INFLUENCE OF THE LONG-TERM FERTILIZATION ON THE WHEAT YIELD, IN PERIOD 1996-2018, AT ARDS LOVRIN

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Abstract

This study aims to analyze the evolution of winter wheat production, between 1996 and 2018, under the influence of 25 fertilization combinations with nitrogen and phosphorus. Nitrogen fertilizers applied have graduations of 0,30,60,90 and 120 kg active substance/ha, and of phosphorus 0, 40,80,120 and 160 kg of active substance/ha. The research carried out on a typical chernozem in the West of Romania showed that the fertilizers are well used by the winter wheat crop. During the 1996-2018 period, the influence of chemical fertilizers with nitrogen and phosphorus has been studied in a 3 years rotation (soya bean- wheat-maize). Unilateral application of nitrogen and phosphorus bring production increases within the range 573 kg grains/ha - 1016 kg/ha, nitrogen and 282 kg grains/ha - 998 kg/ha, phosphorus. The obtained results highlight the fundamental role of the combined application of the two types of fertilizers. The optimal dose of fertilizer, from an economic point of view is $N_{88}P_{122}$, with a production of 6866 kg wheat/ha.

Key words: winter wheat; phosphorus; nitrogen; yield.

Wheat is one of the most important grain. Among the technological elements that make a special contribution to the production of wheat are nutrient assurance, disease control and crop rotation.

Improving the technology of cultivating wheat, as well as other crops, is characterized by small jumps of production, located on an ascending line, determined by the variation of climatic conditions (Dornescu D., 1991). The quality of the harvest is favorably influenced by fertilizers (Hera C. *et al*, 1989, Burlacu G. *et al*, 1980).

Long field experiments play an essential role in understanding the complex soil x plant x climate interactions and their effect on plant productivity. These are essential to understanding the changes occurring in the soil with the application of fertilizers, soil works and other technological links (Gorinoiu G. *et al*, 2016).

Long-term studies are essential for the development of sustainable farming systems beaucose they are the primary sources of scientific knowledge about agronomic conditions over a long period of time (Sandor A.Y. *et al*, 1991, Gorinoiu, G. *et al*, 2017).

MATERIAL AND METHOD

The research was carried out at SCDA Lovrin, on a typical chernozem, in a long-term experience established in 1967. It was studied the effect of long-term application of fertilizers with nitrogen and phosphorus on the production of wheat, grown after soybeans, in a three-year crop wheat-corn-soybean.

The varieties experienced during this period are Alex and Ciprian, the creation of SCDA Lovrin. Nitrogen fertilizers applied have graduations of 0, 30, 60, 90 and 120 kg active substance/ha, and those with phosphorus 0, 40, 80, 120 and 160 kg active substance nitrogen/ha. Like mineral fertilizers have been used ammonium nitrate 33.5%, applied fractionate in the spring and superphosphate 47%, administered under autumn basic structure.

The evolution of wheat production over the 22 years of experimentation has been appreciated by linear regressions in order to see the increase or decrease in the annual average.

The statistical interpretation of the results was performed using the variant analysis method (ANOVA).

RESULTS AND DISCUTIONS

The level of yields obtained and the efficiency of fertilizers administered depended greatly on the precipitations that had fallen during different periods of the year, very uneven in the 22 years of experimentation.

In order to assess the impact of weather conditions on crop productivity, the recorded data were compared with the significance of

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precipitation quantities (reference limits in relation to agriculture requirements, *Table 1*), using data from the Timis County Agro-climatic Resources (Berbecel O. *et al*, 1981).

Table 1

The significance of precipitation amounts (reference limits in relation to the requirements of agriculture)

Time interval	The significance of precipitation amounts				
	Very dry	Dry	Satisfactory	Optimum	Surplus
September-October	Under 40	41-60	61-80	81-150	Over 150
November-March	Under 100	101-150	151-200	201-300	Over 300
April	Under 20	21-30	31-40	41-70	Over 70
May-July	Under 100	101-150	151-200	201-300	Over 300
Annual	Under 350	351-450	451-600	601-700	Over 700

The amount of precipitation falling in the autumn-spring period oscillated in the range of 151.4 mm (2000-2001) - 425.8 mm (2007-2008). The amount of precipitation in this period, as well as their distribution, besides the influence they have on wheat crops in the early stages of vegetation, condition the water reserve in the soil and influence the effectiveness of fertilizers.

The precipitation from April to July, with values between 93.8 mm (1999-2000) and 451.6 mm (2013-2014), condition the production of wheat.

Annually (September-August), the amount of rainfall was between 331.2 mm in the 2002-2003 agricultural year and 913.3 mm in 2015-2016.

The effectiveness of fertilizers has been greatly influenced both by the amount of precipitation fallen during different periods of the year and by their distribution. Production spores obtained by applying fertilizers have been very different from one year to the next.

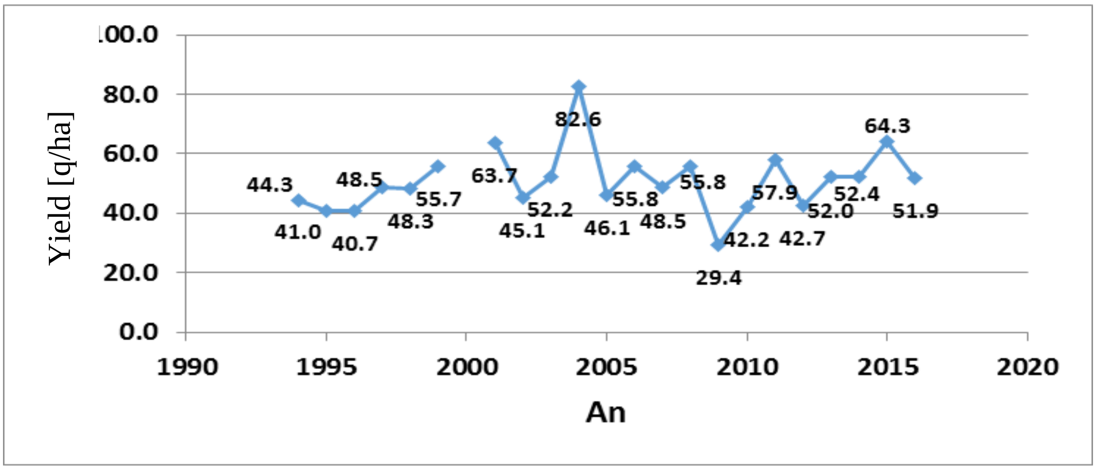

Figure 1 **The evolution of wheat production in the period 1996-2018**

The precipitations recorded in the period 1996-2018 at the Lovrin meteorological station are presented in Table 2. Analyzing this table, we can see that one year was very dry (2002-2003), 3 dry years (1999-2000, 2011-2012, 2016-2017), 2 years with optimal rainfall (2006-2007, 2013-2014); 10 years satisfactory and in four years the rainfall was surplus.

Figure 1 shows the evolution of wheat production in the period 1996-2018. The year 2002, the year when the crop was destroyed due to hail, is missing.

Table 2

The significance of the amount of precipitation in relation to the requirements agriculture, from the period 1996-2018

Characteristic periods										
Year	IX-X	Significance	XI-III	Significance	IV	Significance	V-VII	Significance	Annual	Significance
95-96	80.7	Satisfactory	207.8	Optimum	20.3	Very dry	224.1	Optimum	571.7	Satisfactory
96-97	110.4	Optimum	136.5	Dry	61.0	Optimum	171.6	Satisfactory	539.0	Satisfactory
97-98	90.0	Optimum	131.3	Dry	42.2	Optimum	221.6	Optimum	557.9	Satisfactory
98-99	160.8	Surplus	123.1	Dry	47.7	Optimum	350.6	Surplus	753.6	Surplus

99-00	56.4	Dry	184.7	Satisfactory	28.0	Dry	65.8	Very dry	353.9	Dry
00-01	8.9	Very dry	142.5	Dry	97.7	Surplus	324.7	Surplus	585.9	Satisfactory
01-02	134.6	Optimum	93.8	Very dry	2.0	Very dry	150.6	Dry	466.6	Satisfactory
02-03	113.0	Optimum	166.9	Satisfactory	12.2	Very dry	107.6	Dry	331.2	Very dry
03-04	164.7	Surplus	111.0	Dry	102.0	Surplus	269.7	Optimum	707.6	Surplus
04-05	156.7	Surplus	97.4	Very dry	123.3	Surplus	183.9	Satisfactory	734.7	Surplus
05-06	109.7	Optimum	167.1	Satisfactory	38.4	Satisfactory	167.5	Satisfactory	576.1	Satisfactory
06-07	65.5	Satisfactory	300.7	Surplus	2.1	Very dry	287.3	Optimum	658.3	Optimum
07-08	201.3	Surplus	224.5	Optimum	14.2	Very dry	238.1	Optimum	701.1	Surplus
08-09	91.7	Optimum	201.9	Optimum	19.3	Very dry	185.6	Satisfactory	499.4	Satisfactory
09-10	74.6	Optimum	328.4	Surplus	29.5	Dry	282.7	Optimum	791.9	Surplus
10-11	102.9	Optimum	194.2	Satisfactory	13.6	Very dry	144.6	Satisfactory	469.9	Satisfactory
11-12	50.6	Dry	111.6	Dry	126.2	Surplus	150.4	Satisfactory	442.0	Dry
12-13	46.1	Dry	238.4	Optimum	27.7	Dry	147.0	Dry	509.8	Satisfactory
13-14	79.3	Satisfactory	122.8	Dry	5.1	Very dry	446.5	Surplus	685.1	Optimum
14-15	181.5	Surplus	90.5	Very dry	4.0	Very dry	166.4	Satisfactory	526.9	Satisfactory
15-16	215.5	Surplus	327.0	Surplus	26.2	Dry	294.6	Optimum	913.3	Surplus
16-17	160	Surplus	115.0	Dry	54.0	Optimum	99.0	Very dry	450.5	Dry

There is a clear observation of the variation in wheat production from one year to the next and in time, with the smallest production being recorded in the dry years, where the efficacy of fertilizers has been greatly reduced and implicitly the level of production. The highest level of production was registered in 2004, 8260 kg grains/ha, year with inseminated precipitations, evenly distributed over the entire period of grain vegetation.

Table 3

Examining the multiple regression equation (1996-2018)

	Correlation coefficient	Standard error of correlation coefficient	Regression coefficient	Standard error of regression coefficient	Test t (58 Gl)	
					Value	**Significance**
Free term			34.44796	4.887342	7.04840	***
N	0.385091	0.037650	0.11781	0.011518	10.22805	***
P	0.273150	0.037650	0.06267	0.008639	7.25490	***
pp	0.067241	0.037656	0.00776	0.004346	1.78568	
t^0C	-0.001302	0.037656	-0.01720	0.497461	-0.03458	

Analyzing the values of the regression coefficient presented in Table 3, we can conclude that applied nitrogen and phosphorus fertilizers positively influence the production of wheat. The production of wheat made in the period 1996-2018 increased on average with: 12 kg grain/1 kg of nitrogen, 6 kg grain/1 kg of P2O5 and 0.8 kg/1 mm of precipitations.

Increasing the temperature over the multiannual average has a negative influence on wheat production. Thus, raising the temperature by 1 ° C leads to a decrease in production of 37 kg grain/ha.

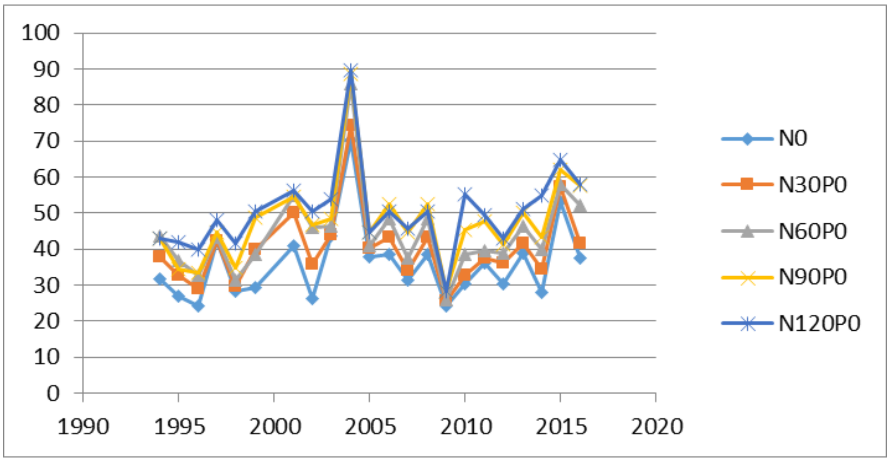

Figure 2 **The evolution of production by unilateral application of** nitrogen

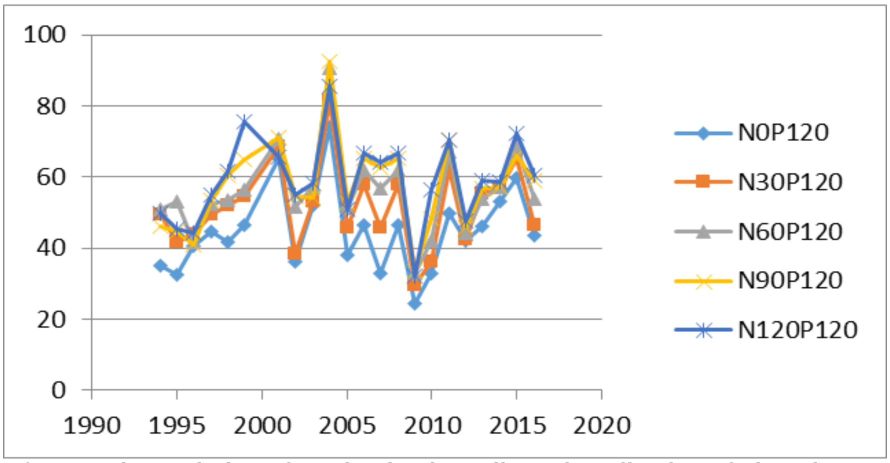

Figure 3 **The evolution of production by unilateral application of phosphorus**

Long fertilization with nitrogen fertilizers led to average yields of 4848-5865 kg/ha, with large production differences between the control and the high nitrogen dosed variants. By the unilateral application of nitrogen, the production increases proportionally with the administered fertilizer dose, the crop increase ranging from 573 kg grains/ha, in fertilized variant with 30 kg/ha nitrogen and 1016 kg/ha, in the fertilized variant with120 kg nitrogen/ha (*figure 2*).

With the unilateral application of phosphorus, the recorded production growth is far below that of nitrogen fertilizers, ranging from 282 kg grains/ha, at application of the P40 dose, to 998 kg/ha at the P160 dose.

Combined administration of the two types of fertilizer bring production increases ranging from 855 kg/ha (N30P40) to 2015 kg/ha (N90P160) (*figure 3*). The optimal dose of fertilizer, from an economic point of view is N88P122, with a production of 6866 kg of wheat/ha.

CONCLUSIONS

From the long-lasting experiments with chemical fertilizers, carried out on the Lovrin chernozem, to the wheat culture, the following conclusions can be drawn:

- Productions obtained during the 22 years of experimentation varied greatly, being influenced by climatic conditions;
- The production of wheat made in the period 1996-2018 increased on average with: 12 kg grain/1 kg of nitrogen, 6 kg grain/1 kg of P2O5 and 0.8 kg/1 mm of precipitations. Increasing the temperature over the multiannual average has a negative influence on wheat production. Thus, raising the temperature by 1 ° C leads to a decrease in production of 37 kg grain/ha.
- Combined administration of the two types of fertilizer bring production increases ranging from 855 kg/ha (N30P40) to 2015 kg/ha (N90P160), the optimal fertilizer dose being $N_{88}P_{122}$, from the economic point of view

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