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PRODUCTIVITY OF AUTUMN WHEAT IN DEPENDENCE OF THE METEOROLOGICAL CONDITIONS AND THE WORKING OF THE SOIL APPLIED IN AGROECOSYSTEM

Rodica MELNIC
Agrarian State University of Moldova, Chisinau, Republic of Moldova

Abstract: Agriculture had been and remains the only source of food for ever-increasing population, especially in the wake of demographic bursts in poorer countries. Its incidence with the global food crisis is increasing the efforts of all the world's states in the more accelerated development of agriculture, in order to liquidate the great food gaps and to ensure the living conditions of all the inhabitants of the Earth. The Republic of Moldova has a considerable agricultural sector that ensures a variety of animal and vegetal products characteristic of the area. The level of harvest of crop plants depends of many factors: climatic, pedological, biological, economical, agro-technical, the way that agricultural lands are exploited, etc. However, in the country's pedo-climatic conditions, the minimal natural factor for high yields is soil moisture (Andrieş, 2009). The productivity of autumn wheat is assessed in dependence of the weather conditions of the agricultural year 2017-2018, the average annual temperature was 12.1 ° C and the annual rainfall amount of 544.6 mm.

***Key words*:** autumn wheat, crop rotation, agrocenoses, harvest structure, soil work.

INTRODUCTION

Soil represents an integral result of the long-term interaction of pedogenic factors - parental rocks with living organisms and their residues, under certain conditions of relief and climate (Andrieş A., 2015). The soil throughout history continues to be a valued object as well as other riches and objects, but the Republic of Moldova does not have substantial natural wealth and therefore soil was, is and will be the main means of productivity in agriculture. Agriculture is and will remain one of the important branches of many national economies, the development of which depends not only on ensuring a balanced food structure but is also an important source of raw materials for many other economic branches.

The main property of the soil is fertility - the productive potential, the possibility to ensure the harvest of agricultural crops (Andrieş, 2015). Soil fertility is one of the main issues for any farming system, including sustainable agriculture. The higher the fertility of the soil is, the higher the productivity of the agricultural crops are per unit area (Boincean, Stadnic, 2015).

Productivity of crop plants depends of multiple factors: natural, biological, technological, economical, managerial, etc. The main natural factors, which ensure high and stable yields in the conditions of the Republic of Moldova, are the atmospheric precipitation (the degree of moisture supply of the plants) and the level of soil fertility. The soils of Moldova are characterized by high fertility. However, in the last 20-25 years, all factors and forms of soil degradation have intensified and expanded (Lungu, Andrieş, Leah, 2015).

The extensive system existing in Moldovan agriculture leads both to the decrease of the agricultural production volume and to the degradation of the physico-chemical features of the soil. The assessment of effective soil fertility allows to develop and implement a plan of actions to increase soil production capacity, effective use of local organic and chemical

fertilizers to optimize the mineral nutrition of crop plants and to prevent environmental pollution with nutrients (Leah, 2000, Cerbari, 2010). However, the modernization of agriculture has led to a multitude of serious negative effects on the environment. The conventional soil cultivation system (the plow-headed plow), along with a high degree of chemicals, has led to a spectacular increase in productivity, but some disadvantages have also emerged over time. Conservation and maintenance of natural soil fertility has been and is being sustained and promoted by researchers and specialists, taking into account the current requirements for the development of sustainable agriculture.

MATERIALS AND METHODS

The experience was carried out on moderately humid clay chernozem, under agrocenosis with autumn wheat in crop rotation plain, having a long standing character in Chetrosu district of Anenii Noi with the conventional work - Ploughing and conservative - No-till. The determination of the productivity and structure of the autumn wheat harvest was carried out in the field - on 2 research plots per 1 m^2, in 4 repetitions and laboratory, according to the morphological and productive characteristics. The meteorological data were collected from the SDE Chetrosu data base.

RESULTS AND DISCUSSIONS

Agriculture is an important branch for country's economy, it is the main source of food for the population of the country and in the case of developing countries. The concept of soil cultivation and technological soil cultivation systems have evolved much over in the past decades, both in the conceptual plan and in the extension of conservative methods of soil cultivation. In conceiving the development of sustainable agriculture, it is accepted that there is no universal valid system for soil cultivation due to local differences, especially climate and soil, but also because of the technical gifted level. Soil conservation systems in different areas must have specific characteristics in conection with ecological features and the technological characteristics of the cultivated plants, so that differentiation becomes mandatory (Canarache, 1999). The influence of the soil working system is an important indicator for soil fertility conservation and the evaluation of the sustainability of the agricultural system (Guş, 1997; Rusu, 2001, Mark et al., 2004, Jitareanu et al., 2006).

Intensive agriculture in the years 1950 - 1994 led to the destruction and deterioration of the physical condition of soils. The plowing of the soil with the plow in Moldova is done at a depth of 30-35 cm and following this soil cultivation system, the arable layer has lost its compaction resistance. Under the newly worked layer of 10-18 cm, thickness was formed a very thick layer. The partial decrease of the negative influence of the secondary compaction of the arable soil layer in the first 5-7 years of the implementation of the conservative farming system, based on the processes of soil cultivation No-till or Mini-till, can be done by the simultaneous using of phyto-ameliorative and agro-technical processes, but, for transition period of 5-7

years, it is necesary to keep the conservative farming balanced system. The research was carried out at the Experimental Didactic Station "Chetrosu" of the SAUM, located on the eastern outskirts of the Codrilor Plateau, on the high terraces of the Bâc River, in long-term stationary. The purpose of this study was to assess the productivity of autumn wheat in crops with conventional Soil and Conservative Soil, No-till and to determine the structural elements of autumn wheat harvest in dependence on weather conditions. In the study was included agrocenosis with autumn wheat with conventional and Conservative - No-till, agricultural year 2017-2018 (Figure 1).

Figure. 1. Autumn wheat

Wheat is an important cereal crop with a high level of mechanization of technological operations, and for its cultivation, it needs a fertile field with a rich content of nutrients, that directly influences the harvest.

Wheat is pretentious to the precursor plant and it is recommended that the early harvest crops leave the structured soil rich in nutrients, and wheat monoculture is usually accepted only 1 year and only in crops for consumption, in no case wheat will be sown after wheat, on seedlings, or on fields that are heavily infested with diseases. The rotation of crops over time and space is necessary to diversify the remaining soil impact of each crop, to cause competition between pests, weeds, and to contribute in a complex way to the balanced functionality of the biotic and abiotic components of the agroecosystem. Agrocenes of autumn wheat (Antonovca variety) studied in crop rotation are shown in Figure 2. The organization of a natural crop rotation should take into account the economical and organizational conditions and the agro biological conditions of the plants. The country's economy and the welfare of the population largely depend of the country's main natural wealth - soil resources (Ursu, 2011).

Figure 2. Autumn wheat in crop rotation, DES Chetrosu

The soil of the studied object is humid sub moderate humus carbonate chernozem and had been described in the Department of Agroecology and Soil Science (SAUM) and published in the doctoral thesis (Gîrlă, 2010, Macrii, 2018). At the studied chernozem, the differentiation of the genetic horizons in the profile is slow. The horizons are highlighted: Ahp - Ahk - Bhk - BCk - Ck (Table 1).

The effervescence of this type of chernozem is observed from 22 cm. Soil rating by properties - 71 points. Underground water is situated in depth. In general this soil is suitable for field crops (Gîrlă, 2010, Macrii, 2018).

Conservation of soil fertility requires the application of a system of work that optimizes the plant's cultural requirements with soil-induced changes, ensuring the improvement of soil characteristics and the achievement of large and constant productions. In the paper the data of the actual fertility of the carbonate chernozem, expressed in the studied crops, were generalized. The comparative productivity of autumn wheat in crops was studied depending of the applied soil system and performed in several rehearsals, averaging (Table 2).

Table 1. Morphological description of carbon black chernozem, DES Chetrosu

Horizon	Morphological description
horizon Ahpk	The submoderated arable Ahpk humid layer has a horizon thickness of 0-22 cm, dark gray with brown hue color. The transition to the Ahk horizon is well seen by cutting the soil from the plow knife. Slight, loose (1-3 mm) placement. The structure of the soil is more dusty and more unstable than the soil structure under more or less unstable granular cultures, often under the lucerne, where it becomes moderately grainy, granular and less prone, moderately stable. From the neoformations, we observe vegetal organic residues, to various extent under putrefaction, rows of roots (pore diameter less than 1 mm). Thick texture. Efficiency from lean HCl. The moisture content of the soil in the upper part - dry, in the lower part - dilapidated.
horizon Ahk	It has a thickness of 22-46 cm. Dark gray color, slow passage. Dried, poorly compacted, porous (diameter 1-3 mm), spongy (pore diameter 3-5 mm). Structure - granular, moderately stable. Neoformations - roots, earthworms, insects, rare crotovines, from 20-35 cm (rarely) mold, carbonate yarns. Thick texture. Efficiency with HCl (10%) - poor. Moisture amount - wet.
horizon Bhk	Thickness 46-90 cm. The gray color with brown nuances, the slow passage. Slightly compacted settlement, porous (1-3 mm in diameter). Grain structure, poorly stable. Neoformations - crowds of mold, yarn, carbonate mycelium, rare - roots, earthworms, crotovines. Thick texture. Effervescence with HCl (10%) - Moderate. Humid soil moisture, less humid than the Ahk horizon.
horizon BCk	Thickness 90-105 cm, brown color, slow passage, more compact than Bhk, fine pores (dimensions <1 mm), granular structure, unstable, glossy humus scratches, rarely mold, yarns, crotovine, roots. Effervescence from the 10% moderate HCl solution. Much more accentuated than Bhk.
horizon Ck	The Ck horizon starts at 105 cm. Pale yellow with brown nuances, fine pores (sizes <1mm), granular, unstable, small carbonaceous concretes scattered in space without focusing deeply, lutely, effervescence from the 10% HCl solution.

Table 2. Influence of the soil type on the productivity of autumn wheat, DES Chetrosu, 2018

Plot number	Forerunner		Variant	Productivity, t/ha
	2017	2018		
1	autumn wheat (s. Antonovca)	autumn wheat (s. Antonovca)	Ploughing	**4,79**
	autumn wheat (s. Antonovca)	autumn wheat (s. Antonovca)	No-till	**5,29**

Table 3. Structure elements of autumn wheat harvest (1 m^2), year 2017-2018

Plot number	Stem number	Stem weight, g	Ear number	Grain weight on 1 m^2, g	Weight of 1000 grains, g	Grain weight on 1 ha, kg
1	variant Ploughing					
	453	462	431	429,3	46,2	4293
	variant No-till					
	589,6	543,9	576,8	529,1	57,4	5291

A higher productivity of winter wheat in crop rotation, prior to autumn wheat, was recorded on the conservative soil work, No-till - 5.29 t/ha compared to conventional soil work, plowing - 4.29 t/ha. In the laboratory, were carried out the structure elements of the winter wheat harvest on both research variants (Table 3).

The harvest of autumn wheat in the years (2015-2016) was based on the conservative soil work, No-till of 2.43 t / ha and on the variant with conventional soil work, plowing - 3.48 t / ha (researches carried out in Department of Agroecology and Soil Science). Compared to previous years, winter wheat harvesting on the conservative soil version is larger than the conventional soil work, which demonstrates that the conservative soil system works beneficially both on soil properties and on productivity. The productivity of autumn wheat has been assessed in relation to the weather conditions of the agricultural year 2017-2018 (Table 4).

The agrometeorological conditions of the agricultural year 2017-2018 were largely beneficial for the development of autumn wheat and contributed to a good harvest level. In September, temperatures higher than 18.3° C were recorded, compared to the multianual

Table 4. Meteorological conditions in the agricultural year 2017-2018, DES Chetrosu

	Air temperature, ºC			**Atmospheric precipitations, mm**		
Months	average	multiannual average (1881-2003)	± comparative multiannual average	average	multiannual average (1881-2003)	± comparative multiannual average
September	18,3	16,2	+2,1	45,3	42,2	+3,1
October	10,9	9,2	+1,7	114,1	29,5	+84,6
November	6,6	4,4	+2,2	29,9	38,9	-9,0
Total autumn	***11,9***	***10,2***	***+1,7***	***189,3***	***110,6***	***+78,7***

December	3,9	-0,3	+1,2	67,4	34,4	+33,0
January	+0,1	-2,6	+2,7	36,0	28,5	+7,5
February	0,0	-1,3	+1,3	45,9	29,8	+16,1
Total winter	***1,3***	***-1,4***	***+2,7***	***149,3***	***92,7***	***+56,6***
March	2,1	3,0	-0,9	88,1	24,3	63,8
April	14,8	10,4	+4,4	0	33,0	-33,0
May	19,0	16,3	+2,7	34,8	48,8	-14,0
Total spring	***12,1***	***9,9***	***+2,2***	***122,9***	***106,1***	***+16,8***
June	22,9	19,9	+3,0	29,9	71,9	-42,0
July	22,8	21,8	+1,0	50,2	58,4	-8,2
August	24,0	21,1	+2,9	3,0	51,3	-48,3
Total summer	***23,2***	***20,9***	***+2,3***	***83,1***	***181,6***	***-98,5***
Total agricultural year	**12,1**	**9,9**	**2,2**	**544,6**	**492,0**	**+52,6**

average - 16.2° C, while a higher quantity was recorded than the multianual average, which had a beneficial effect on soil and sowing. Due to the increased rainfall (+16.8 mm versus the multianual average) in the spring of 2018, they allowed a very good increase and development of autumn wheat and good productivity. Lack of drought is one of the important factors in obtaining a rich harvest.

CONCLUSIONS

The highest productivity of autumn wheat in crop rotation, prior to autumn wheat, was recorded on the conservative soil work, No-till - 5.29 t/ha compared to conventional soil work, plowing - 4.29 t/ha, with about 1.0 t/ha more. Autumn wheat harvest was evaluated in the weather conditions of the agricultural year 2017-2018, the annual temperature average was 12.1° C and the annual rainfall of 544.6 mm, +52.6 mm higher than the multianual average, which has greatly influenced the harvest. At the same time, the higher yield is due to soil moisture conservation on the research version with the application of the No-till Soil Conservation System, being a beneficial agricultural technique to conserve humidity, increase fertility and improve soil structure. The practice of the No-till soil conservation system in Moldova needs a specific and complex adaptation to the climatic conditions, soil, agrocenosis, plant protection technologies, integrated land management, soil work for soil water conservation, which would increase agricultural productivity and maintain long-term soil productivity.

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