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DETERMINING THE TECHNOLOGY INFLUENCE OF SOY ON THE SOIL, PRODUCTION AND ECONOMIC EFFICIENCY ON TURDA AREA

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Abstract: *This paper aims to address the problem of achieving soybean production and how technological factors influence the realization of production. Was choosing the most efficient technological variants of crop. We compared in the experiment realized at ARDS Turda how the two systems works: classic and minimum. Soybean crop has responded favorably to the unconventional technology, the registered production being almost equal with the one obtained in the classic system. Production obtained in the the conservative system was 2709 kg/ha and 2671 kg/ha in the classical system. The soil resistance to penetration in the conservative system below the depth of 30 cm, the force values (kPa) are lower in the conservative system (1438,50 kPa) as compared to the classic system where the force values are higher (1521,50 kPa).*

Key words: *climatic condition, compaction, economic efficiency, soil minimum works system, soybean production.*

Clasificare JEL: Q 01, Q 15, Q 16.

INTRODUCTION

The conservative agriculture tries to improve, conserved and usage more efficient of natural resources and water (Guş and collab., 2008; Rusu and collab., 2009). By eliminating plowing, totally or periodically, the rationalization of the number of passes and the maintainance at the soil surface of at least 30% of the total of vegetal remains (Ibanez and collab., 2008; Carter, 1994; Tianu and Guş, 1991; Chețan and collab., 2015) the soil is protected against surface erosion, thus eliminating its compaction. The negative effects of soil compaction are numerous, and they are also reflected at the cultivated plants, decreasing the production capacity (Rusu and Guş, 2007). The research starts from the possible relation that exists between the soil tillage system, soil compaction, as well as the productions that can be achieved at a lower cost.

MATERIAL AND METODS

The experiment conducted in the years 2012-2014 at ARDS Turda, situated in Transylvania Plain, on a preluvosol with texture sandy loam-clay type, pH-neutral, supply good and very good with mobile phosphorus (more than 4.5% mg P₂O₅/100 g soil) and potassium (more than 30 mg K₂O/100 g soil), soil in humus content is medium (3.5%). Characteristic of this type of soil is typing fast, when passing with of heavy aggregates on surface or where the tillage is carried out under conditions of high humidity. The experiment realised is the polyfactorial type AxBxC-R:2x2x2-3. Each experimental plot has of 48 m²

The experiment included the factors:

Factor (A) the system of soil work: 2 graduation: a₁ – conventional (CS) with plowghing – preparation of the soil – seeding + fertilizing; a₂ – minimum tillage (MT) work with chisel.

Factor (B) treatments on vegetation: 2 graduation: b₁, b₂, after a complex diagram of application in 3 distinct phenofhases: 3-4 leaves trifoliate, early blooming stage, start of training pods (Table 1).

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Factor (C) fertilizing: 2 graduation: c₁ fertilization with N₄₀P₄₀ concomitances with sowing; c₂ fertilization with N₄₀P₄₀ concomitance with additional sowing a fertilisation with N₄₀P₄₀ in vegetative phase 3-4 trifoliolate leaves.

Factor (D) the agricultural year with 3 graduation : d₁-2012; d₂-2013; d₃-2014.

The sowing was done with ("Onix" variety creation ARDS Turda) precision seeder Gaspardo - Direct 400 (sowing concomitant with fertilizing, thus avoiding repeated passages with heavy units on the soil surface), to 18 cm spacing between rows, the depth of incorporation of seed 5 cm, the quantity of seed per hectare 110 kg.

Plowing and chisel work was performed at 30 cm depth. To determine the soil humidity (U%) was utilized gravimetric method; the most the root system it is on the first 30-40 cm soil, compaction determination was performed on the same depth, register concomitantly temperature and soil moisture, the penetration resistance was determined with digital penetrometer Field Scout SC900; the economic efficiency of the application of the conservative soil tillage system (unconventional) was determined in comparison to the classic system (conventional), according to the number of technological tillage applied, the fuel consumption (diesel) and materials (fertilizers, pesticides).

The results were statistically analyzed by ANOVA test.

Table 1. Scheme of treatments

The variable	3-4 leafs	The starting blooming	The beginning the pods formation
b ₁ - 1 treatment	FF (foliar fertiliser: Polyfeed 5 kg/ha) + FG (fungicide: Amistar 0.5 l/ha)	-	-
b ₂ - 2 treatments	-	FF (foliar fertiliser: Polyfeed 3 kg/ha) + FG (fungicide: Amistar 0.5 l/ha)	FF (foliar fertiliser: Polyfeed 3 kg/ha) + FG (fungicide: Amistar 0.5 l/ha) + IS (insecticide: Neoron 0.3 l/ha)

Analysis of the evolution of periodical climatic factors is fully justified especially in the current context, when lots of information from literature draw attention to changes what founded, both globally and locally.

The evolution of temperature and rainfall regime to ARDS Turda, for the period of vegetation of soy, in the years of 2012-2014 experience is shown in Table 2 and Table 3 (Meteorological Station Turda, longitude: 23°47', latitude 46°35'; altitude 427 m).

The months April and May of 2012, they had a warm character and in summer period June-August has installed a permanent drought that lasted for consecutive 21 days, days with temperatures above 32°C, temperature at which biological processes of the plant is stopped. In terms of rainfall all months were very dry. Rains fallen in two months, April and May, have restored a certain proportion of soil water reserve, which has helped the plants to achieve good yields.

Specific to the year 2013 it was the succession heat waves with waves of something cooler temperatures, with large differences from one period to another which resulted in disruption biological cycles at some species of plants. Temperature values have strayed from the multi-annual average +2.1 to +2.5°C, generating two warm months in April and May, the months in which the thermal values exceeded 29°C, is a hot spring. During the summer, although for several years the monthly averages, heat values have exceeded the multi-annual average of +1.7 and respectively +2.9°C in August, the months in general is warm, the maximum temperature values are often

exceeded the threshold of the heat. The late of month July brought two days of strong sunlight and extended in August in which there have been seven days of heat at the same time and which, in conjunction with very low relative humidity (around 20-29%) indicates the settlement stabilization of atmospheric droughts. The highest temperature was +35.8°C on 9.08.2013. In July and August was installed a strong drought that caused the stress plants, intensity rains came late, at the end of august, after the date of 25.08.2013.

The most favorable year for soybean crop, in climatic condition was 2014. April is characterized as warm average monthly temperature of 11.4°C over the last 55 years average which was 9.8°C with offense +1.6°C; and while rainfall fell 72 l, compared of average 44.7 l, with the departure of +27.3 characterize excessive as rainy month. Application of treatments and additional fertilization to soybean, in May had a beneficial effect on growth and development of plants, dissolution of the mineral fertilizer this is due to the thermal regime with the monthly mean temperature 15.1°C, with the departure of +0.4°C on average 55 years that is 14.7°C and hydric regime with precipitation of 66.2 m³/ha and the amount of the monthly deviation -1.5 m³/ha unto average rainfall over the past 55 years is 67.7 m³/ha. The other months of vegetation period of soybean taken into account: June, July, August and September were the hot months with temperature values between 15.1°C and 19.9°C near values of average 55 years: 14.7°C-19.6°C.

Table 2.The thermal regime ARDS Turda, 2012-2014

Years/ months	Monthly - average temperature (°C)												Average annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2012	-2.3	-6.1	4.7	11.8	16.2	21.0	24.0	22.3	19.1	11.4	5.2	-2.6	10.4
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	10.4
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	11.1
Average 10 years	-2.1	-0.4	5.2	12.2	17.3	20.8	23.0	22.5	17.4	11.0	4.8	-0.8	9.8
Average 57 years	-3.5	-0.9	4.1	9.9	14.8	17.8	19.7	19.3	15.0	9.6	3.8	-1.5	9.0

Table 3.The rainfall regime ARDS Turda, 2012-2014

Years / months	Precipitation - monthly amount (mm)												Annual amount
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2012	26.2	30.7	5.3	78.4	89.2	67.4	52.4	28.0	30.2	42.0	9.6	45.0	504.4
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	523.2
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	741.5
Average10 years	26.0	21.3	30.6	55.3	78.9	111.7	94.2	76.8	49.1	49.1	21.6	29.0	598.2
Average 57 years	21.4	18.8	23.4	45.4	68.3	84.2	75.6	55.2	40.4	32.8	28.0	26.8	520.4

RESULTS AND DISCUSSIONS

From Table 4, it can be seen that in the two technological variant until the depth 0-5 cm the penetration resistance value does not exceed 1226 kPa.

Soil penetration resistance in the variant tillage with moldboards plow has values below 1000 kPa on the depth 0-15 cm, on the depth 20-40 cm was 1174-1483 kPa., the force values are higher on the depth 30 cm, therefore it is advisable to alternate the depth of plowing to prevent hardpand.

The values obtained in unconventional tillage systems, below 2000 kPa, does not adversely affect the penetration of plant roots grown, the soil compaction is less dependent on technological variant, more than depth and weather conditions.

Soil moisture on the classic on the first 25 cm depth not exceed 28 mm, increased by 3 percent to 31 mm 25-30 cm depth followed then fall by 2 percent (29 mm) depth 30-40 cm. In reduced version works (chisel) soil moisture shows similar values 24 to 25 mm, these values

increase to 20 cm depth. At the depth 25-40 cm soil moisture is equal to the classic version. The influence of conservative system the accumulation and preservation of soil water it can be seen from the values obtained the depth increase, 0-40 cm.

Temperature was in the normal limits for the period when measurements were made, grouped around 21-23°C whatever depth, in both technologies.

Table 4. The influence of the interaction between system and ground penetration

Tillage system	Depth (cm)	T (°C)	U (%)	kPa	%	Differences	Signification
CS	0-5	23.3	25.3	642	100	0.00	Mt.
MT		23.1	25.9	1064	166	422	***
CS	5-10	23.1	28.8	512	100	0.00	Mt.
MT		23.4	25.7	898	176	386	***
CS	10-15	23.3	24.2	851	100	0.00	Mt.
MT		23.0	24.6	1101	129	250	***
CS	15-20	23.2	24.4	1070	100	0.00	Mt.
MT		22.9	25.8	1244	116	173	**
CS	20-25	23.1	27.8	1174	100	0.00	Mt.
MT		22.8	27.3	1294	110	120	*
CS	25-30	23.2	31.5	1293	100	0.00	Mt.
MT		22.8	31.4	1335	103	43	-
CS	30-35	23.1	29.9	1447	100	0.00	Mt.
MT		23.0	29.7	1404	97	-43	-
CS	35-40	23.1	29.5	1483	100	0.00	Mt.
MT		22.7	29.8	1460	98	-23	-

LSD (p 5%) = 110; LSD (p 1%) = 155; LSD (0.1%) = 225.

Orographic and ecological conditions that characterise Transylvania Plain, leads to a favorable microclimat festivity maintain of diseases to soya bean (ex. bacterial burn produced by the bacterium, *Pseudomonas glycinae*, passing through infected seed and by plant debris, remained after the harvest).

The determination of the degree of attack of the bacteriological burn installed in the soybean experiment was done in the month of July during the three experimental years.

In Table 5, can be noticed that the most favorable influence was in the year 2014, regarding the intensity and the degree of attack of the bacteriological burn.

The degree of attack (DA) is higher in the conservative system, both in the variant with a single treatment, where the DA values were of 0,3% in 2012; of 1,1% in 2013 and 2,05% in 2014.

Table 5. The influence of the soil tillage system and treatments on the bacteriological burn attack (DA) at soybean crop, 2012-2014

System of work /treatment		Year		
		2012	2013	2014
		DA%	DA%	DA%
CS	a ₁ b ₁	0.3	0.5	1.5
	a ₁ b ₂	0.2	0.3	1.2
MT	a ₂ b ₁	0.3	1.1	2.05
	a ₂ b ₂	0.1	0.8	1.7

The evolution of the soybean yields according to the soil tillage system and to the number of fertilizations and treatments are presented in Table 6. A less favorable influence in the formation

of the soybean yield can be attributed to the year 2013, when the soybean yield did not succeed 1700 kg/ha.

The values of the average soybean yields in the three experimental years point out that between the two soil tillage systems there are no many significant differences under this aspect. However, it can be noticed a slight increase of soybean yield, reacting favorably in the case of the minimum soil tillage as well.

Table 6. The average production obtained at soybean according to the system tillage, treatments and fertilizations, 2012-2014

Variant tillage	Yield (kg/ha)		
	2012	2013	2014
a ₁ b ₁ c ₁ (classic, 1 treatment + 1 fertilizing)	2093	1600	3255
a ₂ b ₁ c ₁ (minimum tillage, 1 treatment + 1 fertilizing)	2271	1583	3269
a ₁ b ₁ c ₂ (classic, 1 treatment + 2 fertilization)	2099	1552	3273
a ₂ b ₁ c ₂ (minimum tillage, 1 treatment + 2 fertilization)	2248	1710	3520
a ₁ b ₂ c ₁ (classic, 2 treatments + 1 fertilizing)	2125	1585	3484
a ₂ b ₂ c ₁ (minimum tillage, 2 treatments + 1 fertilizing)	2236	1684	3277
a ₁ b ₂ c ₂ (classic, 2 treatments + 2 fertilization)	2163	1561	3382
a ₂ b ₂ c ₂ (minimum tillage, 2 treatments + 2 fertilization)	2342	1679	3212

The economic efficiency of the conservative systems with the soybean crop is rendered by the number of tillage done which require a fuel consumption calculated at 84,4 l/ha at a cost of 481,08 lei/ha, thus achieving an economy of 17,1 l/ha at a cost of 97,47 lei/ha. In the classic system the technology applied requires a consumption of 101,5 l/ha at a cost of 578,55 lei/ha. The price of the materials used, mostly of pesticides for the protection of soybean crops in both tillage systems, is quite high, thus the economy made is of only 94,47 lei/ha (Table 7).

Table 7. Efficiency technologies culture for 1 hectares soya, 2012-2014

Technology expenses	System of work	
	CS	MT
Consumption diesel fuel, l/ha	101,5	84,4
lei/ha	578,55	481,08
Expenditure with materials, lei /ha	1896,7	1896,7
Total lei/ha	2475,25	2377,78

CONCLUSSIONS

Out of this study we can deduce the idea of the major influence on the soybean yield of the year factor with a decisive role in the formation and the quantitative expression of the yield. Also, we can infer that the second fertilization has a remarkable impact on the soybean yield.

In the three experimental years we can conclude that soybean reacts favorably in the minimum tillage system.

The economic efficiency of the conservative systems with the soybean crop is rendered by the number of tillage done which require a fuel consumption.

The values of soil depth penetration do not go beyond 3000 kPa and they indicate that the development of the radicular system with soybean is not restricted up to 40 cm depth.

The unconventional system (MT) brings along a yield increase of 1,4%.

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- *** Meteorological Station Turda, longitude: 23°47', latitude 46°35'; altitude 427 m
*** ANOVA statistically program