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RESEARCH REGARDING TO THE IMPROVEMENT AND OPTIMISATION OF SOIL CONSERVATION SYSTEM “NO TILLAGE” FOR WHEAT CULTURE, SPECIFIC PEDO-CLIMATIC CONDITIONS OF THE TRANSYLVANIA PLAIN AREA

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Abstract: Production data registered at winter wheat Ariesan cultivar in 2007-2017 period, indicates suitability for cultivation in system with no ploughing, the difference in production between the two systems classic and conservative is just 81 kg/ha thus, in the classic system the average yield was 5671 kg/ha and in “no tillage” system 5590 kg/ha. Application of “no tillage” system at wheat culture requires a fuel consumption of 34.8 l/ha at the price 181 lei/ha compared with the classical technology which consumed 77 l/ha at the price 404 lei/ha, the economy achieved in 223 lei/ha in favor of “no tillage” system.

Key words: direct seeding, climate, yield, efficiency, wheat.

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

INTRODUCTION

From the first experiments carried out at ARDS Turda in 1968-1974, was followed the plowing replacement by with superficial works with a disc harrow (8-10 cm), the preparation of the germinative bed and the sowing in the optimal time. Was no found to exist major production differences. On the tillage with a disc harrow the yield was 44.6 q/ha and in the classic system with plow (at 15-18 cm depth), the production was 46.1 q/ha. The system without works (direct sowing) involves direct sowing on the debris of the preemergent plant by opening ditches in which the seeds and the fertilizers are introduced simultaneously (Chetan et al., 2011, Ignea et al., 2011, Chetan, 2012.). The sowing was done with the Directa seed drill -400, the seed reserve has the capacity of 680 kg and 750 kg the fertilizer (it resembles large areas and does not require many refueling stations), the two dispensers work in the same concoction, the seed and fertilizers are dosed and unloaded into the seed tube that descends them into the coulter so that the future plant has the necessary substances for growth and development in the first vegetation period. The hilly orography of the land with numerous erosion-degraded soils or the temporary excess of humidity in the Turda area imposed protection measures against the loss of the fertile soil layer. Thus, at ARDS Turda, during 1981-1983, an anti-erosion design was carried out, comprising all the organizational systems, depending on the slope of the terrain and the pedo-climatic specific conditions. It is considered that this erosion control system is an integral part of soil conservation in the area and ARDS Turda is representative of the hilly area in the center of Transylvania.

MATERIAL AND METHODS

Through the experiment set up within the ARDS Turda in 2007, we proposed first the conservation of soil (soil resources), the reduction of soil erosion, the reduction of inputs, the

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consumption of fuel and the labor force, and obtain the production at least close to those production obtained in the classical system (plowing).

The biological material was represented by the autumn wheat Arieșan variety (created at ARDSTurda), which, although not a very new variety, is productiv and adapts more easily to the harsher conditions of cultivation in unprocessed soil (it has a easy genetic polymorphism).

The experiments were carried out on the vertic faoziome soil with pH between 6.30-7.00; humus 2.21-2.94%; total nitrogen 0.162-0.124%; phosphorus 9-5 ppm; potassium 126-140 ppm, values were determined in the depth 0-40 cm in soil (OSPA Cluj). The experience has been established on a fertile soil but also with a susceptibility to rapid compaction at the passage of large agricultural aggregates or when working mechanically in high humidity conditions.

Experimental Factors: The factor A - system of work with two graduations: a1-conventional (with plow); a2 - no-tillage (direct seeding); Factor B: The experimental years: b1-2007, b2-2008, b3-2009, b4-2010, b5-2011, b6-2012, b7-2013, b8-2014, b9-2015, b10-2016, b11-2017.

The sowing was carried out with the GASPARD Directa-400 seed drill in both soil cultivation systems, in the conservative system the sowing was carried out directly in the debris of the soyb crop. The seed was treated with the REDIGO PRO 170 FS fungicide (0.5 l/tonne seed), sowing density of 550 g/m², 18 cm distance between the seed and the depth of seed incorporation of 5 cm. Fertilization of the crop was carried out in two phases, with N₄₀P₄₀ kg/ha in the autumn in same time with sowing plus an additional fertilization with N₄₀ kg/ha in the spring at resume the wheat vegetation. Treatments for weed control, pests and pests at ARDS Turda were performed with MET 1500 in two stages of wheat development: at the end of the breed: herbicides SEKATOR PROGRES OD (0.15 l/ha) + DMA 6 (0.5 l/ha) + fungicide IMPULSE PRO 425 EC (0.7 l/ha) + insecticide BISCAYA 240 OD (0.2 l/ha) + growth regulator STABILAN 750 SL (1.4 l/ha) + adjuvant TREND (0,25 l/ha) in a volume of 280 l/ha water; at the bladder: fungicide NATIVO 300 SC (0,8 l/ha) + insecticide FASTER 10 CE (0,15 l/ha) + adjuvant TREND (0,25 l/ha) in a volume of 280 l/ha water.

The experimental data were processed by variant analysis (PoliFact, 2015) and limit differences determination (LSD 5%, 1%, 0.1%).

The evolution of the thermal and pluviometric regime at ARDS Turda for the last 61 years, respectively since 1957, the date of foundation of the resort until now is presented in Figure 1 and Figure 2. The research area is carактерized by a mean annual temperature of 9.1°C and 531 mm multiannual average rainfall (Turda meteorological station, longitude 23°47', latitude 46°35', altitude 427 meters).The pluviometric regime has increased in the Turda area in the last time, the most rainy years was 2010, 2014 and 2016. Year 2016 was the most rainy years in the last 61 years, with the value of 816.8 mm, with a deviation of + 303.2 l/m² but with an uneven distribution of precipitation. The average value of 609.8 mm, in the last years, is maintained in the area with medium aggressiveness. The highest rainfall values are obtained in the summer months, especially in June, which is the rainy month of the year.

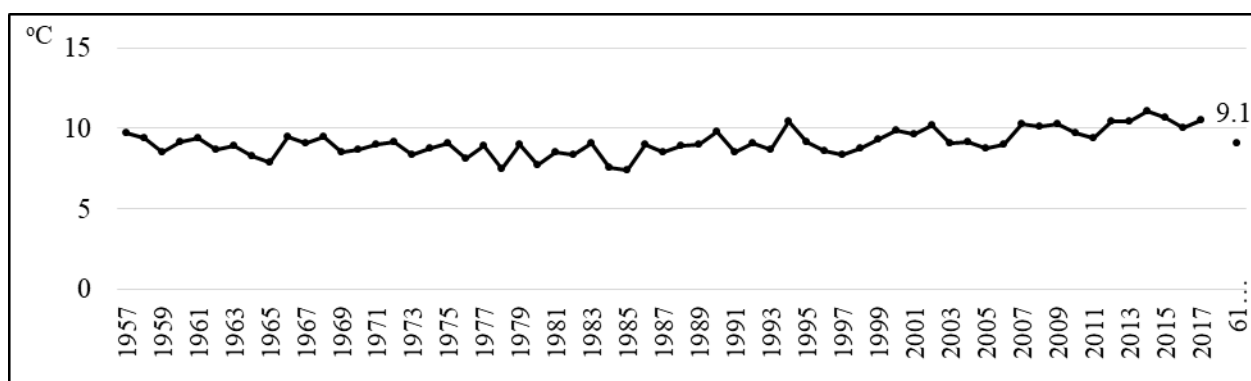


Figure 1. The thermal regime at ARDS Turda, 1957-2017

Specifically, for the 11 year studied, was the uneven distribution of precipitation, was recorded the periodes with drought, with extended pedologicals droughts (2009, 2011, 2012), followed by torrential rains, which although they had large quantities of water, did not have often managed to restore the water reserve in the soil, the drought dominating this whole period of time.

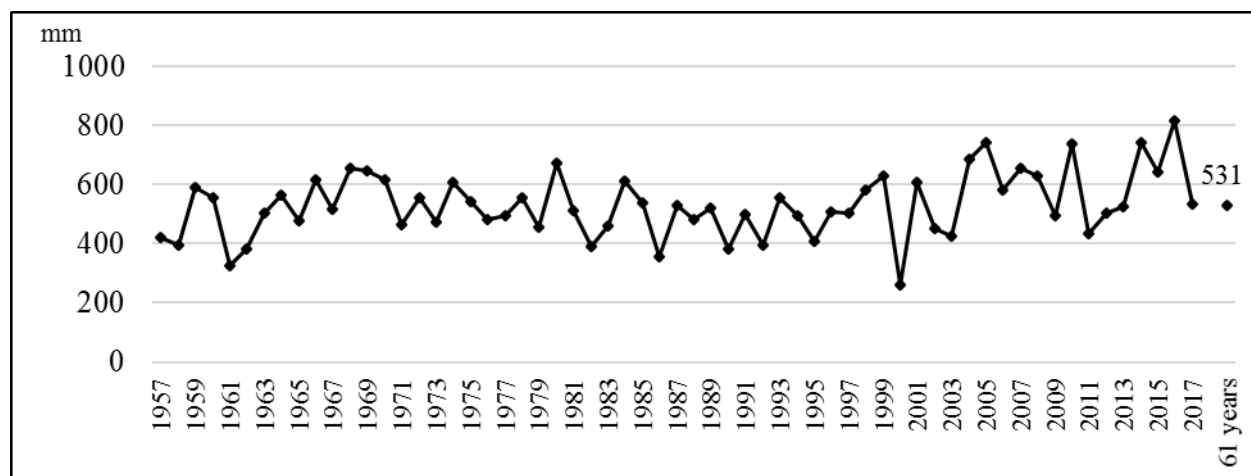


Figure 2. The pluviometric regime at ARDS Turda, 1957-2017

RESULTS AND DISCUSSIONS

The autumn wheat variety Arieșan responded favorably to the conservative technology, the average production of 5591 kg/ha recorded in the 11 years experimental with a value close to the production of 5672 kg/ha that was made in the classic system, at a difference of only 81 kg/ha, but which has statistical assurance, that significantly influence the production of wheat (Table 1).

The crop of autumn wheat is economically, agro-technically and socially motivated in all areas when the culture where it has minimal growth and development conditions. This crop also contributes to the reduction of agricultural land degradation and contributes even to the preservation and enhancement of soil fertility, by the large amount of vegetal remains left on the soil in the form of vegetal mulch or superficially incorporated in the soil (Chețan et al., 2017).

Table 1. The influence of tillage system on winter wheat production, 2007-2017

A- System of work	Yield kg/ha	%	Differences	Semnification
a ₁ - clasic (CS)	5672	100.0	0.00	Mt.
a ₂ - no-tillage (NT)	5591	98.6	-80.95	0
LSD (p 5%) = 18; LSD (p 1%) = 42; LSD (p 0.1%) = 122.				

Comparing the productions obtained in the wheat variety Arieșan in the 11 years it can be stated with certainty that the primary role in the productions obtain is the climate factor or, in other words, the year of culture (Table 2). The drought years 2009 and 2011 have significantly negatively influenced the wheat crop, with outputs ranging from 3272-4653 kg/ha. The drought started in August 2011 continued in the first nine months of 2012 (except in February and very cold in March), all the other months were hot and during the summer months of June-August an burning strong lasts for 21 consecutive days, the days with temperatures above 32°C, temperatures that affected the biological processes of the plants, with negative influence on the production of wheat (4871 kg/ha). In the first experimental years (2008, 2010), production had higher values, these two years influencing production

very positively. Alternating between excessively rainy and excessively droughty, however, the spring months of 2013 were beneficial to wheat crops offering the moisture reserve, a good development of culture, that resulted in a production of 4902 kg/ha, very close to the control variant, with a difference of only 5 kg/ha.

The year 2014 was a climate-favorable for wheat crop, the alternation of months with normal temperatures and warm were beneficial to passes the vegetative stages of wheat, with a very significant positive influence on the production, 7094 kg/ha. The year 2015 - warm and rainy and 2016 - excessive rainy and warm have also significantly influenced the wheat crop, which is influenced by production values of over 7000 kg/ha. The very positive influence of climate conditions and crop technology in 2017 produced a yield of 7079 kg/ha compared with the control variant (2007). As can be seen from Table 2 and analyzing the whole experimental period, the production increase achieved in six years out of the 11 reaches the value of 363 kg/ha to 2329 kg/ha compared to 2007, taken as a witness.

Table 2. The influence year on winter wheat production, 2007-2017

B-year	Yield kg/ha	%	Differences	Semnification
b ₁ - 2007	4897	100.0	0.00	Mt.
b ₂ - 2008	5537	113	640	***
b ₃ - 2009	3272	67	-1625	000
b ₄ - 2010	5261	107	363	***
b ₅ - 2011	4653	95	-244	000
b ₆ - 2012	4871	100	-27	0
b ₇ - 2013	4902	100	5	-
b ₈ - 2014	7094	145	2196	***
b ₉ - 2015	7151	146	2253	***
b ₁₀ - 2016	7226	148	2329	***
b ₁₁ - 2017	7079	145	2182	***
LSD (p 5%) = 26; LSD (p 1%) = 36; LSD (p 0.1%) = 49.				

According to the literature, energy consumption is different for each crop, so in wheat growing technology, the highest energy consumption per unit area is attributed to soil preparation (plowing, disk, rotary harrow, combining). The energy consumed during the mechanical works is influenced by the climatic and soil conditions, the working depth of the machines and equipment, the working speed, the area of the plot, the degree of mechanization, the proper use of the equipment to perform the quality works, the plot area and implicitly productivity at lower costs.

Wheat harvesting in both systems was carried out with the John Deere W540 high-capacity combine, in to the conservative system the harvesting was done by chopping and spreading on the soil surface the straw (vegetal mulch), making a significant reduction in fuel compared to the conventional system which the straw is left in the furrows to be then bundled and transported from the field.

The burning of straw is a dangerous environmental measure and is prohibited by Good Agricultural Practice, and those who do not comply with these rules will be sanctioned.

The technological differences of the conservative system reduce the process of degradation of soil by the compacting phenomenon at repeated passes with heavy machinery on the soil surface caused by the phenomenon of compaction at repeated passes with heavy machinery on the surface of the soil.

The economic efficiency of the two variants of tillage was determined according to the number of technological works applied, the fuel consumption (based on the characteristics of the

machines and the equipment used, the works performed on a land with 1.19% slope coefficient) and the materials used (seed, pesticides, fertilizers, etc.), per one hectare (prices do not include VAT).

The value of expenditures with materials in the conservative system is 1334 lei/ha and in the classical system 1380.5 lei/ha. Due to the high costs of materials needed to set up crops (especially pesticides) and harvesting (including the bales of straw in the classic system), economic efficiency results more from the fuel economy, making the total economy in NT about 15.7%.

Table 3. Efficiency of crop technologies to set up 1 hectare of wheat

Consumption	CS	NT	Differences at NT \pm
Fuel, l/ha	77	34.8	-42.2
Price lei/ha	404	181	-223
Materials (seeds, pesticide, chemical fertilizer, string etc.) lei/ha	1380.5	1334	-46
Total, lei/ha	1784	1515	-269

CONCLUSIONS

To achieve successful results, the best crops rotation combination, soil cultivation method and the best chemical weed control.

The production values obtained in the two systems, classical and no-tillage, are very close, the difference being only 81 kg/ha.

By applying the no-tillage system, a 15.7% yield per hectare is achieved.

Expression of the production potential of Arieșan fall wheat variety is influenced by the year factor.

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