

COMPARATIVE RESEARCH ON WHEAT AND CORN CROPS ON A REPRESENTATIVE SOIL FROM TRANSYLVANIA

Poruțiu¹⁾ Andra, Felix Arion¹⁾, Iulia Mureșan¹⁾, Tudor Sălăgean^{1)*}, Lavinia Moldovan²⁾, Raluca Fărcaș³⁾

¹⁾University of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture, Cluj-Napoca, Romania

²⁾University of Agricultural Sciences and Veterinary Medicine, Faculty of Agriculture, Cluj-Napoca, Romania

³⁾Technical University, Department of Land and Cadastral Measurements, Cluj-Napoca, Romania
*Corresponding author: tudor.salagean@usamvcluj.ro

Abstract. 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. In this study was tracked the effect of the nitrogen-phosphorous interaction in achieving wheat productions. The current research is based on the production results obtained on corn crops (Turda STAR Variety) and wheat crops (Dumbrava Variety) – cultivated following corn, in long term experiments conducted on an argyle chernozem soil in Turda (Cluj County). The production data are obtained from these experiments, which hold objectives that target both the effect of differentiated fertilizations on wheat and corn productions and also the impact of fertilizers on the soil fertility evolution, on the quality of the productions obtained. The goal of this research is to present the differentiated fertilization systems involved in obtaining high productions in the reference area. In this study it was track the effect of the nitrogen-phosphorous interaction in achieving wheat and corn productions. The research presents the stated results as annual (partial) values and as being reference values for further experimental years.

Keywords: wheat crops, corn crops, fertilization systems, nitrogen-phosphorous interaction.

INTRODUCTION

The production data are obtained from experiments framed in the “long term experiments system” from ASAS-ICDCPT 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 (Poruțiu 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).

Approaches dedicated to ensure real management of fertilizing resources on agricultural crops (in this case, wheat-grown following corn and corn) are considering going through stages of scientific evidence on the efficiency of fertilizer application and

then developing a substantiation framework for the optimization of fertilization. Obviously, these approaches involve first of all defining the concepts and objectives of establishing relevant indicators expressing fertilization efficiency and optimization in order to disseminate the results obtained in the delimitation of differentiated fertilization systems (Oțiman, 1979; Oțiman, 1987).

MATERIALS AND METHODS

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.

The field experience which underpins the achievement of objectives is a bi-factorial structure that tracks the effect of the NP interaction on wheat cultivated following corn and corn:

- A factor - phosphorus doses (kg P₂O₅/ha): 0; 40; 80; 120; 160, with annual application to wheat cultivated following corn and corn;
- B factor - nitrogen doses (kg N/ha): 0; 50; 100; 150; 200, with annual application to wheat cultivated following corn and corn;

When harvesting the wheat, production results were collected and for these the absolute increases due to phosphorus application as a fertilizer were calculated.

The processing and interpretation of the data was conducted using the production curves according to polynomial models and they were graphically represented in this study.

Corn hybrid Turda STAR has the following biological, agricultural and productive attributes: tri-linear, semi-early hybrid, with high plants and 13-15 semi erect leaves. Cob has a conical shape, medium length, with 16 rows of beans and it is red. Semi-hyaloid grain is yellow, one thousand grain weight (MMB) of 380 g, yield 79%. The grain has a chemical composition represented by 11,5 – 12,5% protein, 3,8 – 4,6% fat and 69,5 – 71,5% starch.

Soil from the nutrient experiences: 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 cernisols (Borlan et al., 1994).

Fertilizer used in the experiments: complex fertilizer 20-20 is a solid, granulated nitro-phosphate, 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) (Hera, 2008).

When harvesting the corn, production results were collected and for these the absolute increases due to phosphorus application as a fertilizer were calculated. The processing and interpretation of the data was conducted using the production curves according to polynomial models and they were graphically represented in this study.

RESULTS AND DISCUSSIONS

The application of the NP combinations exhibits multiple possibilities of obtaining productions of 5.5 - 7 t grains/ha for wheat grown after corn, at 100 – 200 kg N/ha and 40 – 160 kg P/ha.

Wheat production results 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 1, 2).

Table 1

Summary Indicators of Fertilizer Applied to Wheat Crop (Variety Dumbrava)

Year	Crop	Maximum production obtained (kg/ha)	NP Dose	Significance of factors influence ^{x)}
2011	Wheat grown following corn	5533,33	N150P80	NP - f. d. s.; N - f. d. s.; P - n. s.
2013	Wheat grown following corn	6945,33	N150P120	NP - f. d. s.; N - f. d. s.; P - d. s.
Mean	Wheat grown following corn	6391,60	N150P106	

^{x)} f. d. s. - very distinctly significant; d. s. - distinctly significant; s. - significant; n. s. – insignificant

Table 2

Report on Production and Maximum Increases to the Content of Active Substance/Hectare (N+P)

Year	Crop	Maximum production	NP Dose	Dose sum N+P	Production/NP dose	Prod. Dif. (M)/N P dose
2011	Wheat after corn	5533,33	N150P80	230	24	9.6
2013	Wheat after corn	6945,33	N150P120	270	26	16.8
Mean	Wheat after corn	6391,60	N150P106	256	25	10.1

The illustration of the way of manifestation of the dependencies of average productions per hectare on the two fertilizing factors applied (x_1 = dose of P active substance/ha și x_2 = dose of N active substance/ha) can be graphically expressed. This illustration exhibits the evolution of average productions in relation to P doses (x_1) and N doses (x_2), it highlights the areas of the positive x_1x_2 interactions and suggests the production levels, for wheat grown following corn and corn, probable on the argyle chernozem and that may extrapolate the obtained results.

Corn grain production (Turda STAR hybrid) is very variable from year to year, the quantitative results in 2013 are less than half of the productions obtained in 2011.

The synthesis of the production results obtained for corn linked to the NP fertilization proves specificity due to this crop and especially a real dependency to the favorable climatic condition of that agricultural year (Table 3, 4).

Table 3

Summary Indicators of Fertilizer Applied to Corn Crop (Variety Turda STAR)

Years	Maximum production (kg/ha)	NP Dose	Significance of factors influence ^{x)}
2011	13696	N200P160	NP - f. d. s.; N - f. d. s.; P - n. s.
2013	6493	N200P80	NP - d. s.; N - d. s.; P - n. s.
Mean	8128	N183P93	

^{x)} f. d. s. - very distinctly significant; d. s. - distinctly significant; s. - significant; n. s. – insignificant

Table 4

Report on Production and Maximum Increases to the Content of Active Substance/Hectare (N+P)

Year	Crop	Maximum production (kg/ha)	NP Dose	Dose sum N+P	Production/NP dose	Prod. Dif./NP dose
2011	Corn	13696	N200P160	360	38	19
2013	Corn	6493	N200P80	280	23	2.5
Mean	Corn	8128	N183P93	276	23	5.3

Based on technical analysis, consistent with the average production results obtained, with all the high variability of the grain production, it is possible to obtain maximum yields of 8128 kg/ha at a complex dose of N183P93. For corn crops were taken into consideration the efficiency parameters and indicators for 2011 when the productions were constantly of 12-14 t grains/ha and annual production increases of 3-7,5 t grains/ha.

CONCLUSIONS

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.

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 argyle chernozem at SCDA Turda, specific to the ecological conditions of the Transylvanian Plain.

Turda STAR hybrid responded with grain yields of 12-14 t/ha, with increases in NP interaction accounted for only ½ and over half of the grain production. This hybrid harnessed the NP interaction, at average and high doses of both nutrients.

The maximum production that can be obtained, in the North-West region of the country, for wheat crops (grown following soy) is of 6945,33 kg/ha and for corn crops 13696 kg/ha, so this region is more suitable for corn crops, the quality and quantity of

productions, of course being influenced by the previous crops, climatic conditions and soils specific to the area.

REFERENCES

1. Borlan Z., Hera C., 1984, Agrochemical Optimization of Soil-Plant System, *Romanian Academy Publishing House, București*.
2. Borlan Z., Hera C., Dornescu D., Kurtinecz P., Rusu M., Buzdugan I., Tănase G., 1994, Fertility and Fertilization of Soils (Agrochemistry Compendium), *Ceres Publishing House, București*.
3. Hera C., 2008, Fertilizers and Sustainable Agriculture, *ProcEditura of the Int. Symp. CIEC, Pretoria-South Africa*.
4. Otiman P., 1979, Regarding the Automatic Generation of Models of Optimization of the Activities in Agriculture, *Lucrări șt. Agronomie, Timișoara, nr. 16*.
5. Otiman P., 1987, Optimization of Agricultural Production, *Facla Publishing House, Timișoara*.
6. Poruțiu A., Rusu M., Mărghițaș M., Toader C., Moldovan L., Deac V., Chețan F., 2013, Research Concerning the Agrochemical Optimization of the Fertilization System for Wheat Crops on an Argic Phaeozem Soil in the Transylvanian Plain, *Research Journal of Agricultural Science, 45 (1), Timișoara*.
7. Poruțiu A., 2014, Economic Optimization of the Fertilizing System for Wheat and Corn in the Transylvanian Plain, *PhD Thesis, Cluj-Napoca*.
8. Rusu M., Marilena Mărghițaș, I. Oroian, Tania Mihăiescu, Adelina Dumitraș, 2005, Agrochemistry Treaty, *Ceres Publishing House, București*.