Available online at www.sciencedirect.com

ScienceDirect

Procedia Technology 22 (2016) 457 – 464

Procedia Technology

9th International Conference Interdisciplinarity in Engineering, INTER-ENG 2015, 8-9 October 2015, Tirgu-Mures, Romania

Influence of Soil Tillage Systems and Weed Control Treatments on Root Nodules, Production and Qualitative Indicators of Soybean

Cornel Chetan[a,b,*], Teodor Rusu[b], Felicia Chetan[a,b], Alina Simon[a,b]

[a]*Agricultural Research and Development Station Turda, 27 Agriculturii Street, Turda, 401100, Cluj County, Romania*
[b]*University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Manastur Street, Cluj-Napoca, 400372, Romania*

Abstract

The use of herbicides increases labor productivity being synthetic products, foreign ecosystem, abused, without a thorough knowledge can be dangerous for the environment through the introduction of toxic waste in agricultural ecosystems. It is necessary to reduce the doses used in relation to the use of conservative technology, finding solutions optimized for effective weed control. Research conducted at Agricultural Research and Development Station Turda in the years 2013 and 2014 have followed the effect of 12 variants of herbicides used to control weeds in soybean crop, sown in two tillage systems (classical system and minimal tillage system), the formation of root nodules, soybean production and quality indicators. Tillage system significantly influenced both qualitative indices and soybean crop production (being 2635 kg/ha to the classical and 2131 kg/ha minimum tillage system). The significant influence of tillage soybeans in fat content (20.34% in minimum tillage system; 19.94% to the classical) and on protein (39.89% minimum tillage system; 40.56% in the classic).

Peer-review under responsibility of the "Petru Maior" University of Tirgu Mures, Faculty of Engineering

Keywords: soil tillage systems; treatments; nodules; quality indicators; climatic conditions.

1. Introduction

Minimum tillage seeding system, which at first was an effective technology for soil conservation against erosion [2], has evolved over time to an economic system of sustainable agriculture as an alternative to the conventional

* Corresponding author. Tel.: +40-741-628-313; fax: +40-264-311-792.
E-mail address: cornel_chetan@yahoo.com

Peer-review under responsibility of the "Petru Maior" University of Tirgu Mures, Faculty of Engineering
doi:10.1016/j.protcy.2016.01.088

system. This system improves the physical, chemical and biological soil properties, reduces the risk of environmental pollution by reducing losses of nutrients and decreased direct and indirect greenhouse gas. In that direction, minimum soil tillage systems should be applied appropriate it aimed [1, 5, 12, 20, 22, 23]: reducing soil erosion and compaction, reducing energy consumption, plant protection, soil and water conservation, fuel economy [7, 8, 14, 15, 18, 26].

The most valuable oleo protein plant - is grown in many countries of the world, being used all the biomass, especially are used seeds rich in protein substances, extractive nitrogenous, fats, vitamins and minerals salts [13, 21, 25]. To obtain high yields and quality, a very important role, along with all the other technological links and all other biological material used is the weed control [16, 19].

On soils with a high content of phosphorus in soybean root it develops strong nodules caused by symbiosis with *Bradyrhizobium japonicum*, due to increase their weight and percentage of nitrogen increases the activity of nodules nitrogenize formats. Phosphorus plays an important role in the process of fixing nitrogen biological as the source of energy for converting molecules adenoids-triphosphate (ATP). Potassium influences the symbiotic nitrogen fixation indirectly from legumes, activating nitrogenize, a vital enzyme for the nitrogen fixation. Soil acidity affects nitrogen fixation, a pH less than 6.0 decreases production and their number of nodules root of legumes. Soils that correspond to experienced and studied in terms of the culture of soybean agrochemical requirements. The climatic conditions of the area are favorable to this crop and favor nitrogen fixation, free of the need for high doses of fertilizer [3, 4]. The soybean plants, about 75% by weight of roots develop in the top 30 cm of soil depth [13, 22]; precipitation has therefore decisive role in the success of culture, both in terms of production and weed control. Developed root system and good penetration soy and available until the 1.2-1.5 m soil in deep is allows to extract food and water needs [9, 10]. Mineral fertilization provides increased output on soils with low fertility potential, but on humus rich soils, phosphorus and potassium mineral fertilizers may be waived. Soy procures their nitrogen from different sources: rainwater, nitrogen fixing bacteria activity, humus and nitrogen mineralization residual is a very good run for most crops because improves properties soil physicochemical [6, 11, 17, 27].

This paper has as researching the effect of 12 variants of herbicides used to control weeds in soybean crop, sown in two tillage systems (classical system and minimal tillage system), the formation of root nodules, yields and quality indices of soy, grown on a vertic faeoziom.

2. Materials and methods

The research was conducted in years 2013 and 2014 on the Agricultural Research and Development Station Turda (ARDS Turda). Experimental field is located in Transylvanian Plain, on the faeoziom vertic soil type, texture clay loam, pH neutral, good and very good supply of phosphorus and potassium soil humus content being environment. Experience two-factor type is organized bet on four repetitions. As biological material used Felix soybean cultivar (maturity group 00, during the growing season of 122 days) created at the ARDS Turda. It is a variety with high waist with a height suitable to mechanical harvesting pods insertion basal 16 cm and very good resistance to diseases and pests.

Experimental factors were:

Factor A - year 2 graduations: A_1-2013; A_2-2014.

Factor B - tillage system with too graduation: B_1 system with conventional tillage (CT): 30 cm plowing rotary harrow a deep + sowing+ fertilized; B_2-system minimum tillage (MT): soil processing with chisel + rotary harrow while sowing fertilization.

The dose of complex mineral fertilizer was 100 kg/ha (NPK 20:20:0). Sowing was done using drill Gaspardo Directa 400 John Deere tractor in aggregate, at 18 cm row spacing, seed depth of incorporation was 5 cm, rule 118 kg seed/ha. It provided a number of 95 grains germinate/m^2. The size of the experimental plots is 48 m^2. Previous plant soybean crop was maize.

Factor C - 12 variants herbicide graduations C_1 untreated control; C_2-C_{12}: doses, combinations, and different times of application of the herbicides. The dosage schedule and application rates are summarized in Table 1.

The determination was carried out by displacement nodulation soybean plants spade on the surface of a 0.25 m^2 ground with for the roots, counted nodules on each plant roots of each one (5 plants taken at random) from all 4 repetitions and the average was calculated. Soybean harvest was performed using Wintersteiger combine experimental plots having 1.4 m working width. The output of each variant, in all 4 repetitions to individual weight was calculated at 12% humidity STAS then reported per hectare. The composition of soybeans (moisture, protein, oil) was performed using infrared analyzer laboratory in Inframatic Perten IM9500. For each sample we used a quantity of 500 grams grains obtained from the average variance on each repetition

Table 1. The scheme of treatments

The variant	Herbicide use	Rates l, g/ha	Period of aplication
C_1	Untreated	-	-
C_2	Dual Gold 960 EC (*S-metolaclor* 960 g/l)	1.5 l/ha	ppi
	Pulsar 40 (*Imazamox* 40 g/l) + Agil 100 EC (*Propaquizafop* 100 g/l)	0.8 l/ha+1.5 l/ha	post I
C_3	Frontier Forte (*Dimetenamid* 720 g/l)	1.2 l/ha	ppi
	Basagran Forte (*Bentazon* 480 g/l) + Fusilade Forte (*Fluazifop-P-butil* 150 g/l)	2.5 l/ha+1.5 l/ha	post I
C_4	Proponit 720 EC (*Propisoclor* 720 g/l)	3.0 l/ha	ppi
	Pulsar 40 (*Imazamox* 40 g/l) + Leopard 5 EC (*Quizalofop-P-etil* 50 g/l)	1.0 l/ha + 2.0 l/ha	post I
C_5	Stomp 330 EC (*Pendimetalin* 330 g/l)	5.0 l/ha	ppi
	Pulsar 40 (*Imazamox* 40 g/l) + Select Super (*Cletodim* 120 g/l)	1.0 l/ha +2.0 l/ha	post I
C_6	Sencor 70 WG (*Metribuzin* 700 g/kg)	0.4 kg/ha	ppi
	Basagran Forte (*Bentazon* 480 g/l) + Agil (*Propaquizafop* 100 g/l)	2.5 l/ha + 1.0 l/ha	post I
C_7	Guardian (*Acetoclor* 820 g/l) + Sencor 70 WG (*Metribuzin* 700 g/kg)	2.2 l/ha + 0.4 kg/ha	preem
	Pulsar 40 (*Imazamox* 40 g/l) + Fusilade Forte (*Fluazifop-P-butil* 150 g/l)	1.2 l/ha + 1.5 l/ha	post I
C_8	Dual Gold 960 EC (*S-metolaclor* 960 g/l) + Sencor WG (*Metribuzin* 700 g/kg)	1.4 l/ha + 0.4 l/ha	preem
	Basagran Forte (*Bentazon* 480 g/l) + Leopard 5 EC (*Quizalofop-P-etil* 50 g/l)	1.2 l/ha + 1.0 l/ha	post I
	Basagran Forte (*Bentazon* 480 g/l)	1.0 l/ha	post II
C_9	Frontier Forte (*Dimetenamid* 720 g/l) + Sencor 70 WG (*Metribuzin* 700 g/kg)	2.5 l/ha + 2.5 l/ha	preem
	Pulsar 40 (*Imazamox* 40 g/l) + Agil (*Propaquizafop* 100 g/l)	3.0 l/ha + 1.5 l/ha	post I
	Pulsar 40 (*Imazamox* 40 g/l)	1.0 l/ha	post II
C_{10}	Proponit 720 EC (*Propisoclor* 720 g/l) + Sencor 70 WG (*Metribuzin* 700 g/kg)	2.5 l/ha+ 0.4l/ha	preem
	Basagran Forte (*Bentazon* 480 g/l) + Select Super (*Cletodim* 120 g/l)	3.0 l/ha + 1.5l/ha	post I
C_{11}	Stomp 330 EC (*Pendimetalin* 330 g/l) + Sencor 70 WG (*Metribuzin* 700 g/kg)	4 l/ha + 0.4 l/ha	preem
	Harmony 50 SG (*Tifensulfuron-metil* 50%) + Agil (*Propaquizafop* 100 g/l)	12g/ha + 1,5 l/ha	post I
	Harmony 50 SG (*Tifensulfuron-metil* 50%)	12g/ha	post II
C_{12}	Sencor 70 WG (*Metribuzin* 700 g/kg)	0.5 l/ha	preem
	Harmony 50 SG (*Tifensulfuron-metil* 50%) + Select Super (*Cletodim* 120 g/l)	18 g/ha + 2.0 l/ha	post I

Table 2. Thermic regime for the years 2013, 2014 ARDS Turda

Year	Months - temperature recorded (^oC)											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2013	-2.4	2.0	3.5	12.3	16.8	19.4	20.9	22.1	13.8	11.2	7.1	-1.7
2014	0.5	3.8	8.8	11.4	15.1	18.5	20.4	19.9	16.6	10.8	5.7	1.3
Average 58 years	-3.5	-0.9	4.1	9.8	14.7	17.7	19.6	19.2	14.9	9.6	3.8	-1.5

Table 3. Rainfall regime for the years 2013, 2014 ARDSTurda

Year	Months - rainfall recorded											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2013	19.8	10.3	57.9	53.3	79.3	86.2	37.6	44.0	57.8	67.8	5.9	3.3
2014	51.6	15.5	23.1	72.0	66.2	48.4	144.4	83.8	48.4	67.4	34.2	86.8
Average 58 years	21.3	18.6	23.1	44.7	67.7	84.5	76.7	55.9	40.3	32.0	32.9	27.8

.

Pre-emergence herbicides with soil incorporation at variants 2-6 have been applied on 08.04, before seeding of soybean culture, in variants 7-12 were used herbicides applied immediately after sowing before emergence of the soybean (12.04). Completion of pre-emergence treatments with post-emergence herbicides on vegetation was achieved when the soybean crop has 4-6 leaves, dicotyledonous weeds are in the rosette stage and perennial monocotyledonous weeds are 15-20 cm height ranging between hard (21.05). Last post- emergence treatment was performed on 03.06, in versions 8.9.11, when height soy is 30 cm and the weeds are at a more advanced stage of growth, 22-30 cm. To obtain the best results we used herbicides combined with complementary action.

Soybean requirements for humidity are high, critical period recorded in the second decade of June and mid-August, in stages of blooming and seed filling. As shown in Table 3, for the periods indicated rainfall was lower than the average for the last 50 years which had an impact on plant growth and development, seed size and weight with a negative effect on yield. Temperatures recorded during flowering and exploit soybean (reproductive stage) were between 19-22^{o}C (table 2), being the optimum range of temperature requirements to soy (20-22^{o}C).

3. Results and discussion

From an inventory of existing weeds work experience with minimum result of 21 species of which the most common being *Xanthium strumarium* annual dicots and *Hibiscus trionum* (with participation from 21-100%), followed percentage of annual monocots and *Echinochloa crus-galli, Setaria glauca* (8-80% participation). Species of perennial dicotyledonous weeds attended with values between 3-40% and perennial monocotyledonous species represented by *Agropyron repens* but only on some versions percentage of 13-77% (in hearths). The cultivated soybean variants were present in the classical system a total of 24 weed species being dominant annual dicotyledonous weeds present in all experimental variants with participation between 1-100%. *Xanthium strumarium* was the most common species, its presence being between 55-123 plants / m2. Perennial dicotyledonous weeds had a participation rate of 2-21% weeding, the largest share *Convolvulus arvensis* having, her presence was recorded in all variants. Annual monocotyledonous weeds (with participation of 1-26%) occur later in culture and not causing major damage to culture. By plowing plow (with return furrow), in the autumn, *Agropyron repens* is controlled largely, resulting in low participation rate of 3-9% in three experimental compared to the high percentage of 13-77% on minimum work experience.

Table 4. Influence of experimental years the number of nodules formed, 2013, 2014 ARDS Turda

The factors	The beginning of flourishing			The end of flourishing		
	Nodules formed (no)	%	Differences	Nodules formed (no)	%	Differences
A_1- 2013	28.4^{MT}	100	0.0	63.1^{Mt}	100	0.0
A_2- 2014	34.1^{***}	120.1	5.7	69.3^{***}	109.8	6.2
	LSD (p 5%) = 0.02 LSD (p 1%) = 0.03 LSD (p 0.1%) = 0.4			LSD (p 5%) = 0.12 LSD (p 1%) = 0.16 LSD (p 0.1%) = 0.20		

Different climatic conditions in the two experimental years influenced the different formation nodules at soy. Year 2014 is considered a very favorable agricultural year for most agricultural crops, the optimal temperature and rainfall favored better assimilation of atmospheric nitrogen; this is achieved through very significant positive difference to the results of 2014. The average number of nodules formed on the beginning of flourishing 34.1 nodules/plant is higher compared to the same period in 2013, 28.4 nodules/plant, a difference of 5.7 (very significant positive) on the beginning of flourishing period; differences remain and finally flourishing period when the values of 63.1 nodules/ plant on 2013 were lower by 6.2 compared to 2014, where the number of nodules was 69.3 nodules/plant (Table 4).

Tillage system (Table 5) very significant negative influence on the number of nodules formed root system of soybeans, same to the beginning of flourishing and the end of flourishing, intense period of activity of nitrogenize; this is due loose soil by plowing. The roots of soybean plants had explored a well worked soil (loose, airy) have developed strong root nodules majority (over 90%) are found only on the first 30 cm of soil.

The number of nodules formed on two phenophases, in experimental variants 2 and 3 of weed control treatments (herbicides applied pre-emergence + post I + post II) is high (very significantly positive) comparative with variants with application of herbicides ppi + post I, where number of nodules is lower, especially during begining of flourishing (very significantly negative) then the number has increased to end of flourishing on nodules. This demonstrates that the greatest influence on soybean nodulation has application period, then treatment (Table 6).

The degree of weeding springs dry soybean crop is higher, this is due to the adaptability of weeds to harsh environmental conditions to plant crops. Due to lack of water in the soil, so before sowing and after sowing soybean seeds had low germination, emergence faulty result, the land was invaded by weeds competed vigorously soybean plants. The rains came after a long period rather weak and quantitatively determined gradual emergence of soybean plants so that the sowing date (April 2013) to the full emergence of culture (end of May) has been almost a month, while the occupied land and weeds pre-emergence herbicides applied to soil had the desired effect. 2014 reference year for soybean crop due to favorable climatic conditions, has led to the high yields in both systems tillage, minimum tillage and classic, which shows the applicability of minimal systems for soybean crop.

Table 5. Influence of tillage system on the number of nodules formed ARDS Turda 2013,2014

Variant tillage		Number nodozities formed (no)	
		The beginning of flourishing	The end of flourishing
B_1 - conventional tillage	Value	33	68
	Differences	0	0
	Semnification	Mt.	Mt.
B_2- minimum tillage	Value	30	65
	Differences	-3	-3
	Semnification	000	000
		LSD (p 5%) = 0.11 LSD (p 1%) = 0.21 LSD (p 0.1%) = 0.46	LSD (p 5%) = 0.10 LSD (p 1%) = 0.18 LSD (p 0.1%) = 0.40

Table 6. Influence of treatments on the number of nodules formed ARDS Turda, 2013, 2014

The factor	Begining of flourishing			End of flourishing		
	Nodules formed (no)	%	Differences	Nodules formed (no)	%	Differences
C_1 (no treatment)	30.5^{Mt}	100	0.0	62.8^{Mt}	100	0.0
C_2 (2 treatments)	29.8^{000}	97.7	-0.7	68.5^{***}	109.2	5.8
C_3 (2 treatments)	25.8^{000}	84.4	-4.8	66.8^{***}	106.4	4.0
C_4 (2 treatments)	29.5^{000}	96.7	-1.0	54.5^{000}	86.9	-8.3
C_5 (2 treatments)	28.8^{000}	94.3	-1.8	67.3^{***}	107.2	4.5
C_6 (2 treatments)	35.3^{***}	115.6	4.8	65.0^{***}	103.6	2.3
C_7 (2 treatments)	36.5^{***}	119.7	6.0	69.5^{***}	110.8	6.8
C_8 (3 treatments)	35.8^{***}	117.2	5.3	75.4^{***}	120.2	12.7
C_9 (3 treatments)	28.0^{000}	91.8	-2.5	66.6^{***}	106.1	3.8
C_{10} (2 treatments)	28.5^{000}	93.4	-2.0	58.8^{000}	93.6	-4.0
C_{11} (3 treatments)	36.0^{***}	118.0	5.5	72.0^{***}	114.7	9.3
C_{12} (2 treatments)	30.5^{-}	100.0	0.0	67.1^{***}	106.9	4.3
	LSD (p 5%) = 0.17 LSD (p 1%) = 0.23 LSD (p 0.1%) = 0.30			LSD (p 5%) = 0.29 LSD (p 1%) = 0.38 LSD (p 0.1%) = 0.49		

Higher values of production (2635 kg/ha) have been obtained from soybean cultivation in classical system compared to the system with minimal work, where average yields were achieved by 2131 kg/ha; considerable difference very negative, 504 kg/ha. Drought in the spring of 2013 had a negative effect on soybean emergence and the effect of treatments applied to soil after sowing of resulted in yields achieved (Table 8).

Weed spectrum, time of occurrence, degree of weeding and methods of combating in differently influence soybean production. No chemical treatments (herbicides) not can control the weeds, since sowing was done at a distance of 18 cm between hard rows and mechanical hoeing not be done. Soybean production system dependent system tillage work and weed control, chemical and cultural methods.

Table 7. Soybean yield in experimental years 2013, 2014 at ARDS Turda

The factor	Yield (kg/ha)	%
A_1- 2013	1538^{Mt}	100
A_2- 2014	3228^{***}	210
	LSD (p 5%) = 75; LSD (p 1%) = 100; LSD (p 0.1%) = 129	

Table 8. Harvests bet on whichever soybean tillage, 2013-2014

Variant tillage	Yield obtain (kg/ha) and semnification
B_1 - conventional tillage	2635^{Mt}
B_2 - minimum tillage	2131^{000}
	LSD (p 5%) = 121; LSD (p 1%) = 222; LSD (p 0.1%) = 492

Table 9. Influence of herbicide treatments on soybean production, ARDS Turda 2013, 2014

The factor	Variant comparison – C_1 untreated			Variant comparison - C_2 treated		
	Yield(kg/ha)	%	Differences	Yield (kg/ha)	%	Differences
C_1 (no treatment)	630^{Mt}	100.0	0.00	630^{000}	26	- 1789
C_2 (2 treatments)	2420^{***}	384	1789	2420^{Mt}	100.0	0.00
C_3 (2 treatments)	1937^{***}	307	1307	1937^{000}	80	- 483
C_4 (2 treatments)	2449^{***}	389	1818	2449^{-}	101	29
C_5 (2 treatments)	2426^{***}	385	1795	2426^{-}	100	6
C_6 (2 treatments)	2853^{***}	453	2222	2853^{***}	118	433
C_7 (2 treatments)	2990^{***}	474	2360	2990^{***}	124	570
C_8 (3 treatments)	3071^{***}	487	2440	3071^{***}	127	651
C_9 (3 treatments)	2666^{***}	423	2035	2666^{**}	110	246
C_{10} (2 treatments)	2640^{***}	419	2010	2640^{*}	109	220
C_{11} (3 treatments)	2549^{***}	404	1918	2549^{-}	105	129
C_{12} (2 treatments)	1964^{***}	312	1334	1964^{000}	81	- 456
	LSD (p 5%) = 173 LSD (p 1%) = 230 LSD (p 0.1%) = 299			LSD (p 5%) = 173 LSD (p 1%) = 230 LSD (p 0.1%) = 298		

The main characters of soybean by quantitative productivity (number of grains per plant, MMB, MH) are: content in fat, protein and fiber. With laboratory analyzer was performed to determine the composition of soybeans to establish relationships that exist between soil tillage system, weed control treatments and MMB, protein and fat.

Year took that factor (climatic conditions) does not affect the content in fat and protein but very significant influence on grain weight. Due to drought in 2013 installed, weight soybeans (MMB) had the value of 163 grams, compared to 2014, which favored the rich in rainfall cultural development throughout the growing season, resulting in high production obtained value MMB 185 grams, grains exceeding 22 grams MMB obtained in 2013.

A first criterion for assessing the quality of soybeans is protein content. The results show that it is possible to decrease between hard limits of the content of the protein through treatment application weed control. Applying herbicides resulted not only changing protein content (very significant negative) and the fat content compared to the control (untreated). Herbicides applied to C_7-C_{11} variants are very significantly influenced positively in percentage fat soybeans, other variants of herbicides significantly influences and distinct significantly positive, except on C_4 and C_6 variants with values on 18.86% to 20.00%, close to the version used as witness. Tillage system significantly influences the content of soybeans in fat percentage values of 20.34% in minimum tillage system, being higher than the classical system, where the value is 19.94%. Tillage system contributes to changing on grain protein content, so the minimum system in protein percentage is lower (39.89) than the classical system where the value is 40.56%. The minimum tillage very significant negative influence thousand grain mass, their weight is smaller than grain weight obtained from soybean cultivation in classic system with plowing (Table 10).

4. Conclusions

Soil tillage systems, are very significant negative influence on the number of nodules formed root system of soybeans, to begining of flourishing at the endof flourishing, the most intense period of activity of nitrogenize. Soybean production system depends on the tillage system and weed control methods, chemical and cultural. The year had the greatest influence on the production of soybean cultivation on two systems: classic and minimum tillage. Treatments significantly influence distinct and highly significant positive in grains fat content but very significant negative content in protein. Tillage system significantly positive influence of fat content in soybeans and very significantly negative content in protein.

Table 10. Influence of tillage system and treatments on soybean quality indices ARDS Turda 2013, 2014

The factor		Indices quality (values)					
		Fat (%)	Differences	Protein (%)	Differences	MMB (g)	Diferenţa
A-Year	A_1- 2013	20.10^{Mt}	Mt.	40.13^{Mt}	0.00	163^{Mt}	Mt.
	A_2- 2014	20.18^{-}	0.08	40.32^{-}	0.19	185***	22
		LSD (p 5%) = 0.58 LSD (p 1%) = 2.92 LSD (p 0.1%) = 29.18		LSD (p 5%) = 0.56 LSD (p 1%) = 2.79 LSD (p 0.1%) = 27.85		LSD (p 5%) = 3.0 LSD (p 1%) = 3.5 LSD (p 0.1%) = 4.0	
B-Tillage system	B_1- CT	19.94^{Mt}	0.00	40.56^{Mt}	0.00	178^{Mt}	0.00
	B_2 - MT	20.34*	0.40	39.89^{000}	- 0.67	171^{00}	- 7
		LSD (p 5%) = 0.18 LSD (p 1%) = 0.42 LSD (p 0.1%) = 1.32		LSD (p 5%) = 0.05 LSD (p 1%) = 0.11 LSD (p 0.1%) = 0.35		LSD (p 5%) = 3.0 LSD (p 1%) = 5.0 LSD (p 0.1%) = 11.0	
C-Treatments	C_1 (no treatment)	19.88^{Mt}	0.00	41.00^{Mt}	0.00	179^{Mt}	0.00
	C_2 (2 treatments)	20.13*	0.25	40.19^{000}	- 0.81	174^{-}	-5
	C_3 (2 treatments)	20.13*	0.25	39.85^{000}	- 1.15	172^{0}	-7
	C_4 (2 treatments)	19.86^{-}	- 0.01	40.43^{000}	- 0.57	170^{00}	-9
	C_5 (2 treatments)	20.18**	0.30	40.30^{000}	- 0.70	172^{0}	-7
	C_6 (2 treatments)	20.00^{-}	0.13	40.30^{000}	- 0.70	179^{-}	0.2
	C_7 (2 treatments)	20.31***	0.44	39.75^{000}	- 1.25	172^{0}	-7
	C_8 (3 treatments)	20.11*	0.24	40.28^{000}	- 0.73	179^{-}	-0.3
	C_9 (3 treatments)	20.26***	0.39	40.19^{000}	- 0.81	169^{00}	-11
	C_{10} (2 treatments)	20.45***	0.58	39.85^{000}	- 1.15	175^{-}	-4
	C_{11} (3 treatments)	20.29***	0.41	40.24^{000}	- 0.76	174^{-}	-5
	C_{12} (2 treatments)	20.09*	0.21	40.35^{000}	- 0.65	177^{-}	-2
		LSD (p 5%) = 0.19 LSD (p 1%) = 0.26 LSD (p 0.1%) = 0.34		LSD (p 5%) = 0.17 LSD (p 1%) = 0.22 LSD (p 0.1%) = 0.29		LSD (p 5%) = 6.0 LSD (p 1%) = 8.0 LSD (p 0.1%) = 11.0	

Acknowledgements

This paper was published under the frame of the European Social Fund, Operational Programme Human Resources Development 2007-2013, project no. HRD/159/1.5/S/132765. This paper was performed under the frame of the Partnership in priority domains - PNII, developed with the support of MEN-UEFISCDI, project no. PN-II-PT-PCCA-2013-4-0015: Expert System for Risk Monitoring in Agriculture and Adaptation of Conservative Agricultural Technologies to Climate Change.

References

[1] Bucur D, Jităreanu G, Ailincăi C, Effects of long-term soil and crop management on the yield and on the fertility of eroded soil,Journal of Food, Agriculture & Environment Vol.9 (2): 207-209, 2011.

[2] Carter MR, Conservation Tillage in Temperatur Agrosystems, Lewis Publishers an Arbor London, 1994.

[3] Cheţan C, Rusu T, Bogdan I, Cheţan F, Șimon A, Combaterea buruienilor la soia cultivată în sistemul minimum-tillage şi producțiile obținute, la SCDA Turda, Simpozionul USAMV Cluj-Napoca Prospects for the 3rd Millennium Agriculture, 2014.

[4] Cheţan F, Rusu T, Cheţan C, Șimon A, Ignea M., Rezultate de producţie obţinute la soia, în perioada 2007-2012, în sistemul de lucrări minime ale solului, la SCDA Turda, INCDA Fundulea, 2014.

[5] Cheţan F, Chetan C, Rusu T, Șimon A, Influenţa sistemului de lucrare a solului şi a fertilizării asupra formării nodozităților radiculare la soia, Simpozionul Îngrăşămintele clasice şi ecologice eficiente pentru folosire în agricultura durabilă organizat de Filiala Națională CIEC Bucureşti, 2014.

[6] Cheţan F, Cultivarea soiei în sistemul de agricultură conservativ, metodă de reducere a dozelor de fertilizanţi, Buletin informativ Septembrie, nr. 21, SCDA Turda, Agricultura Transilvană, Ed. SC Eladesign SRL Turda, pag. 37, 2014.
[7] Cociu IA, Agrotehnica culturilor. Contribuţii la fundamentarea, realizarea şi dezvoltarea de tehnologii durabile şi economic viabile bazate pe agricultura conservativă, Analele INCDA Fundulea, Vol. LXXIX, nr. l: 122, 2011.
[8] Cruz HC, The effect of crop rotation and tillage system on some soil properties, root distribution and crop production. Ph.D. Dissertation, Purdue Univ. W. Lafayette IN, 1982.
[9] Delbert EJ, Soybean cultivar response to reduced tillage systems in northern USA dryland areas, Agronomy Journal, vol. 81;
[10] Dencescu S, Miclea E, Butică A, Cultura soiei, p.130-133, Ed. Ceres, Bucureşti, 1989.
[11] Diaconescu O, Miclea E, 1971, Soia, p.132-133, Ed. Agrosilvică, Bucureşti, 1971.
[12] Fabrizzi KP, Garcia FO, Costa JL, Picone LI, Soil water dynamics, physical properties and corn and wheat responses to minimum and no-tillage systems in the southern Pampas of Argentina. Soil & Tillage Research 81: 57–69, 2005.
[13] Guş P, Cernea S., Rusu T, Bogdan I, Sisteme de semănat, fertilizat şi întreţinere a culturilor, Editura Risoprint, Cluj-Napoca, p. 220, 2004.
[14] Horn R, JJH van den Akker and Arvidsson J, Subsoil compaction. Disstribution, Processes and Consequences. Advances in GeoEcology 32, Germany, 2000.
[15] Ibanez JJ, Effland WR, Krasilnikov PV, Cacovean H, Rusu T, Pedodiversity analysis and soil conservation, 5th International Symposium Soil Minimum Tillage System, p. 134-154. Ed. Risoprint, Cluj-Napoca, 2008.
[16] Ionescu NE, Combaterea buruienilor şi protecţia mediului în cultura cerealelor şi a plantelor tehnice,Ed.SCNelmaco Impex SRL, Bucureşti, p. 151-152, 2000.
[17] Ion V, Fitotehnie, Publicaţie online, 2010.
[18] Jităreanu G, Influenţa sistemului de lucrare asupra unor proprietăţi fizice ale solului, În lucrările Simpozionului Lucrările solului - prezent şi viitor. Cluj-Napoca.vol.II, 1997.
[19] Lal R., Eckert DJ, Fausey NR, Edwards WM, Conservation tillage in sustainable agriculture, In Sustainable Agricultural Systems, St. Lucie Press, Florida, USA, pag. 203-223, 1990.
[20] Moraru PI, Rusu T, Şopterean ML, Soil Tillage Conservaton and its Effect on Erosion Control, Water Management and Carbon Sequestration, In ProEnvironment / ProMediu no. 3: 359 – 366, 2010.
[21] Muntean LS, Axinte M, Borcean I, Roman Gh, Fitotehnie, EDP, Bucureşti, 1995.
[22] Rusu T, Moraru PI, Coste C, Cacovean H, Cheţan F, Cheţan C, Impact of climate change on climatic indicators in Transylvanian Plain, Romania. Journal of Food, Agriculture & Environment Vol. 12 (1): 469-473, 2014.
[23] Rusu T, Cheţan C., Bogdan I, Cheţan F, Moraru PI, Pop AI, Duda B, Coste C, Strategia de control a buruienilor din cultura de soia, Volumul 41 "Lucrări ştiintifice", UniversitateaAgrară de Stat din MoldovaFacultatea de Agronomie, Chişinău, 2014.
[24] Rusu T, Cheţan C, Bogdan I, Cheţan F, Ignea M, Duda B, Ivan I, Bunea Gh, Researches regarding weed control in soybean crop, Simpozionul USAMV Cluj-Napoca: Prospects for the 3rd Millennium Agriculture, 2014.
[25] Scurtu I, Economia şi tehnologia culturilor agricole, Ed. Independenţa economică, Piteşti, p. 231-236, 2001.
[26] Unger P, Cassel D, Tillage implement disturbance effects on soil properties related to soil and water conservation a literature review, In Soil and Till. Research, nr. 19, 1991.
[27] Vidican R, Rusu M, Rotar I, Mărghitaş M, Manualul aplicării fertilizanţilor, Ed. Risoprint, Cluj-Napoca, 2013.