

UPTAKE OF MICROELEMENTS IN OILSEED RAPE PLANTS UNDER MINERAL FERTILIZATION WITH NITROGEN AND PHOSPHORUS

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Abstract

*With a large and growing demand in the market, rapeseed (*Brassica napus* subsp. *napus*.) is a crop with relatively high requirements for macronutrient fertilization. The aim of the experiment was to study the effect of mineral fertilization with different doses of nitrogen and phosphorus on the accumulation of microelements in the vegetative organs and grains of oilseed rape plants. The experiment was carried out in the long-term experimental fields of SCDA Livada. There were taken and analyzed 96 plant samples and the results were statistically processed. Fertilization with nitrogen and phosphorus led to statistically assured changes in the contents of microelements, mostly in the aerial parts of the rapeseed. Regarding their accumulation in the grain, there were obtained variations of contents that were not significant to all doses of fertilizer applied. The conclusions of the experiments showed that the evaluation of contents of manganese, iron, zinc, and copper in rapeseed plants can help in choosing the optimal dose of mineral fertilizers in order to assure balanced microelement composition in plants and thus, consequently to avoid their deficiency.*

Keywords: mineral fertilization, oilseed rape, microelements

INTRODUCTION

With a continuously growing population, estimated to be about 10 billion by 2050, it has become imperative to find ways to increase grain production in order to solve the food problem according to the concepts of the Green Revolution considering the existing land (Khoshgoftarmanesh et al., 2009).

On the other hand, climate changes lead to the choice of crops that offer, in addition to good yields, multiple benefits. Considering these reasons, rapeseed crops are among the most profitable. Rapeseed becoming the third most

important source of vegetable oil in the world (Lääniste et al., 2004). Oilseed rape (*Brassica napus* L ssp. *Oleifera* D.C.) is a plant with many uses: rapeseed oil proved to be healthy for human nutrition, it is also used in the biodiesel industry, as green manure, fodder for animal feed, being in the same time a melliferous plant. In Romania, big fluctuations were registered for the cultivated surface and the rape production. In 1980 there were 14.3 thousand hectares cultivated with rape, with a production of 1317 kg/ha, in 2006, there were cultivated 120 thousand hectares with 1666 kg/ha, being planned

for 2007-2008 a surface of approximately 400 thousand hectares. Rapeseed production in 2022 is estimated at 1.56 million tons, reaching the highest level after 2018.

In order to obtain increased productivity in the rape crop, it must be considered that the nutrient demand for oilseed rape is considerably higher than that of cereals (Narits, 2010).

This study shows aspects concerning the effects of mineral fertilization with nitrogen and phosphorus in different doses on the contents of microelements in rapeseed plants and grains.

MATERIALS AND METHODS

Rapeseed plant samples were collected from the long-term experimental field at Livada Satu-Mare County, Romania, a unit located in the North West region of Transylvania (23°12' east longitude and 47°86' north latitude), 132 m above sea level.

The experiment is of the bifactorial type with five graduates, with progressively increasing doses of phosphorus (0, 40, 80, 120, 160 kg/ha) and nitrogen (0, 40, 80, 120, 160 kg/ha).

Dried plant samples were mineralized using a nitric-perchloric acid mixture and the contents of Cu, Zn, and Mn were determined by flame atomic absorption spectrometry.

The experimental design was entirely randomized with 3 replications.

The effects of treatments were studied by analyses of variance and average test (Tukey)

RESULTS AND DISCUSSIONS

Rapeseed has the highest phosphorus consumption among all crops; it is believed that phosphorus fertilizers can be applied at any time to maintain a high level of mobile phosphorus in the soil. Rapeseed,

Brassica napus, depends on nitrogen fertilization due to its low nitrogen use efficiency (Bouchet et al., 2016).

Cu, Zn and Mn are among the essential elements for feeding the rapeseed plant. Nowadays it is considered that microelements like copper, manganese, zinc and others play an important role in the physiological processes of rapeseed, as in the case of many other higher plants. The deficiencies of these elements are quite rare in rapeseed plants.

Copper is a trace element necessary for plants with an important role in the processes of oxidation and respiration, in the formation of chlorophyll, in the germination of seeds, in increasing the resistance to drought and in the supply of water (Zubkova et al., 2021).

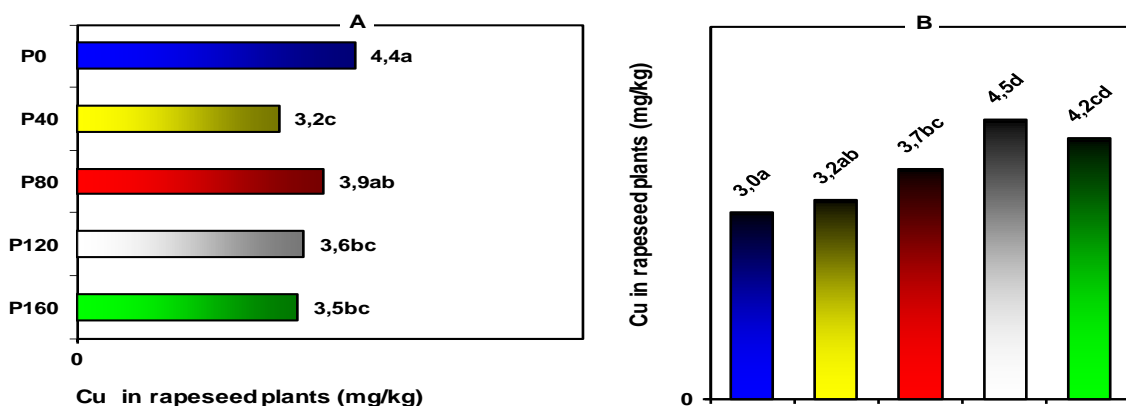
The application of phosphorus fertilization led to the immobilization of copper in the soil, which resulted in the highest value of copper content being obtained in rapeseed plants from the control variant (4.4 mg/kg) (Figure 1). Fertilization with increasing doses of nitrogen led to slight increases in copper contents, the changes being statistically assured compared to the control only at high doses of N100, N150, and N200.

Zinc is known as an essential microelement for plants, an enzyme activator and determining enzyme component, it plays an important role in cell division, protein synthesis and auxin production.

This element is necessary in the case of rapeseed crops placed in acid or alkaline soil. In general, rapeseed is not sensitive to zinc deficiency. Fertilization with phosphorus did not produce statistically significant changes in the average values of zinc content, although a weak downward trend was observed as a result of the increase in the dose of phosphorus applied (Figure 2). The increase in the nitrogen dose led to increases in the zinc content, the changes being statistically assured

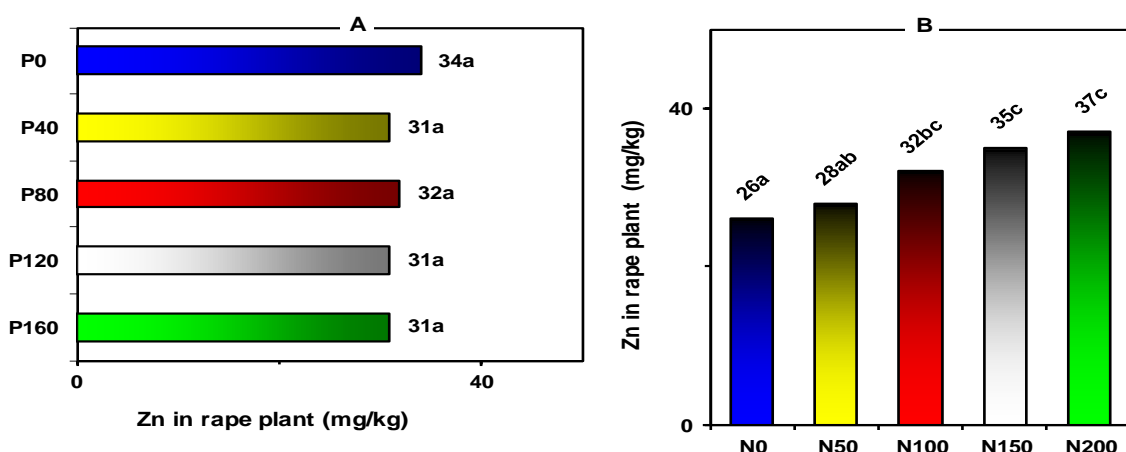
compared to the non-fertilized version, starting with the application of the

equivalent fertilizer dose of 100 kg N/ha.



* Values followed by the same letter (a, b, c) are not significantly different at the 5% level according to the Tukey's honestly significant differences test

Figure 1. Effects of fertilization with phosphorus (A) and nitrogen (B) on the copper content of rape plants



* Values followed by the same letter (a, b, c) are not significantly different at the 5% level according to the Tukey's honestly significant differences test

Figure 2. Effects of fertilization with phosphorus (A) and nitrogen (B) on the zinc content of rape plants

Another essential element for rapeseed is manganese as it takes part in various biochemical processes of plants and has an important role in the assimilation of molecular and mineral nitrogen (Zubkova et al., 2021).

In our experiment, only nitrogen fertilization leads to statistically assured changes in the mean values of manganese contents in rapeseed samples, at high nitrogen doses. Fertilization with different doses of

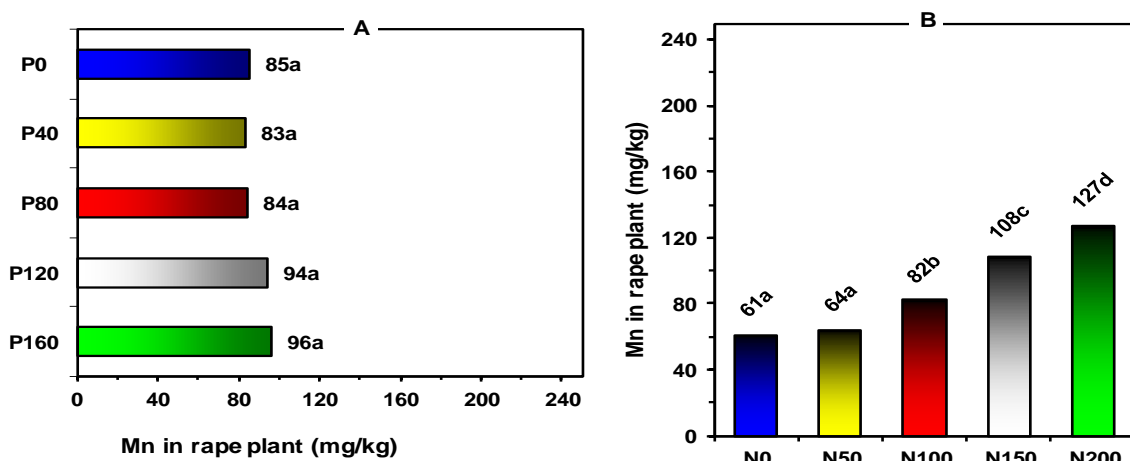
nitrogen led to variations in manganese contents between 61 mg/kg and 127 mg/kg, the highest value being recorded at the maximum dose of nitrogen applied. Fertilization with phosphorus did not produce statistically significant changes in the average manganese content of rapeseed plants (Figure 3).

The contents of microelements were also determined in the rape seeds for a better evaluation of the quality of the rape

culture under the influence of the applied

mineral

fertilizers.

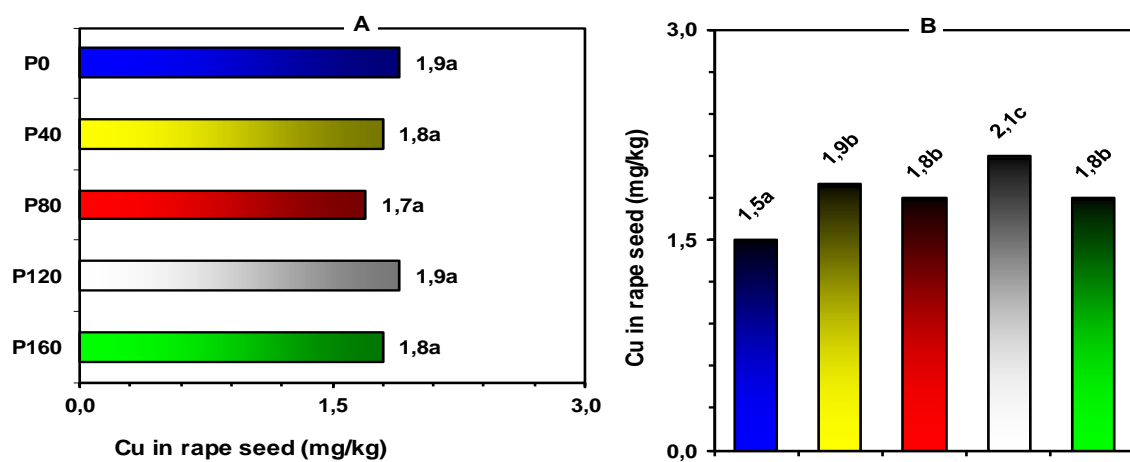


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Figure 3. Effects of fertilization with phosphorus (A) and nitrogen (B) on the manganese content of rape plants

Phosphorus fertilization did not produce statistically significant changes in the mean values of copper contents in rape seed. In the case of nitrogen fertilization, the highest value of the copper content in

the grains was obtained for the plants harvested from the fertilized variant with the equivalent dose of 150 N kg/ha (Figure 4).



* Values followed by the same letter (a, b, c) are not significantly different at the 5% level according to the Tukey's honestly significant differences test

Figure 4. Effects of fertilization with phosphorus (A) and nitrogen (B) on the copper content of rape seed

In the case of zinc, statistically assured increases (compared to the non-fertilized version) were observed in the average values of the contents at the maximum dose of nitrogen applied (Figure 5). Fertilization with progressively increasing

doses of phosphorus did not determine significant changes in the zinc contents of the rape seeds, these having lower values compared to the values obtained from the chemical analysis of the aerial parts of the plant.

Regarding the influence of nitrogen or phosphorus fertilization on the manganese content of rape seed, a statistically

assured increase was observed in the N200 variant compared to the non-fertilized variant (Figure 6).

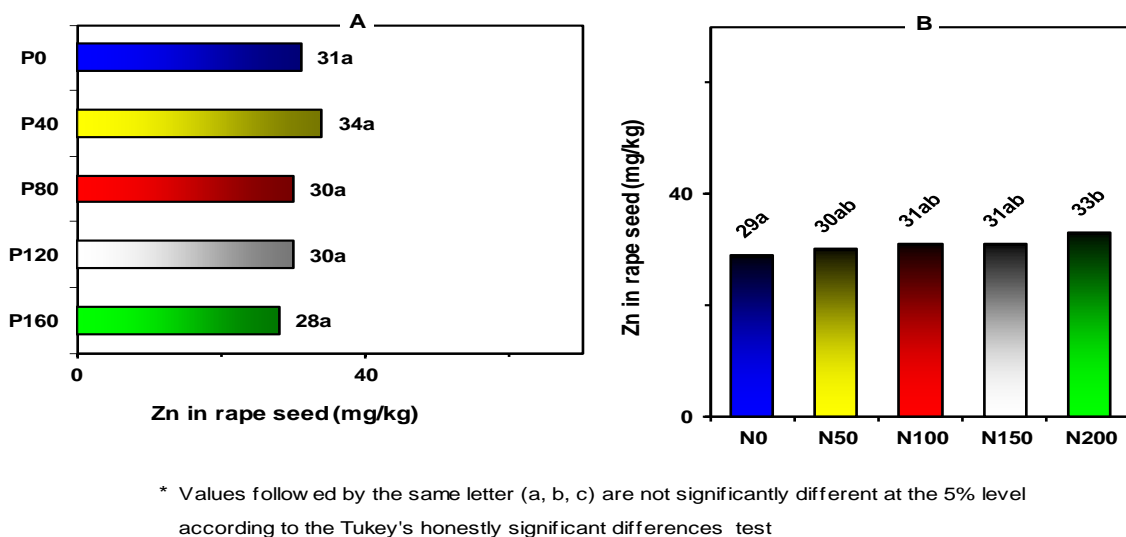


Figure 5. Effects of fertilization with phosphorus (A) and nitrogen (B) on the zinc content of rape seed

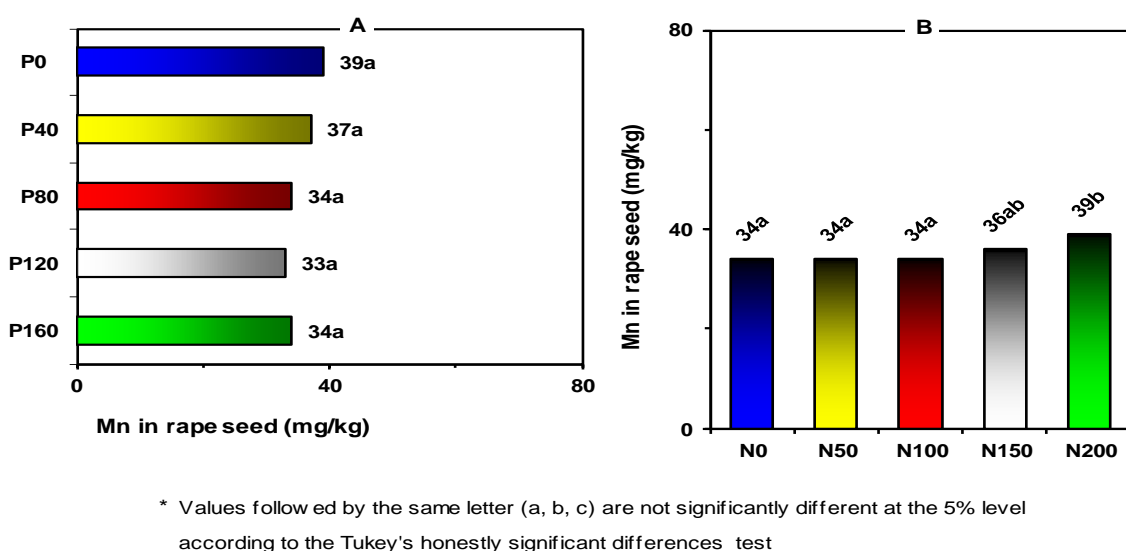


Figure 6. Effects of fertilization with phosphorus (A) and nitrogen (B) on the manganese content of rape seed

CONCLUSIONS

Analysis of microelement contents in the aerial part of rape and in seed under the mineral fertilization with different doses of phosphorus and nitrogen showed that uptake was different. The values obtained for contents in the aerial part of plants were higher compared with those of seed. Phosphorus fertilization had a blocking effect of microelements from the first dose of fertilizer applied, making absorption difficult compared to the control variant.

Nitrogen fertilization leads to a decrease in pH and, consequently, to increased mobility of microelements in the soil solution, which is why we observed increased uptake of microelements in the plant organs, with the increased dose of nitrogen.

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