Research Regarding the Influence of the Weed Control Treatments on Production and Qualitative Indicators of the Soybean Cultivated in Minimum Tillage System

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ABSTRACT

The use of herbicides 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 ARDS 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), on the 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).

Keywords: *soil tillage systems, treatments, yield, quality, climatic conditions.*

INTRODUCTION

Minimum tillage seeding system (MT) has evolved over time to an economic system of sustainable agriculture as an alternative to the conventional system (CS). 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 (CO₂). In that direction, minimum soil tillage systems should be applied appropriate it aimed (Fabrizzi et al., 2005; Moraru et al., 2010; Bucur et al., 2011; Rusu et al., 2014; Chețan et al., 2014; Rusu et al., 2014): reducing soil erosion and compaction, reducing energy consumption, plant protection, soil and water conservation, fuel economy. The

soybean it is 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 un-nitrogenous, fats, vitamins and minerals salts (Muntean et al., 1995; Scurtu, 2001; Gus et al., 2004).

MATERIALS AND METHODS

The research was conducted in years 2013 and 2014, the 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 poly-factor type is organized bet on four repetitions.

Tab. 1. The scheme of treatments

Variant	Herbicide use	Rates l, g/ha	Time of application
C1	Martor Netratat	-	-
C2	Dual Gold 960 EC (S-metolaclo 960 g/l) Pulsar 40 (Imazamox 40 g/l) + Agil 100 EC (Propanilzafof 100 g/l)	1,5 l/ha 0,8 l/ha+1,5 l/ha	ppi post I
C3	Frontier Forte (Dimetenamid 720 g/l) Basagran Forte (Bentazon 480 g/l) + Fusilade Forte (Fluazifop-P-butyl 150 g/l)	1,2 l/ha 2,5 l/ha+1,5 l/ha	ppi post I
C4	Proponit 720 EC (Propisoclor 720 g/l) Pulsar 40 (Imazamox 40 g/l) + Leopard 5 EC (Quizalofop-P-etil 50 g/l)	3,0 l/ha 1,0 l/ha + 2,0 l/ha	ppi post I
C5	Stomp 330 EC (Pendimetalin 330 g/l) Pulsar 40 (Imazamox 40 g/l) + Select Super (Cletodim 120 g/l)	5,0 l/ha 1,0 l/ha + 2,0 l/ha	ppi post I
C6	Sencor 70 WG (Metribuzin 700 g/kg) Basagran Forte (Bentazon 480 g/l) + Agil (Propanilzafof 100 g/l)	0,4 kg/ha 2,5 l/ha + 1,0 l/ha	ppi post I
C7	Guardian (Acetoclor 820 g/l) + Sencor 70 WG (Metribuzin 700 g/kg) Pulsar 40 (Imazamox 40 g/l) + Fusilade Forte (Fluazifop-P-butyl 150 g/l)	2,2 l/ha + 0,4 kg/ha 1,2 l/ha + 1,5 l/ha	preem post I
C8	Dual Gold 960 EC (S-metolaclo 960 g/l) + Sencor WG (Metribuzin 700 g/kg) Basagran Forte (Bentazon 480 g/l) + Leopard 5 EC (Quizalofop-P-etil 50 g/l) Basagran Forte (Bentazon 480 g/l)	1,4 l/ha + 0,4 l/ha 1,2 l/ha + 1,0 l/ha 1,0 l/ha	preem post I post II
C9	Frontier Forte (Dimetenamid 720 g/l) + Sencor 70 WG (Metribuzin 700 g/kg) Pulsar 40 (Imazamox 40 g/l) + Agil (Propanilzafof 100 g/l) Pulsar 40 (Imazamox 40 g/l)	2,5 l/ha + 2,5 l/ha 3,0 l/ha + 1,5 l/ha 1,0 l/ha	preem post I post II
C10	Proponit 720 EC (Propisoclor 720 g/l) + Sencor 70 WG (Metribuzin 700 g/kg) Basagran Forte (Bentazon 480 g/l) + Select Super (Cletodim 120 g/l)	2,5l/ha+0,4l/ha 3,0l/ha + 1,5l/ha	preem post I
C11	Stomp 330 EC (Pendimetalin 330 g/l) + Sencor 70 WG (Metribuzin 700 g/kg) Harmony 50 SG (Tifensulfuron-metil 50%) + Agil (Propanilzafof 100 g/l) Harmony 50 SG (Tifensulfuron-metil 50%)	4 l/ha + 0,4 l/ha 12g/ha + 1,5 l/ha 12g/ha	preem post I post II
C12	Sencor 70 WG (Metribuzin 700 g/kg) Harmony 50 SG (Tifensulfuron-metil 50%) + Select Super (Cletodim 120 g/l)	0,5 l/ha 18g/ha + 2,0l/ha	preem post I

As biological material used Felix soybean cultivar (maturity group 00, during the growing season of 122 days) created the Agricultural Research and Development Station 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:

A -Year 2 graduations: A1-2013; A2-2014

B-tillage system with two graduation:
B1 system with conventional tillage (SC): 30 cm plowing rotary harrow a deep + sowing+ fertilized; B2-system minimum tillage (MT): soil processing with chisel + rotary harrow while sowing fertilization. The dose of complex mineral

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

Year	Months - temperature recorded (°C)											
	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

Tab. 3. Rainfall regime for the years 2013, 2014 ARDS Turda

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

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 / m². The size of the experimental plots is 48 m². Previous plant soybean crop was maize.

C-12 variants herbicide graduations C1 untreated control; C2-C12: doses, combinations, and different times of application of the herbicides. The dosage schedule and application rates are summarized in Tab. 1.

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 Inframate Perten IM 9500.

For each sample we used a quantity of 500 grams grains obtained from the average variance on each repetition.

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 Tab. 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°C (Tab. 2), being the optimum range of temperature requirements to soy (20-22°C).

RESULTS AND DISCUSSIONS

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

Tab. 4. 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
DL (p 5%)	75	
DL (p 1%)	100	
DL (p 0.1%)	129	

Tab. 5. Harvests on whichever soybean tillage, 2013-2014

Variant tillage	Yield obtain (kg/ha) and semnification
B ₁ - conventional with plowing system (SC): plowing +rotary harrow + sowing +fertilized	2635 ^{Mt}
B ₂ - minimum tillage system (MT): soil processing with chisel + rotary harrow + sowing while fertilization	2131 ⁰⁰⁰
DL (p 5%)	121
DL (p 1%)	222
DL (p 0.1%)	492

Tab. 6. 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
DL 5%	173			173		
DL 1%	230			230		
DL 0.1%	299			298		

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.

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 5).

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.

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

Tab. 7. Influence of tillage system and treatments on soybean quality indices ARDS Turda 2013, 2014

The factor		Indices quality (values)					
		Differences	Protein (%)	Differences	MMB (g)	Differences	
A-Year	A ₁ - 2013	20.10 ^{Mt}	0.00	40.13 ^{Mt}	0.00	163 ^{Mt}	0.00
	A ₂ - 2014	20.18 [·]	0.08	40.32 [·]	0.19	185 ^{***}	22
DL (p 5%)		0.58		0.56	3		
DL (p 1%)		2.92		2.79	3		
DL (p 0.1%)		29.18		27.85	4		
B-Tillage system	B1-Classic with plowing	19.94 ^{Mt}	0.00	40.56 ^{Mt}	0.00	178 ^{Mt}	0.00
	B2-Minimum tillage	20.34 [*]	0.40	39.89 ⁰⁰⁰	- 0.67	171 ⁰⁰	- 7
DL (p 5%)		0.18		0.05	3		
DL (p 1%)		0.42		0.11	5		
DL (p 0.1%)		1.32		0.35	11		
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
DL (p 5%)		0.19		0.17		6	
DL (p 1%)		0.26		0.22		8	
DL (p 0.1%)		0.34		0.29		11	

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 (TKW).

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 TKW 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 C7-C11 variants are very significantly influenced positively in percentage fat soybeans, other variants of herbicides significantly influences and distinct significantly positive, except on C4 and C6 variants with values on 18.86% to 20.00%, close to the version used as witness.

Tillage system significantly influence 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 7).

CONCLUSIONS

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.

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