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Ignea, Mircea and Muresanu, Felicia and Cheţan, Felicia

Agricultural Research and Development Station Turda, Agricultural Research and Development Station Turda, Agricultural Research and Development Station Turda

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THE INFLUENCE OF SOME TECHNOLOGICAL FACTORS ON PRODUCTION OBTAINED FROM THE AUTUMN WHEAT GROWN IN THE SYSTEM WITH MINIMUM SOIL WORKS AND THE ECONOMIC EFFICIENCY OF CROP TECHNOLOGIES

MIRCEA IGNEA[1], FELICIA MUREŞANU[2], FELICIA CHEŢAN[3]

Abstract: *This paper aims to address the problem of achieving autumn wheat production and how technological factors influence the realization of production. It was considered choosing the most efficient technological variants of crop. To this scope we compared, in the experiment, the conventional soil works system (with ploughing, seedbed preparation, fertilizing, seeding) and soil minimum works system or conservative works system. The results led us to conclude that the highest yields are obtained in the conservative system of works, economically feasible yields and that are obtained using a minimum works technology, in which the crop protection is ensured by seed treatment, 2 or 3 treatments per vegetation when productions of 4500-5000 kg / ha are obtained, with reduced expenditures by 9.3 -16.2%, compared to conventional technology.*

Key words: *soil minimum works system, conservative agriculture, sustainable agriculture, cultivation technology, autumn wheat.*

INTRODUCTION

The soil minimum work systems have become in the last twenty years a constant concern in Romanian agriculture they could be a viable alternative to sustainable farming system. Currently, the conservative works define extremely varied processes (Gush et al., 2008). Between classical or conventional farming system (with ploughing, seedbed processing, sowing) and conservative farming system (no tillage) where intervention on soil is minimal, there is a lot of tillage methods specific to certain conditions work, endowment with equipments or even tradition, all aimed at preserving soil characteristics.

For this reason it was considered necessary to study comparatively the conventional crop system of autumn wheat with minimal tillage system, in the situation of fertilization differentiated, complex treatments with fungicides, insecticides and foliar fertilizers, under a five-year experiment. The advantages of this culture system are: reducing or even eliminating soil degradation, increased soil fertility, better soil water management, reducing production costs. Principled in the conservative technology (no tillage) do not interfere with the soil starting with precursory crop harvesting until sowing the next crop, thus the soil is kept covered all year round; the winter rug made naturally from precursory plants debris and weeds from spontaneous flora has the role to protect the soil of water or wind erosion or by thaw and snowmelt during the winter.

The winter protector rug can be destroyed after by herbicides. This mode of intervention is the best environmental option for annual crops. (CARLIER et al., 2006). Integrated control of weeds, pests and diseases is made primarily with pesticides with low environmental impact. (NAGY, 2007).

This paper focuses on how technological factors contribute to the achievement of production and economic efficiency of the technologies used, the problem being studied in a complex experiment, in five years of study.

[1] Eng. Ignea Mircea, SR III, AGRICULTURAL RESEARCH AND DEVELOPMENT STATION TURDA; mircea.ignea@yahoo.com
[2] PhD Eng. Mureşanu Felicia, SR I, AGRICULTURAL RESEARCH AND DEVELOPMENT STATION TURDA
[3] PhD Candidate Eng. Cheţan Felicia, SR, AGRICULTURAL RESEARCH AND DEVELOPMENT STATION TURDA

MATERIAL AND METHOD

The experiment conceived and conducted to S.C.D.A. Turda includes two ways of soil works, a conventional classical system (with ploughing, soil preparation, fertilization and seeding) in parallel with the conservative ("no tillage" with seeding directly into precursory crop stubble), in a crop rotation of three years, in wheat-soybean-corn rotation with experimental versions that include technological measures that contribute to vegetation control of the experiment plants, namely: fertilization and treatments. It was cultivated the wheat variety Ariesan (created at SCDA Turda), which although is not a very new variety, had good reputation in conditions of production and has a slight genetic polymorphism, which makes it easily adaptable to harsh conditions of raw land cultivation.

The experiment was performed in three repetitions; was seeded at 18 cm spacing and seeding depth set at 5.5 cm. The seed was treated with fungicides Yunta 246 FS: 2 l / t.

Experimental factors:

1. A – the soil tillage system - two gradations (A1-conventional tillage system; A2 - "no tillage" system)
2. B - experimental years - 5 gradations (B1-2008; B2-2009; B3-2010; B4-2011; B5-2012)
3. C - fertilization system - two gradations (C1- fertilization simultaneous with seeding with N40P40; C2 - basic fertilization simultaneous with seeding with N40P40 + N50P30 at the resumption of vegetation)
4. D – the treatments system - 4 graduations. (Table 1)

Weather conditions in the years subject to experimenting:

Generally, monthly temperatures were higher than the multi-annual averages during the wheat vegetation. Only in 2008 was closer to a normal year though temperatures were higher during the wheat vegetation in 2008, also. The monthly temperatures, expressed through multi-annual averages were higher in the most months of the vegetation period of wheat. The heat also (above 32^{o}C) had an important role in lowering production these being of 25 days in 2012.

In terms of precipitation in 2008, a normal year, 2009 was an exceptionally dry year and 2010 was very rainy. They have been followed by 2011, a dry year with a drought that installed in August 2011 and lasted until the end of 2012. In 2012, the wheat has hardly sprouted in March due to soil drought from the fall of 2011, followed by powerful snowing that lasted until March 2012. Generally in the summer months was installed a strong soil drought, which along with high temperatures led, in most of the five years studied, to the forced ripening.

From Table 1 it can be seen that at the experiment design was preferred a large number of treatments, for covering against pests that over-winter in soil and keeping into account that chemical treatments are the only way to control pests of the crops seeded in conservative system.

It also observes that the recipes used in treatment are complex ("tank mix") in order to combat in complex diseases, weeds and pests. The fact that is referred to the most complex treatment scheme, it was conceived with the idea to get comparable production and in the technologies with fewer treatments.

The foliar fertilizer present in each treatment was introduced in order to give plant nutrient supplements to be able to develop in the most adverse conditions of crop.

Table 1. Complex treatments applied at the autumn wheat in experiment

Phenophase/ Variant	At the resumption of vegetation (treatment 1)	Phenophase of twinning ending (treatment 2)	Phenophase of bellows (treatment 3)	Phenophase of flowering (treatment 4)
D1 (4 treatments)	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso0.1l/ha	Foliar fertilizer Agrofeed 5 kg/ha Fungicide Falcon 0.6 l/ha Herbicide Sekator 0.135 kg/ha + Esteron 0.5 l/ha + SDMA 1l/ha	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso 0.1l/ha Fungicide Falcon 0.6 l/ha Adjuvant Trend 0.3 l/ha	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso 0.1l/ha Fungicide Falcon 0.6 l/ha Adjuvant Trend 0.3 l/ha
D2 (3 treatments)	-	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso0.1l/ha Herbicide Sekator 0.135 kg/ha + Esteron 0.5 l/ha+SDMA 1l/ha	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso 0.1 l/ha Fungicide Falcon 0.6 l/ha Adjuvant Trend 0.3 l/ha	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso 0.1l/ha Fungicide Falcon 0.6 l/ha Adjuvant Trend 0.3 l/ha
D3 (2 treatments)	-	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso 0.1l/ha Herbicide Sekator 0.135 kg/ha + Esteron 0.5 l/ha+SDMA 1 l/ha	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso 0.1l/ha Fungicide Falcon 0.6 l/ha Adjuvant Trend 0.3 l/ha	-
D4 (2 treatments	-	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso0.1l/ha Fungicide Falcon 0.6 l/ha Herbicide Sekator 0.135 kg/ha + Esteron 0.5 l/ha+ SDMA 1l/ha	-	Foliar fertilizer Agrofeed 5 kg/ha Insecticide Calypso 0.1l/ha Fungicide Falcon 0.6 l/ha Adjuvant Trend 0.3 l/ha

RESULTS AND DISCUSSIONS

Table 2. The influence of soil work system on production capacity at autumn wheat. (SCDA Turda, 2008 – 2012)

Factor	Production (Kg/ha)	Relative production (%)	Differences	Signification
A : Soil work system				
A1: conventional with ploughing	4247	100.0	0	mt
A2 : conservative: no tillage	4581	107.9	334	*
DL 5%		239		
DL 1%		551		
DL 0.1 %		1753		

From Table 2 it observed that the influence of conservative soil works system brings a production increase of 334 kg / ha, significant production increase, which allow us to believe that it is due to a better preservation of water in uncultivated soil and covered throughout the year with vegetation or plant debris.

Table 3. The influence of the experimental years on the production capacity of autumn wheat (SCDA Turda, 2008 – 2012)

Factor	Production (Kg/ha)	Relative production (%)	Differences	Signification
2008	5007	100.0	0	mt.
2009	3110	62.1	-1897	ooo
2010	4483	89.5	-523	oo
2011	4544	90.8	-462	o
2012	4927	98.4	-79	-
DL 5%		374		
DL 1%		515		
DL 0.1 %		709		

From Table 3 is noticed that the closest to normal year in Turda, considered as control, was 2008 and the yields obtained in all other years are lower with values from -1897 kg / ha in the atypical year 2009 until -79 kg / ha in 2012, when although the wheat has sprouted later, though rains in April and May helped to recover, the production being around the control value.

The influence of fertilization in the conservative tillage system reflected in the productions made, shows us that the phased fertilization represents, beside the basic one, a crucial factor in achieving a production increase of 733 kg / ha and that of statistically is very significant. (Table 4).

Table 4. The influence of fertilization on the production capacity of the autumn wheat (SCDA Turda, 2008 – 2012)

Factor	Production (Kg/ha)	Relative production (%)	Differences	Signification
C1:N40P40 simultaneous with seeding	4048	100.0	0	-
C2: N40P40 simultaneous with seeding + N50P30 at the resumption of vegetation	4780	118.1	733	***
DL 5%		125		
DL 1%		170		
DL 0.1 %		230		

Table 5. The influence of treatments on vegetation in the two crop systems on the production capacity at the autumn wheat (SCDA Turda, 2008 – 2012)

Soil work system	Treatments	Production (Kg/ha)	Relative production (%)	Differences	Signification
A1:Conventional	D1	4332	100.0	0	mt
A2 :With minimum works	D1	4601	106.2	268	-
A1:Conventional	D2	4238	100.0	0	mt
A2 : With minimum works	D2	4613	108.8	375	*
A1:Conventional	D3	4203	100.0	0	mt
A2 : With minimum works	D3	4521	107.5	317	*
A1:Conventional	D4	4215	100.0	0	mt
A2 : With minimum works	D4	4590	108.9	376	*
DL 5% DL 1% DL 0.1%				269 487 1209	

Table 6. Crop technologies of the autumn wheat from experiment

Technology				conventional		conservative	
No	**Work**	**Aggregate**	**MU**	**Np (UM/sch)**	**Nc (l/UM)**	**Np (UM/sch)**	**Nc (l/UM)**
1	Harvesting soybean with chopping and spreading on the ground (preceding crop)	CASE IH 1680 AF	ha	15,0	21,0	15.0	21.0
2	Ploughing at 22 – 25 cm	John Deere 6620 SE + MULTI MASTER 125 T	ha	5,0	24,0	5.0	24.0
3	Basis fertilization	U650 + MA 3,5	ha	26,0	1,3	-	-
4	Disking the soil	U650 + GDU 3,4	ha	4.8	14.4	-	-
5	Working soil simultaneously with sowing	John Deere 6620 SE + HRB 403 D + GC 2	ha	9,0	9,0	-	-
6.	Direct seeding simultaneously with fertilization	John Deere 6620 SE + Gaspardo Directa 400	ha	-	-	15.0	8.0
7	Rolling the sown field	L 445 + 3 TN – 5,3	ha	15.0	2,5	-	-
8	Phased fertilization at the resumption of vegetation	U650 + MA – 3,5	ha	26,0	1,3	26.0	1.3
9	Making treatment at the resumption vegetation	L 445+ EEP 500	ha	-	-	13.0	1.6
10	Herbicide simultaneously with treatment at the phenophase of twinning ending	L 445+ EEP 500	ha	13,0	1,6	13.0	1.6
11	Making treatment in phenophase of bellows	L 455 + EEP 500	ha	13,0	1,6	13.0	1.6
12	Making treatment in phenophase of starting flowering	L 455 + EEP 500	ha	-	-	13.0	1.6
11	Harvesting wheat crop with chopping and spreading on soil	CASE IH 1680 AF	ha	20,0	19,0	20,0	19,0
12	Transport of main product	U650+ RM2	ore	8	5,3	8	5,3

We see that in case on vegetation treatments applied in conservation tillage system, the differences are significant when apply 3 and 2 treatments, the production increases being 317 kg / ha, until 376 kg / h. Combating pests and diseases was made at the right time of most powerful attack of these pests. Applying the herbicides is made when weeds are in the rosette stage, optimal for destruction. (Table 5).

To establish the comparative economic efficiency of both work technologies were reported costs to 1 ha worked in the two technologies. Have considering all treatments performed and calculated at 2012 prices of the products excluding VAT, expressing the tabular form for various technological options. (Table 6).

Working technologies are presented in Table 6.

From calculation of technologies values using 2, 3 and 4 treatments can be obtained the values from Table 7:

Table 7. Centralizing table

No.	Technological variant	No. of treatment	Value(lei)	%	Economy (%)
1.	Conventional technology	2	2097.06	100	-
2.	Technology with reduced works 1	4	2062.10	98.3	1.7
3.	Technology with reduced works 2	3	1901.53	90.7	9.3
4.	Technology with reduced works 3	2	1757.85	83.8	16.2
Prices on expenditures categories					
1.	Materials	Conventional technology	1755.82	100	-
		Technology with reduced works 2	1729.80	98.52	1.5
		Technology with reduced works 3	1753.92	89.6	10.4
2.	Workmanship	Conventional technology	204.74	100	-
		Technology with reduced works 2	93.70	45.8	54.2
		Technology with reduced works 3	88.98	43.5	56.5
3.	Fuel	Conventional technology	443.64	100	-
		Technology with reduced works 2	267.70	60	40
		Technology with reduced works 3	26+1.72	59	41

As seen the cost reduction of technologies used has as its source the removal of technology elements with minimal tillage system. In choosing one of the technologies studied with reduced work must choose a way of balance between output and afferent costs. Reducing expenses by 9.3-16.2% compared to conventional technology, should be consistent with maximizing the production version ie 3 and 2 vegetation treatments, technologies in that the production increase amounts to 376 kg / ha.

CONCLUSIONS

1. Experiencing the wheat crop in two tillage systems: one conventional with ploughing, preparing seedbed, fertilized and seeding and the other one with direct seeding in the precursory crop stubble simultaneously with fertilization show us that can get almost equal productions. Slightly higher yields obtained without tillage system is due to maintaining longer the humidity level in the soil.

2. The conservative system of soil working brings a significant production increase of 334 kg / ha. The experiment being conducted for a period of five years, it appears that the influence of experimental years is very significant. It also has a great influence the fertilization system.

3. The values of mechanical technologies are substantially equal, if we refer to the technologies applied in the conservative system of works; also observe that the classical system is significantly more expensive than conservative. It also observed that there is, as price, a difference between the applied technology with 3 and 2 treatments, respectively, with a price reduction in the favour of that with 2 treatments, this due to fewer crossings and reduced material costs.

4. Cost reduction is significant up to 16.2% on total technology. The most significant reducing of fuel up to 41% and with labour up to 56.5%, these reductions being due to reduced number of mechanical works.

5. Correlating economic data with yields obtained, we can conclude that to have a good and healthy production, our opinion is the use of technological variant with 2 fertilizations and 3 or 2 treatments, depending on the year of crop and abandoning traditional technology, with the condition of strict crop rotation.

6. Depending on the requirements of agricultural year, the system of conservative agriculture keeps the soil properties, restores natural fertility and enhances water regime of soil; mulch on the soil surface protects the soil, and in the transformation process under the action of micro-and macro-organisms in the soil helps improve the soil structure (hydro-stable macro-aggregates content increases) and weed growth is slowed.

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