INFLUENCE OF CONSERVATIVE AGRICULTURAL SYSTEM ON WHEAT PRODUCTION A STUDY CASE AT AGRICULTURAL RESEARCH AND DEVELOPMENT STATION TURDA

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Abstract*: The paper aimed to make a comparison between the influence of conservation (no tillage) system and conventional tillage system on wheat productivity. The research work was carried out at Turda Agriculture Research and Development Station, within a partnership with Agricultural University from Cluj-Napoca during the period 2008-2011. The experiments were organized according to a split-plot model, four factors are considered: A Factor: agricultural system of work with two graduation: A1-classical or conventional system(with plugging, preparation of the soil, sowing ,a.s.o); A2- conservative agricultural system or "no tillage"; B Factor: years of experimentation with four graduation; C Factor: fertilization, with two graduation: N40 P40, concomitant with sowing and N40 P40, concomitant with avowing + N50 P30, in spring when the vegetation of wheat are recompensing; D Factor: treatments in the vegetation period, with four graduation. The Conservative Agricultural system had a positive impact on wheat yield leading to 303 kg/ha higher then the conventional system of work. Also the fertilization system applied in this experiment, revealed that the grain yield is higher in conservative system with 338 kg/ha then the conventional system of agriculture. The C2 system of fertilization is most significant in conservative agricultural system, but in conventional system it is not. The cause of higher level of production obtained in conservative system, we think, is the conservation of water in soil more than in conventional system, who reveal in quality of grains (number of grain in the wheat-car, MMB, a.s.o). In the conventional system of agriculture, where are a followed a basically plowing, are cutting the capillary system, through the water are lifted. This action has to result blockage of access to the deep water of the plants. This thing is reveal, almost in dry period on the year, when the plants suffer on this cause. All of this focused on the winter wheat yield. Then is necessary to utilize of the conservative agricultural system, like a technological variety for the area in that is observed a low level of precipitation. The experiments reveal the most importance assignment of the years of culture.*

Key words: *conservative agricultural system, no tillage, water conservation, fertilization, treatments*

INTRODUCTION

Global warming largely due to anthropogenic causes, manifested in our country in the past 100 years by increasing the average temperature with two degrease, and the rainfall fell to 50 mm/year (ANM, 2007).

The ARDS Turda in 55 years of existence has recorded an annual average temperature increase with 0.6^{o}C, and the amount of rainfall of their increase with 11.4 mm. The winter months have become warmer and summers have become much hotter; pluviometer regime is manifested mainly by excessive rainfall in June and July when several torrential rains fall are followed by long periods of severe drought that sometimes leads to decreased soil moisture until close to the withering (GRECU and all,2012).

Under the circumstances it is a question of how to keep a larger quantity of water in soil throughout the year by different agrotehnical methods. ARDS Turda has initiated a comparative experiment comparing a system of farming no tillage, with conventional system of agriculture, with plowing, soil preparation, seeding, aso.

Minimal soil work have become in the past 20 years a constant concern for Romanian agriculture, they could be a viable alternative to sustainable agriculture in the area including Transylvania Plain.

Sustainable agriculture cannot be seen as a valid system of soil work anywhere. It has specific differences due to the differences in local climate and soil. Soil conservation schemes should have specific characters depending on the features and characteristics of cultivated plants they must be applied accordingly differentiated from (CANARACHE, 1999; GUS and all, 2004, 2008).

KOEPKE, 2003, HEMAT and ESKADAR, 2004, ERENSTEIN and all, 2008, GUPTA and all, 2008, (citation by GRIGORAS and all, 2012), affirmed that despite of common factors and experiences identified in various countries where conservation agriculture is applied, regional differences has to be taken into account too.

Currently defined processes for the maintenance works extremely varied. Between classic farming or agriculture conventional system in which an intervention on the soil is minimal there are plenty of methods of work of certain specific soil conditions, machinery or even tradition.

It is known that agriculture contributes to the global warming with about 1/3 of the total greenhouse gases are released in the atmosphere mainly in the deconstructed soil by erosion or compaction. The soil worked released in the atmosphere a quantity of carbonic gas greater than in the case of raw land.

It is only one reason for choosing a protective agricultural system.

An effective application of the conservative system of agriculture at ARDS Turda on land located mostly on the slopes with a clay content of over 46%, with humus at average values (3.19%) up to good values (4.31%) with a structure of argiloasa loam, sometimes even in the same plot, with an hydric variation from month to month and from year to year, with temperatures (in the last 10 years which that topped constantly annual average values, monthly and has had beneficial effects on the reduction of soil erosion by keeping it covered all year round by increasing the reserve of water in soil and its use in dry periods the productions made on production costs and production organization into a more flexible system.

MATERIAL AND METHODS

The experiment designed and conducted at ARDS Turda, includes two ways to work the soil, a conventional system classic (plowing, sowing and preparation of land) in contrast with the conservative system ("no tillage") in a 3-year rotation, in Wheat-Corn-Soybean with experimental variants including technological measures which contribute to plant vegetation control, fertilization and experiment. It was cultivated wheat variety Arieşan (created at S.C.D.A. Turda), which although not a very new variety, had the good reputation and has an easy genetic polymorphism, making it more easily adaptable to harsh conditions of unprocessed field cultivation.

The experiment was carried out in three repetitions; It was sowing with seeding machine Gaspardo Directa 400; distance between rows are 18 cm and the depth of sowing set at 5.5 cm. Two fertilization levels were applied: the sowing dose of N40P40 in B1 and fertilization with N40P40 at N50P30 resuming drilling + vegetation in the spring in the second variant of fertilization (B2). The seed was treated with insecticide/fungicide Yunta 246 FS: 2 l\/to.

The treatments were applied after a schema with 4.3 and 2 treatments with various combinations of pesticides. The treatments were applied with complex recipes (to combat diseases in complex, weeds and pests) into 4 distinct stage of wheat plants so evolution as shown in table 1. Complex treatments are necessary taking into account that it is the only way

to control pests, weeds and diseases in this system of agriculture. From this point of view the system applied by us has only elements of sustainable agriculture (CARLIER et al. 2006).

Table 1

Complex treatements aplied on wheat

Stage/ Variant	Begin of vegetation	Wheat twinning stage	Bellows stage	Flowering stage
D1	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Calypso 0.1l/ha	Foliar fertilizer: Polyfeed 5 kg/ha Fungicid Falcon 0.6 l/ha Herbicide: Sekator 0.135 kg/ha + Esteron 0.5 l/ha	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Proteus0.4l/ha Fungicide: Falcon 0.6 l/ha Adjuvant: Trend 0.3 l/ha	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Proteus0.4l/ha Fungicide: Prosaro 1 l/ha Adjuvant: Trend 0.3 l/ha
D2	-	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Calypso 0.1l/ha Herbicide: Sekator 0.135 kg/ha + Esteron 0.5 l/ha	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Proteus0.4l/ha Fungicide: Falcon 0.6 l/ha Adjuvant: Trend 0.3 l/ha	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Proteus0.4l/ha Fungicide: Prosaro 1 l/ha Adjuvant: Trend 0.3 l/ha
D3	-	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Calypso 0.1l/ha Herbicide: Sekator 0.135 kg/ha + Esteron 0.5 l/ha	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Proteus0.4l/ha Fungicide: Falcon 0.6 l/ha Adjuvant: Trend 0.3 l/ha	-
D4	-	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Calypso 0.1l/ha Fungicide: Falcon 0.6 l/ha Herbicide: Sekator 0.135 kg/ha + Esteron 0.5 l/ha	-	Foliar fertilizer: Polyfeed 5 kg/ha Insecticide: Proteus0.4l/ha Fungicide: Prosaro 1 l/ha Adjuvant: Trend 0.3 l/ha

Climatic conditions in four experimental years are following (table 2).

Table 2

Thermic and raining conditions in four experimental years

Months	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.
Temperatures												
Media 50 ani	**19.4**	**14.9**	**9.6**	**3.7**	**-1.8**	**-3.7**	**-1.0**	**4.0**	**9.8**	**14.8**	**17.8**	**19.5**
2007-2008	20.1	13.7	9.3	1.9	-3.2	-2.8	+3.8	5.4	10.5	15.0	19.4	19.5
2008-2009	21.0	14.0	10.7	4.1	1.1	-2.9	-0.5	3.7	13.2	16.2	18.7	21.0
2009-2010	20.7	17.4	10.0	5.2	0.1	-3.1	1.0	4.3	10.5	15.4	18.9	20.7
2010+2011	21.0	14.2	7.4	7.6	-1.6	-3.8	-3.2	5.3	10.7	15.6	19.2	20.1
Media 50 ani	**57.0**	**40.0**	**30.1**	**29.1**	**26.4**	**21.3**	**18.2**	**22.6**	**46.1**	**67.4**	**80.6**	**74.7**
2007-2008	118.1	84.7	93.0	25.4	20.8	17.3	11.2	30.3	58.4	89.0	136.8	125.2
2008-2009	9.0	41.0	45.4	21.1	45.9	9.5	22.4	53.5	8.4	31.4	113.4	52.5
2009-2010	38.1	3.4	77.8	48.0	35.0	39.2	30.6	17.6	52.0	87.6	172.6	121.0
2010-2011	49.2	67.2	31.6	30.8	40.4	26.8	19.9	15.3	22.6	41.4	116.8	130.4

The monthly temperatures in these four experimental years were generally higher than the multi-annual average by 50 years. In the year 2008-2009 during the months of April, May, June and July temperatures higher in conjunction with a shortage of rain have caused problems for wheat culture.

As regards the pluviometer note that in 2007-2008, was the closest to the average multi-annual although had some maximum in August and October 2007, in May and June 2008, not negatively, wheat production in the rest of the month was retrieved values somewhere near the mean value over several years. The year 2009 was dry during the period of vegetation of the wheat. If during the fall of 2008, the amount of rainfall has been preserved around the average value over several years, in the spring of 2009, two periods of drought and left its mark on the production-wheat, April and May being overly dry. The months June, July was excessively rainy; but August, again, was overly dry. 2010 has started with small values in August 2009, it was succeeded by a rainy fall and winter; a dry March and then all the months of spring and summer to be with large differences in addition to multi annual average. Autumn 2010 were normal and slightly in excess of the average multi-annual, so wheat came into the winter in good condition. The year 2011 was, in assembly, a dry year (during the months March, April and May it manifest a excessive drought) in June was excessive rainfall, but rains came late, in the third decade of the month. July was an excessively rainy month. From August we have a very strong drought, until the end of the year.

RESULTS AND DISCUSSIONS

Influence of soil system of work on the production capacity of Arieşan variety, shows us that in the conservative system of work (taking about this four studying years) the yields were higher than in the case of conventional system. Of course, the values that make the difference ranged from year to year and from one system of fertilization to another as we will see below. Increase of 7.3% means 303 kg/ha in conservative system of work in contrast with conventional system is due to, we sink, conservation of the water in the soil.

Table 3

Influence of soil system of work on the production capacity of wheat (ARDS Turda, 2008 – 2011)

The factor	Production (Kg/ha)	Production (%)	Diff.	Signification
A : the system of soil work				
A1: conventional system	4134	100.0	0	wt.
A2 : conservative system	4438	107.3	303	*
			DL 5% DL 1% DL 0.1 %	300 724 2305

Study of the influence of experimental years on the production capacity of Arieşan variety in the two systems of agriculture is presented in table 4.

Table 4

The influence of years of experimentation on the wheat production (ARDS Turda, 2008 – 2011)

The factor	Production (Kg/ha)	Production (%)	Diff.	Signification
B1: 2008	5007	100.0	0	wt.
B2: 2009	3110	62.1	1897	000
B3: 2010	4483	89.5	524	0
B4: 2011	4544	90.8	462	0
AVERAGE:	4286	-	-	-
			DL 5% DL 1% DL 0.1 %	396 555 784

On this four experimental years has registered an average of the production of 4286 kg/ha.

In the year 2008 were experimentally obtained the highest yields of 5007 kg/ha. In year 2009, characterized by high temperatures (more than normal) in the months of April and May and lack of rainfall, yields were significantly statistically lower 3110 kg/ha or 62% less

than in 2008. The production was more less in conservative system than in the classic system, probably because during the winter months rainfall have also been reduced, and the evaporation was higher in the classic system than in uncultivated ground, as well as recovery of soil moisture was made more difficult after the rains in the raw soy. In the third experimental year, the yield was not so highest that in 2008 but the production were over 4000 kg\ha (4438 kg\/ha, significantly smaller). In 2011, a dry year in spring, production was only 90.8% of production obtained in 2008: 4544 kg\/ha.

It can be concluded that conditions in the ARDS. Turda in normal climatic winter wheat grown in conservative farming system can get higher yields compared to conventional farming system; but they intervene when problems related to climate (heat surplus, deficit of precipitation) system of conventional agriculture has proven superior.

Table 5

Influence of fertilization on the production capacity of winter wheat (ARDS Turda, 2008 – 2011)

The factor	Production (Kg/ha)	Production (%)	Diff.	Signification
C1:N40P40 simultaneously with seeding	4022	100.0	0	-
C2: N40P40 + simultaneously with seeding N50P30 to resumption of vegetation	4550	113.1	527	***
AVERAGE:	4286	-	-	-
			DL 5% DL 1% DL 0.1 %	153 211 291

As it was expected, averaged over four experimental years, to add nutrients to the resumption of N50P30, vegetation has led to production increases of 13.1% compared to the very significant only at version fertilized with N40P40 due to seeding (table 5).

At the time of initiation of the experiment was deemed especially conservative agriculture system, it would be necessary that some technological factors (fertilization, treatment by insecticides-fungicides) to provide additional inputs, the wheat crop to offset disadvantages related to lack of mobilization of soil and the negative impact of insects and diseases of cryptogrammic pests in this type of system. On average over the entire experimental system has achieved a small increase of production, if we refer to the influence on vegetation treatments on production, but between the treatments applied (2, 3, 4 treatments in different stage of development of the plant with a complexes recipe) have not been recorded statistically significant differences. Influence of treatment is given in table 6.

Table 6

Influence on vegetation treatments on production capacity of wheat (ARDS Turda, 2008 – 2011)

The factor	Production (Kg/ha)	Production (%)	Diff.	Signification
D1: 4 treatments (begin of vegetation; wheat twinning stage; bellows stage; flowering stage)	4299	100.0	0	wt
D2 : 3 treatment (wheat twinning stage; bellows stage; flowering stage)	4306	100.2	7	-
D3 : 2 treatment (bellows stage; flowering stage)	4238	98.6	62	-
D4 : 2 treatment (bellows stage; flowering stage)	4302	100.1	2	-
			DL 5% DL 1% DL 0.1%	157 208 269

Table 7

Influence of the interaction system of ground-work – experimental year on production of wheat (ARDS Turda, 2008 – 2011)

System of work	Years	Production (Kg/ha)	Production (%)	Diff.	Signification
Conventional	2008	4655	100	0	wt.
Conservative	2008	5358	115.1	703	*
Conventional	2009	3307	100	0	wt.
Conservative	2009	2912	88.1	394	-
Conventional	2010	4101	100	0	wt.
Conservative	2010	4865	118.6	763	*
Conventional	2011	4474	100	0	wt
Conservative	2011	4615	103.2	141	-
				DL 5% DL 1% DL 0.1%	558 872 1631

In table 7 are presented interaction "ground work system x years". The year 2008 was the experimental favorable year of culture of wheat in the classic and conservative systems.

In a situation where there has been provided from precipitation water requirements (experimental year 2009), yields were significantly reduced in the statistical system, both classic and conservative. The impact of reductions in production was higher in the conservative agriculture where crop reductions with 394 kg/ha. In 2010 and 2011 yields were higher up to 763 kg/ha at this growth contributed production and better use of fertilizers applied.

With regard to the link with the production work of soil and fertilization applied in table 8 is apparent that at the first level of fertilization with N40P40 at the same time sowing, growth in production agriculture system compared to conventional conservative system is insignificant of 271 kg\/ha instead of fertilization with the variant N40P40 at the same time sowing N50P30 the resumption of production, growth of vegetation is 338 kg/ha and has statistical significance. Hence the conclusion that the second fertilization is beneficial for the production obtained in the conservative agricultural system.

Higher yields obtained in the conservative agricultural system in some years, then to the classic system, we think that is mainly due to a better preservation of the water in the soil; also the water from soil depth gains amounting in capillary to roots zone. On the other hand the restoration of water into the soil after a period of drought is more difficult in raw land, especially during heavy rains. Example of 2009, when after two months of drought, excessive rains which fell in June could not offset the loss of water from the soil in conservative system of agriculture, which has led to greater production of the conventional agriculture. To reveal the effect of better use of water from the soil, have made a series of measurements for production of 2011, a year which will dry and may to continue in next several years. It is observed that in 2011 bigger production obtained in conservative system of agriculture is due to several qualitative factors (the number of grains in ear, MMB, aso), who had the better values compared to the conventional system of soil work (19.6 and 20.0 grains in ear versus 18.6 19.0 in conventional system and also the MMS obtained in conservative values had 47.87 and 29.5 gr., compared with 28.7 and 28.3 in conventional system), these values are obtained in conditions than the wheat cultivated in conventional system of agriculture are better sistered.

Economic efficiency of studied technologies has taken the agricultural classic system control with 2 treatments, considered the best practice validated so far. The cost of reduction in four technological ways was made by comparing of the results. In table 8, the costs were calculated from 1 ha of wheat production, at prices up to date.

Table 8

Influence of the interaction "fertilization x soil work system" on the production of wheat (SCDA –May) 2008-2011)

System of work of the soil	Fertilization	Production (Kg/ha)	Production relative (%)	Diff.	Signification
conventional	1 fertilization	3887	100.0	0	wt
conservative	2 fertilization	4158	107.0	271	-
conventional	1 fertilization	4382	100.0	0	wt
conservative	2fertilization	4118	107.7	338	*
			DL 5% DL 1% DL0.1%	331 663 1842	

Table 9

The price of a surface of 1 ha utilizing some technological variants

No.	System of work	Number of treatments	Number of fertilization	Operation expenses(lei/ha)	
				Lei	%
1	Conventional	2	2	2518.08	100
2	Conservative	3	1	2309.00	91.7
3	Conservative	2	1	2271.12	90.2
4	Conservative	3	2	2312.55	92.2
5	Conservative	2	2	2306.43	91.6

In table 9, it is apparent that technology is the cheapest in the conservative, is the system that you do 2 treatments and one fertilization, the simplest of technologies studied. This economic result obtained in conjunction with productions; note that productions are close, and in the year, normal 2008 variety Arieşan obtained a production higher than conservative system, in technology with 1 and 2 fertilization treatments.

The differences occur in production, as it was claimed as a result of the influence of experimental year.

CONCLUSIONS

1. The studies carried out have revealed that in the technology of agricultural conservative system yields are higher than in conventional agriculture, this being due to greater soil water dynamics of conservative agriculture technology that lends itself to the autumn wheat, used in the olden days with the drought we are going.

2. Conservative agricultural system, restore the fertility of the soil characteristics, and these hydric operate of the soil.

3. From the organizational point of view, the technology is more sample, reduce the number of passes, which makes the soil degradation by compaction is significantly reduced. Using this system, the environment is restoring the microbial life, restore soil biodiversity, and carbon emanation of the carbonic gas in atmosphere shall be reduced, thereby reducing the percentage of participation of agriculture at global warming.

4. Conservative agriculture by reducing the number of trips you significantly reduces fuel costs, labor, and technology throughout the economy by about 10%.

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