1957-2016

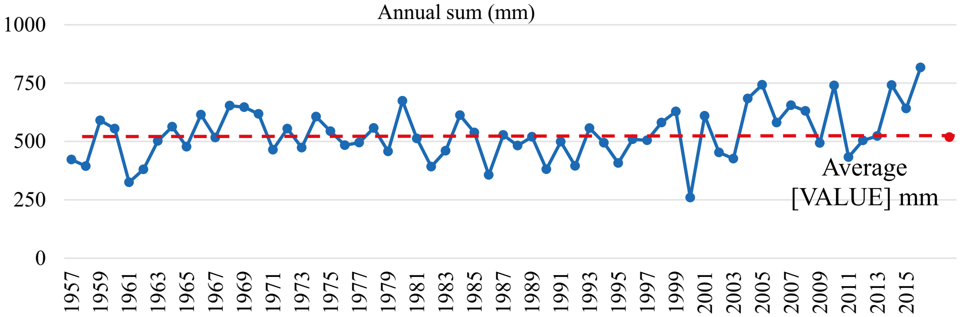


Figure 2. The rainfall regime ARDS Turda, 1957-2016

April and May in 2012 were warm, and during June-August there was a permanent heat which lasted for 21 days in a row; during this period temperatures were over 32^{o}C, and the biological processes of the plant stopped. From the point of view of rainfall all months were very droughty. The rainfall from the two months, April and May somehow restored the water reserve in the soil, which helped plants make good productions.

Specific for 2013 was the alternation of heat waves with waves of cool temperatures, with high differences from one period to another, which resulted in the disruption of biological cycles at certain species of plants. The temperature values deviated from multiannual average by +2.1 up to +2.5^{o}C, generating three warm months, of which April and May, where thermal values exceeded 29^{o}C. During summer, compared to the monthly multiannual average, thermal values exceeded the multiannual average by +1.7 in July and respectively by +2.9^{o}C in August, the months being warm in a whole, the maximum values of temperature exceeded many times the heat threshold. The end of July – beginning of August recorded seven days of continuous heat and which, corroborated with relatively very low moisture (around 20-29%) determined the installation of a stabilized atmosphere drought.The highest value of temperature was +35.8^{o}C on 9.08.2013. In July and August a strong drought installed which caused stress to plants, intensive rain came late, at the end of August, after 25.08.2013.

From a climate point of view, 2014 was a favorable year for agricultural crops, the alternation of months with normal temperatures from a thermal point of view with hot ones was beneficial for the ongoing of vegetative steps. The rainfall from 2014 with the annual amount of 741.5 mm was quantitatively high, especially in the summer, even if the number of rainy days was smaller.

2015 was characterized as a warm and rainy year. The average of the year was 10.6°C, that is 1.5°C higher than the multiannual average in 60 years. The rainfall of this year exceeded by 122.4 l/m^2 the multiannual average in 60 years (518.8 l/m^2). The amount recorded was 641.2 l/m^2.

2016 is characterized as a warm year, with a deviation of +0.9°C compared to the multiannual average, recording an annual average temperature of 10°C. From the point of view of the rainfall regime, 2016 with 816.8 l/m^2 and a deviation of +288 l/m^2 compared to the multiannual average is characterized as an excessively rainy year.

The reduction of the weed degree of the land was made inside the crop rotation by the herbicidation of the wheat stubble with Glifosat (glifosat acid 360 g/l) in dose of 3-4 l/ha in 300 l water, 15-20 days after wheat was harvested. Three weeks later mustard was sowed as green fertilizer in order to keep the soil covered with vegetation until sowing, when mustard was chopped and incorporated in the soil through an artificial soil work. The species of weeds presented in the weed crop before the herbicide treatment were 25, of which 17 annual dicotyledonous (DA): *Xanthium pensylvanicum, Chenopodium album, Polygonum convolvulus, Polygonum aviculare, Polygonum lapathifolium, Erigeron canadensis, Capsella bursa-pastoris, Veronica persica, Sonchus oleraceus, Papaver dubium, Ambrozia artemisiifolia, Galium aparine, Delphinium consolida, Arctium lappa, Viola arvensis, Hibiscus trionum, Amaranthus retroflexus*; 5 perennial dicotyledonous (DP): *Convolvulus arvensis, Rubus caesius, Cirsium arvense, Taraxacum officinale, Lathyrus tuberosus*; 2 annual monocotyledonous (MA): *Setaria glauca, Echinochloa cruss galli* and a perennial monocotyledonous species (MP): *Agropyron repens.*

Inside the experience, in c_2 variant, herbicidation was made at the end of the wheat twinning, when annual dicotyledonous weeds have 2-3 leaves, perennial dicotyledonous weeds like bull thistle (*Cirsium arvense*) are up to 10 cm high and annual monocotyledonous weeds like bristle grass (*Setaria glauca)*, beared grass (*Echinochloa cruss galli*) have 2-4 leaves and are not united. Herbicidation was made using the sistemic products Sekator Progres OD + DMA 6 (0.15 l/ha + 0.6 l/ha) which fight against a large spectre of annual and perennial dicotyledonous weeds and some monocotyledonous.

In the no-tillage system, in the first year of application, the number of weeds was higher compared to the conventional system (Figure 3). After the first year of experimenting, during 2013-2016, one can notice a reduction of weeds in the no-tillage system (from 50 weeds/m^2 in 2012 to 48 weeds/m^2 in 2013, 40 weeds/m^2 in 2014, 31 weeds/m^2 in 2015, 21 weeds/m^2 in 2016). The decrease of the degree of weeds in no-tillage is also due somehow to vegetal debris (mulch) left on the soil surface from the pre-emerging crop (in our case soy) they are incorporated, just like in the case of the conventional system. Also, in no-tillage one can notice a drop of the number of annual dicotyledonous weeds and a rise of the number of perennial dicotyledonous weeds, as well as of the number of perennial monocotyledonous weeds. Among the species of perennial monocotyledonous weeds, *Agropyron repens* was present during all experimental years, fighting against it in the wheat crop cultivated in no-tillage system is harder to achieve even if complex herbicides to fight against weeds were applied.

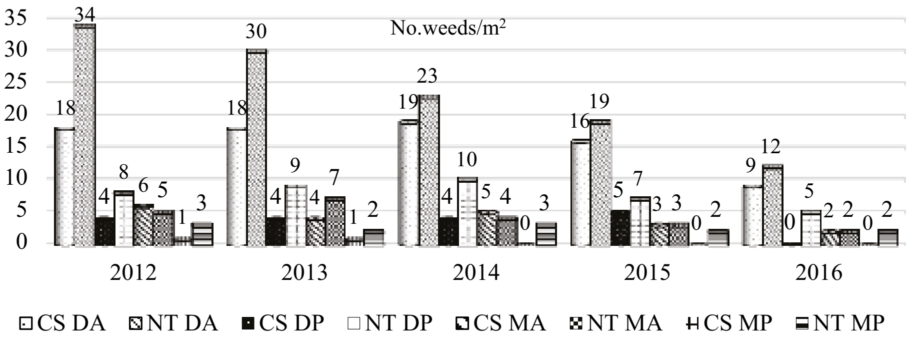


Figure 3. Species of weeds participating at the weed degree of wheat crop, 2012-2016

The degree of weeds of wheat in the conventional system, during all five experimental years, is smaller (compared to no-tillage), the weeds present were 29 weeds/m^2 in 2012, 24 weeds/m^2 in 2013, 28 weeds/m^2 in 2014, 24 weeds/m^2 in 2015 and 11 weeds/m^2 in 2016.

The total mass of weeds determined during 2012-2016 in c_1 variant -without herbicides is 18.5 t/ha in the conventional system and 25.5 t/ha in no-tillage system (Table 2). The highest number percentage in both soil tillage systems was represented by annual dicotyledonous weeds, that is 80 weeds/m^2 and 5.2 t/ha vegetative mass in the conventional system, respectively 118 weeds/m^{2}and 5.6 t/ha in no-tillage system. The highest percentage as vegetative mass was represented by perennial dicotyledonous weeds, with 10.7 t/ha in the conventional system and 14.7 t/ha in no-tillage. Annual monocotyledonous weeds had the lowest degree of participation at the crop weed in both soil tillage systems, of 2.1 t/ha in conventional system and 2.3 t/ha in no-tillage. Perennial monocotyledonous represented 0.5 t/ha in the conventional system and 2.9 t/ha in no-tillage.

Table 2. Weed degree of wheat crop in c_1 variant - without herbicides, 2012-2016

Soil tillage system / year / variant		Annual dicotyledonous			Perennial dicotyledonous			Annual monocotyledonous			Perennial monocotyledonous		
		No/m^2	g/m^2	t/ha	No/m^2	g/m^2	t/ha	No/m^2	g/m^2	t/ha	No/m^2	g/m^2	t/ha
c_1 x conventional system	2012	18	153	1.5	4	368	3.7	6	55	0.6	1	29	0.3
	2013	18	73	0.7	4	249	2.5	4	49	0.5	1	24	0.2
	2014	19	95	1.0	4	222	2.2	5	52	0.5	-	-	-
	2015	16	124	1.2	5	241	2.3	3	29	0.3	-	-	-
	2016	9	83	0.8	-	-		2	22	0.2	-	-	-
Total		**80**	**528**	**5.2**	**17**	**1080**	**10.7**	**20**	**363**	**2.1**	**2**	**53**	**0.5**
c_1 x no-tillage system	2012	34	247	2.5	8	319	3.2	5	63	0.6	3	77	0.8
	2013	30	81	0.8	9	434	4.3	7	58	0.6	2	54	0.5
	2014	23	62	0.6	10	271	2.7	4	61	0.6	3	69	0.7
	2015	19	82	0.8	7	235	2.3	3	31	0.3	2	51	0.5
	2016	12	92	0.9	5	224	2.2	2	20	0.2	2	43	0.4
Total		**118**	**564**	**5.6**	**39**	**1483**	**14.7**	**21**	**233**	**2.3**	**12**	**294**	**2.9**

In c_2 variant- with herbicides, the efficiency of these treatments determined the formation of a vegetative mass of reduced weeds in both soil tillage systems (Table 3). Annual dicotyledonous weeds had a weight of 0.46 t/ha in the conventional system and 0.68 t/ha in no-tillage. Perennial dicotyledonous weeds represented 8.0 t/ha in the conventional system and 12.7 t/ha in no-tillage. The lowest value was recorded at annual monocotyledonous weeds, 0.2 t/ha in the conventional system and 0.3 t/ha in no-tillage and were present only during the first experimental years.

Table 3. Weed degree of wheat crop in c_2 variant - with herbicides, 2012-2016

Soil tillage system / year / variant		Annual dicotyledonous			Perennial dicotyledonous			Annual monocotyledonous			Perennial monocotyledonous		
		No/m²	g/m²	t/ha	No/m²	g/m²	t/ha	No/m²	g/m²	t/ha	No/m²	g/m²	t/ha
c_2 x conventional system	2012	2	14	0.1	2	251	2.5	1	11	0.1	1	23	0.2
	2013	1	9	0.09	1	147	1.5	1	13	0.1	1	25	0.3
	2014	1	11	0.1	1	128	1.3	-	-	-	-	-	-
	2015	1	7	0.07	1	143	1.4	-	-	-	1	25	0.3
	2016	1	10	0.1	1	131	1.3	-	-	-	-	-	-
Total		**6**	**51**	**0.46**	**6**	**800**	**8.0**	**2**	**24**	**0.2**	**3**	**73**	**0.7**
c_2 x no-tillage system	2012	2	15	0.2	3	293	2.9	1	12	0.1	2	28	0.3
	2013	2	15	0.2	2	254	2.5	1	11	0.1	1	20	0.2
	2014	1	8	0.08	2	261	2.6	1	13	0.1	1	22	0.2
	2015	1	10	0.1	2	229	2.3	-	-	-	2	27	0.3
	2016	1	11	0.1	2	235	2.4	-	-	-	1	24	0.2
Total		**7**	**59**	**0.68**	**11**	**1272**	**12.7**	**3**	**36**	**0.3**	**7**	**121**	**1.2**

Optimizing the soil tillage system for the autumn wheat crop must ensure the accumulation and preserve in the soil of the entire quantity of water coming from the rainfall during summer and autumn. It is known that during the last years the climate in the Transylvanian Plain has changed, with the increase of the annual average temperature as well as the non-uniformity of rainfall, that is why the agrotechnique applied must be adapted to more oscillating ecological conditions. Following the determinations made during 2012-2016, regarding the moisture existing in the soil in the autumn wheat crop, one can notice that there are certain differences among the soil tillage systems (Figure 4).

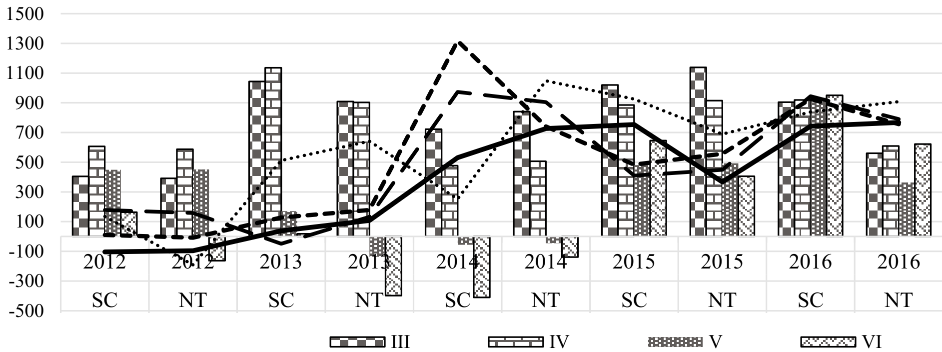


Figure 4. Influence of the tillage system applied to wheat crop on the water reserve of the soil (m^3/ha), 2012-2016

In March-April 2012, although there were before three droughty months and only January was rainy, the accessible moisture reserve kept in normal limits, with a tendency to drop towards minimum values. The results of the lack of rainfall in spring were felt in the following months June-September, with pedologic drought 0-100 cm deep (-104 m^3/ha in the conventional system in September; -163 m^3/ha in June, -8 m^3/ha in July in no-tillage system). In August, excessively droughty, the pedologic drought was accompanied by the atmosphere drought and very high temperatures. The soil moisture renewed in October, which was beneficial for the post-emerging crop from the rotation.

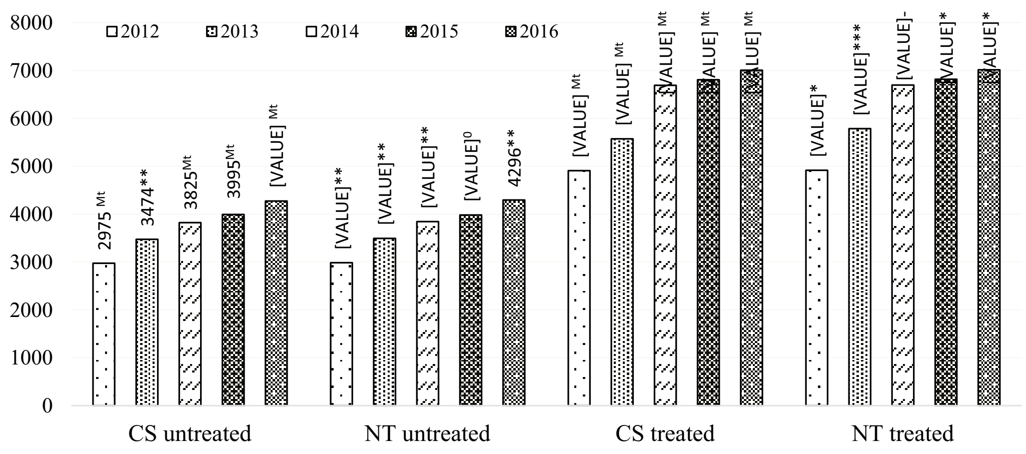
In 2013, wheat followed in the rotation after soy, benefitting from the renewal of the accessible moisture in the soil. The spring months alternating between excessive rain and excessive drought ensured normal moisture reserves to the wheat crop, of 908 m^3/ha. In the autumn of 2013, an autumn in which rainy months alternated with droughty months, the moisture reserve renewed reaching very good values, close to optimal supply (60% of the interval of active moisture).

In the spring of 2014, the values of the accessible reserve maintained to values close to optimal, that is between 506-840 m^3/ha. Only in May and June the values of the accessible reserve dropped under the fading coefficient (-56 m^3/ha and -411 m^3/ha, in the conventional system; -46 m^3/ha and -139 m^3/ha in the no-tillage system).

The renewal of the water reserve during 2015-2016 had to suffer because of short torrential rain when the leakage from slopes was higher than the infiltrations in the soil. In the no-tillage system, the accesible water reserve is kept better in the soil even during drought, the depth water rises through capillaries to the radicular area compensating the lack of water due to drought. The water reserve in the soil in no-tillage is renewed harder than in the conventional system, but here the loss of water is as rapid. The higher degree of weeds in the first years of application in no-tillage leads also to a higher consumption of water, with influence on the wheat production.

The wheat production made during the experimental years 2012-2016 has significant differences, given by the soil tillage system and by the treatments applied, as well as by the climate conditions specific for the years taken into account in the study (Figure 5). Thus, compared to the conventional system without herbicides, where productions ranged between 2975-4275 kg/ha, in the no-tillage system productions ranged between 2987-4296 kg/ha. Except for 2015 where the production made was very close, in both soil tillage systems, with a difference of only 11 kg/ha (3995 kg/ha in the conventional system and 3984 kg/ha in the no-tillage system).

The wheat production achieved in the case of the c_2 variant - treatments including herbicides is significantly higher. In 2013, 5788 kg/ha were achieved in the no-tillage system and 5575 kg/ha in the conventional system, with a difference of 214 kg/ha. In 2012, 2015, 2016 productions ranged between 4919-7016 kg/ha in the no-tillage system. Thus, the no-tillage system influences significantly positive production and is suitable for the wheat crop in the Transylvanian Plain and it mandatory needs at least one treatment against weeds. The conventional soil tillage system recorded productions ranging between 4909-7007 kg/ha. 2014 (a rainy year) determined very close productions between the two soil tillage systems (6693 kg/ha in the conventional system and 6697 kg/ha in no-tillage system).



DL (p 5%) =7.6; DL (p 1%) =11; DL (p 0.1%) = 26

Figure 5. Interaction of factors tillage system x treatments x years on wheat production, 2012-2016

In achieving these wheat productions, a very important role besides the treatments applied was also played by the fractionated application of mineral fertilizers to supplement the reserve of nutritive elements in the soil, crop rotation, correctiveness of execution of all works the soil tillage system involves.

CONCLUSIONS

The no-tillage system determines in the case of wheat crop a higher degree of weeds during the first years of application, but it decreases starting with 2013, determining the progressive growth of wheat production. This decrease of weeds has a positive influence on the water reserve in the soil, and together with mulch influence the rhythm of loss of water in the soil in no-tillage.

The conventional system determines a more reduced total mass of weeds, of 18.5 t/ha in the variant of treatments without herbicides and 9.36 t/ha in the variant of treatments with herbicides. In the no-tillage system, the total mass of weeds was 25.5 t/ha in the variant of treatments without herbicides and 14.88 t/ha in the variant of treatments with herbicides.

The higher values of the accessible water reserve in the soil were recorded, during the first years, in the conventional soil tillage system, but at the same time a more rapid loss is recorded here than in the no-tillage system, where the accumulation of water in the soil is made harder but is lost slower.

The wheat production achieved in the conventional system in the variant without herbicides, during 2012-2016 recorded values ranging between 2975-4275 kg/ha, and in the no-tillage system a higher production was achieved, ranging between 2987-4296 kg/ha. In the no-tillage system where treatments with herbicides were applied, productions ranged between 4919-7016 kg/ha.

The land particularities from the hills in the Transylvanian Plain determined by relief, climate and soil condition impose the use of certain conservative soil tillage alternatives, as it is only such that certain objectives can be achieved, for example: the increase and capitalization of the soil capacity to preserve high water quantities and thus to avoid the surface and depth leaks; the decrease of the number of tillage and the avoidance of water evaporation, structure degradation and the decrease of soil erosion; the ensurance of a favorable crop state to reduce the soil erosion during critical times from the point of view of rain erosion and snow melting; the ensurance of durable growth and development conditions of crop plants.

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