

EFFECT OF APPLYING ORGANO-MINERAL FERTILIZERS ON THE CONCENTRATION OF COOPER IN WHEAT AND MAIZE SEEDS

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Abstract

Were studied copper concentration of wheat and maize seeds harvested from four variants fertilized with different doses of organo-mineral fertilizers with nitrogen, phosphorus, potassium and farmyard manure. In wheat grains, for the three years under study, average copper concentration, in the control was 1.640ppm.

A higher concentration was determined in variant $N_{100}P_{100} + 60$ t/ha farmyard manure, there was of 36.4% compared to control, of 2.236ppm, being statistically significant.

In terms of the concentration of copper in the grains of maize, in unfertilized variant was 2.858 ppm.

The biggest difference compared to the control variant was registered in the version fertilized with $N_{100}P_{100} + 60$ t/ha farmyard manure, this being with 1.077 ppm bigger.

Percentage was higher by 37.7% being.

Key words: copper, wheat, maize, seeds, fertilizers, organo-mineral.

INTRODUCTION

Brune A. et al., (1995) argue that the differentiated toxicity of metals in plants is, at least in part, related to their compartmentalization in the plant: epidermis, mesophilic (and in their cells, in the cell wall, vacuoles and chloroplasts). Most of the metal content is attached to the cell walls (Abd El-Aziz S.S. et al, 2009).

For plants the accessibility of heavy metals is not constant. It varies depending on the species and soil and climatic conditions. Wastewater irrigation leads to an increase in the concentration of heavy metals (Cu, Cr, Mn, Ni, Pb and Zn) in the roots, stems and seeds of wheat plants, the most significant increase being in the case of manganese and zinc (M. Karatas et al., 2006, XuY. et al., 2013).

Salad, unlike carrots and potatoes, has a greater ability to accumulate zinc, copper and cadmium, and clover absorbs copper faster than grasses. The tolerance levels of various heavy metal crops are in descending order:

herbs, grasses, grains, potatoes, and sugar beet (R.L. Hough et al., 2003, Hejcman M. et al., 2013).

Plants exposed to excessive levels of copper in the soil can be toxic to most animals. Thus, sheep are very sensitive to copper, the toxicity occurring when the food contains 12-15 ppm Cu. Critical values in plants, dangerous for animals are 30 ppm Cu (Ciobanu G., 2007, Diacono M. and F. Montemurro, 2010).

By applying moderate doses of chemical fertilizers with nitrogen, phosphorus and potassium maize crop the concentration of copper in grains increases insignificantly (Vuşcan A., 2017).

This article shows the influence of the organo-mineral fertilizers over copper concentration in wheat and maize seeds.

MATERIAL AND METHOD

The wheat and maize seeds were harvested in the long term trials at the Agricultural Research and Development Station Oradea, in 2014 – 2016 period.

Variants studied:

V₁ - N₀P₀ + 0 t/ha farmyard manure,

V₂ - N₅₀P₀ + 20 t/ha farmyard manure,

V₃ - N₅₀P₅₀ + 40 t/ha farmyard manure,

V₄ - N₁₀₀P₁₀₀ + 60 t/ha farmyard manure.

Laboratory investigations were carried out in the “*Research Laboratory of risk factors for Agriculture, Forestry and the Environment*”, Faculty of Environmental Protection Oradea.

To determine the copper concentration, the plant samples were mineralized with a mixture of sulfuric and perchloric acids.

Samples of vegetal biological material were prepared according to the working methods and analyzed with a spectrophotometer with atomic absorption SHIMADZU AA-6300 to determine the concentration of copper.

The links between different doses of organo-mineral fertilizers and copper concentration in wheat and maize seeds were calculated using Microsoft Excel program; of the 5 types of functions available on the program (linear, exponential, logarithmic, polynomial and power) was chosen the function with the highest value of R².

RESULTS AND DISCUSSIONS

Wheat grains harvested from experiment with chemical fertilizers with nitrogen, phosphorus and farmyard manure had an average concentration of copper of 1.640 mg/kg in variant N₀P₀ + 0 t/ha farmyard

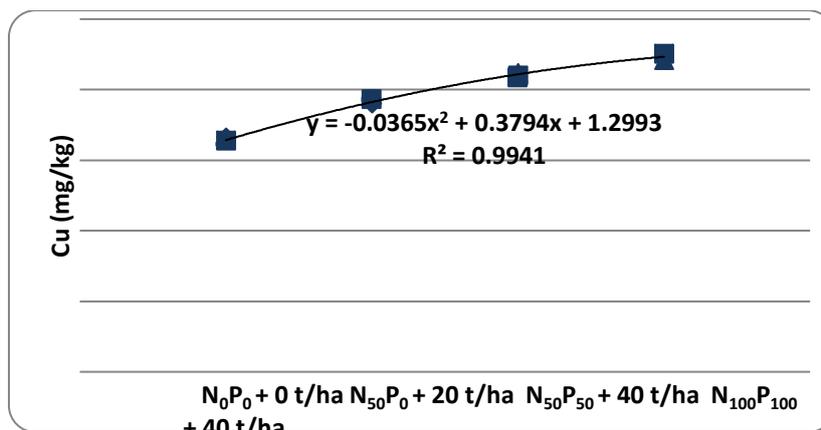
manure (control), 1.920 mg/kg (17.1% higher compared to control variant) in variant N₅₀P₀ + 20 t/ha farmyard manure, 2.102 mg/kg (28.2% higher compared to unfertilized variant) in fertilized variant N₅₀P₅₀ + 40 t/ha farmyard manure, respectively 2.236 mg/kg (36.4% higher compared to the control variant) in variant N₁₀₀P₁₀₀ + 60 t/ha farmyard manure. In fertilized variant N₅₀P₀ + with 20 t/ha farmyard manure the difference was statistically insignificant, and variants N₅₀P₅₀ + 40 t/ha farmyard manure and N₁₀₀P₁₀₀ + 60 t/ha farmyard manure the differences were statistically insured as being “significant”.

Table 1

The influence of NP fertilizers and manure on copper concentration in winter wheat seeds

Variant	Cu concentration		Difference		Statistical significance
	mg/kg	%	mg/kg	%	
N ₀ P ₀ + 0 t/ha farmyard manure	1.640	100	-	-	Control
N ₅₀ P ₀ + 20 t/ha farmyard manure	1.920	117.1	0.280	17.1	-
N ₅₀ P ₅₀ + 40 t/ha farmyard manure	2.102	128.2	0.462	28.2	*
N ₁₀₀ P ₁₀₀ + 60 t/ha farmyard manure	2.236	136.4	0.596	36.4	*
		LSD 5%	0.310		
		LSD 1%	0.611		
		LSD 0.1%	0.958		

Mathematical modeling of the results regarding the concentration of copper in wheat grains from the variants of experiment with nitrogen, phosphorus and farmyard manure studied, from the 5 tested functions (exponential, linear, logarithmic, polynomial, power), polynomial type function, $y = -0.036x^2 + 0.379x + 1.299$, $R^2 = 0.994$, best quantifies the relationship between doses of nitrogen, phosphorus and farmyard manure fertilizers and the concentration of copper in wheat grains (Figure 1).



*FYM - farmyard manure

Fig. 1. Correlation between doses of NP fertilizers and manure and copper concentration in wheat grains

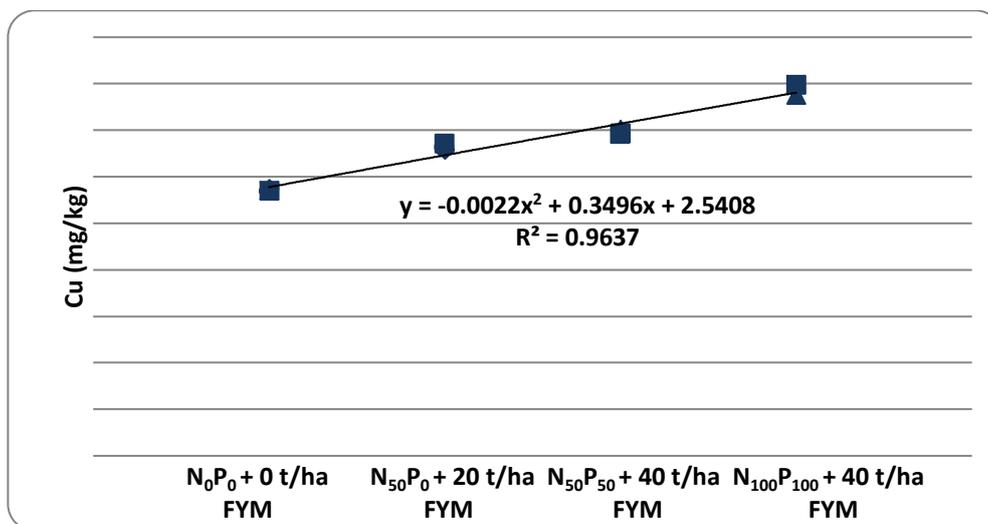
In the three years studied, the average concentration of copper in maize grains, the experiments with chemical fertilizers with nitrogen, phosphorus and farmyardmanure was 2.858 mg/kg for the control variant, 3.322 mg/kg (16.2% higher compared to control) in variant N₅₀P₀ + 20 t/ha farmyard manure, 3.479 mg/kg (21.7% higher compared to the control variant) in the fertilized variant with N₅₀P₅₀ + 40 t/ha farmyard manure, respectively 3.935 mg/kg (37.7% higher compared to unfertilized variant) in variant N₁₀₀P₁₀₀ + 60 t/ha farmyard manure.

Table 2

The influence of NP fertilizers and manure on copper concentration in maize grains

Variant	Cu concentration		Difference		Statistical significance
	mg/kg	%	mg/kg	%	
N ₀ P ₀ + 0 t/ha farmyard manure	2.858	100	-	-	Control
N ₅₀ P ₀ + 20 t/ha farmyard manure	3.322	116.2	0.464	16.2	-
N ₅₀ P ₅₀ + 40 t/ha farmyard manure	3.479	121.7	0.621	21.7	*
N ₁₀₀ P ₁₀₀ + 60 t/ha farmyard manure	3.935	137.7	1.077	37.7	**
		LSD 5%	0.57		
		LSD 1%	0.967		
		LSD 0.1%	1.500		

The mathematical modeling of the results regarding the copper concentration in the maize grains from the variants of the experiment with nitrogen, phosphorus and farmyardmanure studied, shows that the polynomial type function, $y = -0,002x^2 + 0,349x + 2,540$, $R^2 = 0.963$, quantifies the best link between doses of NP fertilizers and farmyard manure and the concentration of copper in the maize grains.



*FYM - farmyard manure

Fig. 1. Correlation between doses of NP fertilizers and manure and copper concentration in maize grains

CONCLUSIONS

Changes in the copper concentration of seeds caused by the use of different doses and combinations of fertilizers led to a different translocation of copper in wheat and maize grains.

Compared to the unfertilized control in all the studied variants, the copper concentration in the wheat grains increased; on average during the period studied they were "statistically significant". In the variant fertilized with N₁₀₀P₁₀₀ + 60 t/ha manure, the biggest difference was registered, 36.4%.

For maize, there were statistically assured differences in the variants fertilized with N₅₀P₅₀ + 40 t/ha manure and N₁₀₀P₁₀₀ + 60 t/ha, being 21.7%, respectively 37.7% higher than the control, recording concentrations of 3.479 mg/kg and 3.935 mg/kg, respectively.

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