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THE INFLUENCE OF FERTILIZING SCHEMES AND THERMAL REGIME ON WHEAT YIELDS IN THE NORTH-WEST REGION OF ROMANIA

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Abstract

The current research is based on the production results obtained on wheat crops (Dumbrava Variety), cultivated following corn and following soy, in long term experiments conducted on an argyle chernozem as a representative soil for the north-western region of Romania, especially Cluj County. The production data are obtained from these experiments, which hold objectives that target both the effect of differentiated fertilizations on wheat yields and the quantity of the productions obtained.The goal of this research is to exhibit the differentiated fertilization systems involved in obtaining high productions for wheat (grown following soy, respectively following corn) in the reference area. In this study it was tracked the effect of the nitrogen-phosphorous interaction and the effect of the thermal regime during three experimental years (2011, 2012, 2013) in achieving the wheat productions.

Key words*: fertilization systems, nitrogen-phosphorous interaction, thermal regime, wheat crops, wheat yield.*

INTRODUCTION

Agricultural performance as a requirement of contemporary society requires assimilation into production of all elements of technical progress - scientific and economic - advanced in all its sides that determine quantitative and qualitative productivity, higher yields, economic efficiency obtained under optimum systems involved in their implementation, food safety and consumer protection (Chețan et al., 2016).
Promoting during the last decades of sustainable agriculture and sustainable concepts entails the application of the principles that lead to productive agricultural technologies, technically and economically efficient solutions with effective protection of the environment and consumers that ensure not only productivity but also real optimization of production, social and environmental components and causes a new quality of life (Kurtinecz and Rusu, 2007; Ciontu et al., 2012, Marin et al., 2016).
Optimizing agrochemical soil - plant system is meeting the essential objective in a higher degree and the crops requirements to soil reaction and representation of elements and nutrients in specific concentrations and ratios between them (Borlan and Hera, 1984; Rusu et al., 2009; Mărghitaş et al., 2011).
In this study was tracked the effect of the nitrogen-phosphorous interaction in achieving wheat and corn productions. The research presents the stated results as annual (partial) values and it will continue with them as being reference values for further experimental years (as stages in long term experiments) and with approaches that will substantiate the suggested solutions. The production data are obtained from such experiments, framed in the "long term experiments system" from Fundulea network, which hold objectives that target both the effect and efficiency of differentiated fertilizations on productions and also the impact of fertilizers on the soil fertility evolution, on the quality of the productions obtained (Poruţiu et al., 2013).
In the context of the optimization of soil-plant system, an important scientific and practical role is played by the agrochemical optimization

alternatives that harmonize the fertilizing components of the soil with the demands of the vegetal species that can exploit better the production capacity of the soil and genotypes cultivated in order to obtain high vegetal productions that are consumable in large quantities, having superior quality indices, in terms of maintaining an equilibrium in the environment and determining food safety and security (Rusu et al., 2005).

MATERIALS AND METHODS

Experimental approaches were performed under Agricultural Research and Development Station from Turdaconditions, using the experimental protocol of long term experiences, located in the agricultural year 1966/1967, for wheat-corn-soy rotation (Haş, 2006).

Dumbrava wheat variety has the following biological, agronomical and productive characteristics: plants height - 85-95 cm, exhibit a white, 9-11 cm long ear. The grain is medium-sized, oval and red. One thousand grain weight (MMB) is quite high, within 45-50 g, the hectoliter mass (MH) of 75-80 kg/hl (Turda, SCDA).

The field experience which underpins the achievement of objectives is a bi-factorial structure that tracks the effect of the NP interaction on wheat and corn according to the following experimental schemes: A factor - phosphorus doses (kg P_2O_5/ha): 0, 40, 80,120, 160 with annual application to wheat; B factor - nitrogen doses (kg N/ha): 0, 50, 100, 150, 200 with annual application to wheat after corn andnitrogen doses (kg N/ha) 0, 40, 80, 120, 160 with annual application to wheat following soy.

According to soil mapping, pedological and agrochemical study and from the soil quality monitoring results, this soil fits the argic chernozem type, in the pedological class of cernisoils (SRTS, 2012).

The fertilizers used in the experiments are represented by a complex fertilizer 20:20:0 which is a solid, granulated nitrophosphate, which holds when applied, the effect of the interaction of the two elements from its composition (N:P), here in balanced concentrations and reports (1:1:0) and nitrate of ammonium which is a simple nitrogen mineral fertilizer that holds the active substance in nitrate and ammonia state.

RESULTS AND DISCUSSIONS

Wheat crops respond positively to the NP levels applied to the soil in the experience, the production effects are at the level of 3-6 t grains per surface unit with production differences (increases) that are very distinctly significant for all nitrogen-phosphorous combinations applied (Table 1).

Table 1. Summary Indicators of Fertilizer Applied to Wheat Crops (Dumbrava Variety)

Year	Crop	Maximum production obtained (kg/ha)	NP Dose	Significance of factors influence [x)]
2011	Wheat grown following corn	5533.33	N150P80	NP - v. d. s.; N - v. d. s.; P - n. s.
	Wheat grown following soy	5400.00	N120P160	NP - f. d. s.; N - v. d. s.; P - v. d. s.
2012	Wheat grown following corn	6696.13	N150P120	NP - v. d. s.; N - v. d. s.; P - v. d. s.
	Wheat grown following soy	5755.80	N120P120	NP - v. d. s.; N - v. d. s.; P - v. d. s.
2013	Wheat grown following corn	6945.33	N150P120	NP - v. d. s.; N - v. d. s.; P - d. s.
	Wheat grown following soy	6564.00	N160P160	NP - v. d. s.; N - v. d. s.; P - s.
Mean	Wheat grown following corn	6391.60	N150P106	
	Wheat grown following soy	5906.60	N133P146	

[x)]v.d.s. - very distinctly significant; d.s. - distinctly significant; s. - significant; n.s. - insignificant

Table 2. Report on Yield and Maximum Increases to the Content of Active Substance/Hectare (N+P)

Year	Crop	Maximum yield	NP Dose	Dose sum N+P	Production/NP dose	Prod. Dif. (M)/NP dose
2011	Wheat after corn	5533.33	N150P80	230	24	9.6
	Wheat after soy	5400.00	N150P160	310	19	6.7
2012	Wheat after corn	6696.13	N150P120	270	25	14.2
	Wheat after soy	5755.80	N120P120	240	24	8.9
2013	Wheat after corn	6945.33	N150P120	270	26	16.8
	Wheat after soy	6564.00	N160P160	320	21	10.6
Mean	Wheat after corn	6391.60	N150P106	256	25	10.1
	Wheat after soy	5906.60	N133P146	279	21	8.9

Wheat production results in the experimental years 2011 - 2012 - 2013 allow a synthesis of their analysis regarding some production effective approaches through differential fertilizing systems based on the NP complex effect, a high priority and often used technology (Table 2).

Technical results obtained as the mean of the years 2011, 2012, 2013 prove the possibility of obtaining maximum yields of wheat, Dumbrava variety, of 6391.60 kg/ha using N150P106 fertilizer effort (crop after corn) and 5906.60 kg/ha with a fertilizer dose of N133P146 (crop after soy).

Wheat crops which emphasize a technical and productive response very distinctly significant to the effect of NP interaction and mostly very distinctly significant to the influence of N factor action, respond to the effects mentioned by units and production curves according to the polynomial model $y = a + bx - cx^2$ (Figure 1, Figure 2).

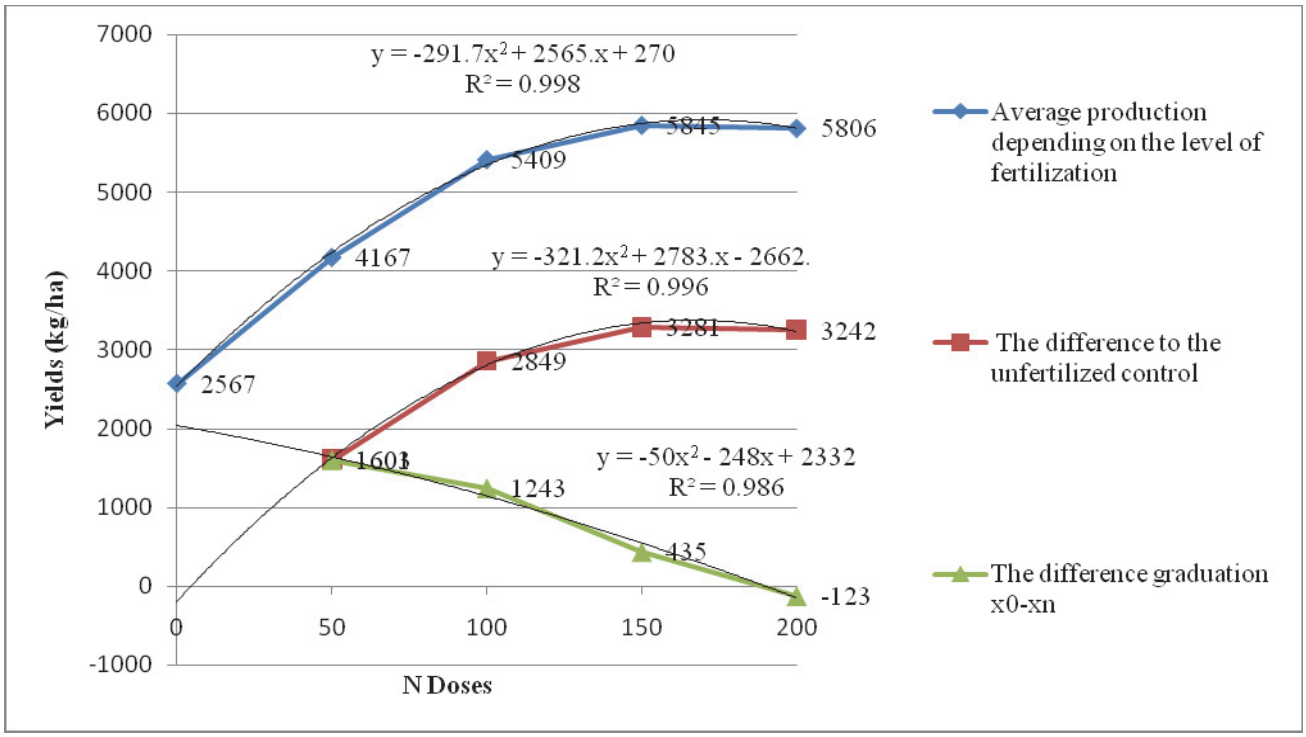

Figure 1. Curves of the Average Yield of Wheat (Dumbrava Variety)
Caused by the Variation of N and NP (Previous Plant - Corn)

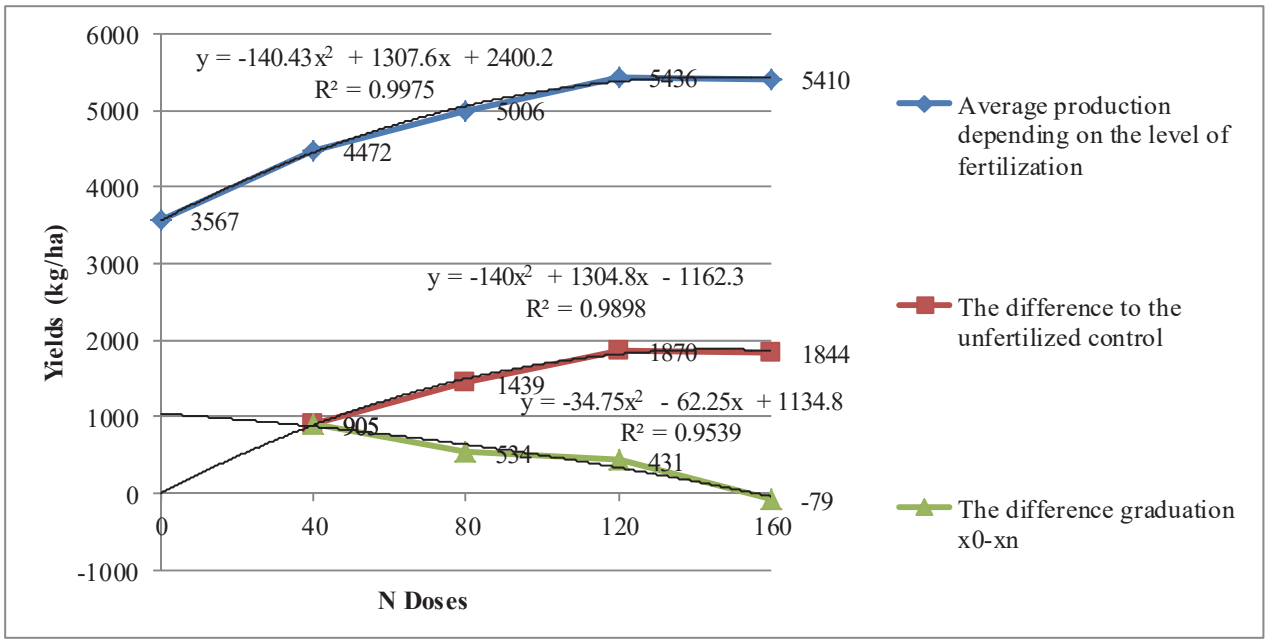

Figure 2. Curves of the Average Yield of Wheat (Dumbrava Variety)
Caused by the Variation of N and NP (Previous Plant - Soy)

The thermal regime during 2011, 2012, 2013 exhibit the characteristics of the Transylvanian Plain, with local specificity (Agricultural Research and Development Station from Turda) and particular specificity of the research period (years) (Figure 3).

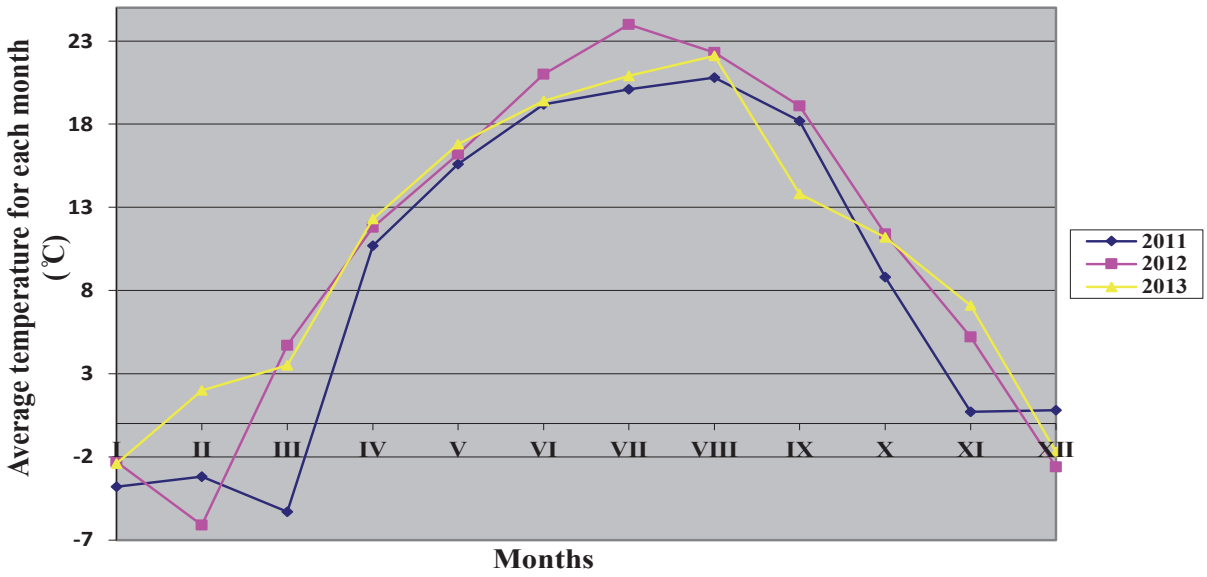

Figure 3. Thermal Regime during 2011-2012-2013

2011 is generally characterized by average monthly temperatures above normal in spring and during those with active vegetative activity (March-September) which makes the average annual temperature to be 9.4˚C with 0.5˚C above the normal average temperature of the research area. July and August have the highest temperatures. These deficits and disorders jeopardize the current vegetation and the following crops. This year is warm with temperature, surpluses during summer 2012 exhibits a surplus of thermal conditions and therefore is warmer in spring - summer - autumn, with July and August the warmest. The average annual temperature is 10.4˚C with 1.4˚C over the annual average of this indicator.

In terms of heat 2012 it is warmer than the previous year. 2013 exhibits the characteristics of previous years, with surplus heat in spring - summer when the vegetation is in full swing. The average annual temperature is 10.4˚C with 1.4˚C than the annual average, meaning that this year continues the trend of general and local heating.

Regarding the experimental years 2011 - 2012 - 2013 heating can be stated as a general feature, especially in the summer months which are the warmest. The consequences of climate anomalies related to excess heat especially reflected in yields obtained, to which were found large variations from year to year and between the experimenys variants.

CONCLUSIONS

Statistically it was proven to be essential and very distinctly significant the effect of NP interaction for wheat crops grown after corn and after soy, followed by the individual action of nitrogen and less of the phosphorus.

Wheat grown after corn has a higher apparent response and a more constant one to NP interaction, then to N, the previous plant here proves to induce a better harness of the fertilization applied;

The level of physical productions and of the increases determined the promotion of polynomial (bi-factorial) function model in the following form: $y = a \pm bx_1 \pm cx_1^2 \pm bx_2 \pm cx_2^2$. In this model of production functions, expressing through the frequent term ($-cx_1^2$) and ($-cx_2^2$), proved as real the capping tendency of the productions at high NP doses and firstly at nitrogen doses (over 150 kg a.s./ha).

Capping trends of the fertilizing effect occurs on doses exceeding 150 kg N/ha and 80 kg P_2O_5/ha for wheat grown after corn, and for wheat grown after soy this effect occurs when exceeding the following doses: N-120 kg/ha, P_2O_5-40-80 kg/ha.

It turns out that the effect of phosphorus contributes to a better use of high and very high doses of N. Therefore, the NP interaction remains the primarily effect, followed by the effect of nitrogen, as essential and then the effect of phosphorus.

In the set of the mentioned alternatives of fertilization with the mentioned doses, grain yields can be obtained of 5-6-6.5 t/ha for wheat crops on argic chernozem at Agricultural Research and Development Station from Turda, specific to the ecological conditions of the Transylvanian Plain.

For wheat grown after corn, in 2011, the values of technical optimum doses are: DOT_N - 153.75 kg/ha, DOT_P - 127.4 kg/ha and in 2013, DOT_N - 188 kg/ha, DOT_P - 126.25 kg/ha.

For wheat grown after soy, in 2011, the values of technical optimum doses are: DOT_N - 159.61 kg/ha, DOT_P - 50 kg/ha and in 2013, DOT_N - 301.13 kg/ha, DOT_P - 363.75 kg/ha.

When using these fertilizing schemes, excess heat is also beneficial for both wheat cultivated following corn and for wheat cultivated following soy. The maximum yields obtained are higher in 2012 and 2013, when the average temperature for each month exceeded the normal than in 2011, when the temperatures recorded were closer to the normal ones.

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