

TREATMENTS EFFECT OF BIOFUNGICIDE CARBECOL AND BIOFERTILIZER ECOLIT ON THE NITROGEN, PHOSPHORUS AND POTASSIUM CONTENTS IN TOMATO (*SOLANUM LYCOPERSICUM* L.) PLANTS

INFLUENȚA TRATAMENTELOR CU BIOFUNGICIDUL CARBECOL ȘI BIOFERTILIZANTUL ECOLIT ASUPRA CONȚINUTULUI DE AZOT, FOSFOR ȘI POTASIU LA PLANTELE DE TOMATE (*SOLANUM LYCOPERSICUM* L.)

ROTARU V.¹, TODIRAȘ V.¹

Corresponding author email: rotaruvlad@yahoo.com

Abstract. *The impact of treatments with ecological plant protection products on nutrient status of tomato plants is not elucidated. A green house experiment was conducted with the purpose to determine the influence of treatments with a new biofungicide Carbecol and biofertilizer Ecolit on nitrogen, phosphorus and potassium contents in tomato (*Solanum lycopersicum* L.), cultivar Tolstoy. The experiment included 6 variants, a control one (untreated) to which no treatments were applied. Carbecol was applied alone or in combination with biofertilizer Ecolit. Experimental results revealed an increase in the nitrogen, phosphorus and potassium contents in treated tomato plants. Hence, the results of the study demonstrated that the integrated use of ecological plant protection product Carbecol and biofertilizer Ecolit has the potential to improve mineral nutrition of tomato plants.*

Key words: Carbecol, Ecolit, nitrogen, phosphorus, potassium, tomato

Rezumat. *Impactul tratamentelor cu produse ecologice de protecție a plantelor asupra conținutului elementelor de nutriție la plantele de tomate nu este pe deplin elucidat. S-a organizat o experiență în căsuța de vegetație cu scopul de a determina influența tratamentelor cu biofungicidul Carbecol și biofertilizantul Ecolit asupra conținutului de azot, fosfor și potasiu în frunzele plantelor de tomate (*Solanum lycopersicum* L.), cultivarul Tolstoi. Experiența a inclus 6 variante, varianta controlul a servit plante netratate. Biofungicidul s-a aplicat separat sau în combinație cu tratările cu biofertilizantul Ecolit. Rezultatele experimentale au stabilit că aplicarea Carbecolului și Ecolitului au majorat conținutul de azot, fosfor și potasiu în frunzele plantelor. Rezultatele studiului au demonstrat că efectuarea tratamentelor cu produsul ecologic Carbecol în combinație cu aplicarea biofertilizantului Ecolit manifestă potențial de ameliorare a nutriției minerale a plantelor de tomate.*

Cuvinte cheie: Carbecol, Ecolit, azot, fosfor, potasiu, tomate

¹Institute of Genetics, Physiology and Plant Protection MSU, Chisinau, Republic of Moldova

INTRODUCTION

The use of synthetic pesticides to control vegetable diseases raises negative effects on the environment, human health and food security (Pathak *et al.*, 2022). Ecological plant protection products have become a major feature of organic agricultural production aimed at reducing crop losses by enhancing the resistance of plants to phytopathogen attacks. Among vegetables, tomato species plays an important role in food security (Ali, 2022). Tomato is a valuable horticultural crop with a global production around 120 million tons and a high economic value in many agricultural regions, including the Republic of Moldova. However, this crop is susceptible to fungal infections, in particular to pathogen *Phytophthora infestans*. To combat the late blight of tomato the application of ecological plant protection products is increasing to control this disease. Mineral nutrients play a potential role in supporting plant health that is influenced by various abiotic and biotic factors, such as biofertilizer, biopesticides and fungi diseases (Walters and Bingham, 2007). Huber and Graham (1999) established that mineral nutrients are particularly and directly involved in plant protection as structural components and metabolic elicitors. Likewise, Ojha and Jha (2021) in their review underlined the fact that the plant nutritional status plays a particular role in determining the plants' susceptibility or resistance toward the attack by pathogens. It is necessary to note that the impact of plant protection products treatments on the nutrition status of tomato plants is not well evaluated (Cocetta and Ferrante, 2020). Also, it has been demonstrated that humic substances have a range of benefits in particular as elicitor of resistance of crops against diseases (Scheuerell and Mahaffee, 2004). That's why it is important to know the physiological changes in plants due to the application of plant protection products. We hypothesized that treatments of plant protection products beside their protection activity could also have an effect on mineral status of crops. The main objective of this investigation was to evaluate the effect of the foliar application of biopesticide Carbecol and biofertilizer Ecolit alone or in combination on nitrogen, phosphorus and potassium contents in tomato plants.

MATERIAL AND METHOD

The experiment with tomato (cv Tolstoy) was performed at the Institute of Genetics, Physiology and Plant Protection, Moldavian State University of the Republic of Moldova. The soil used for the experiment was carbonated chernozem. The experiment included 6 treatments, with a control group (untreated) to which no treatments were applied. The product Carbecol has a potential to control late blight of tomato. Individual and combined applications of Carbecol, Ecolit and copper sulphate were carried out at the following stages of plant development: 1-st at 14 days after transplanting; 2-nd at the intensive growing stage; the 3-rd at flowering stage and the 4-th at the fruits development stage. Carbecol was applied at doses of 4 kg/ha and 6 kg/ha. Biofertilizer Ecolit was applied at a dose of 3 l/ha and copper sulphate at 0,5% concentration. Each treatment was replicated three times. Treatments were applied by

spraying the solution onto the tomato foliage. After the last treatment the leaves were collected from each treatment. The nitrogen, phosphorus and potassium concentrations in leaves were analyzed according to the protocol described in manual of agrochemistry (Mineev, 1989). The data were analyzed by using STATISTIC 7 program. All the results were the means \pm SE of three replicates.

RESULTS AND DISCUSSIONS

Nitrogen (N) is one of the most important nutrients having a critical impact on plant nutrition as well as on host-pathogen development. A higher level of nitrogen negatively affects the plant's resistance to pathogen attacks (Blachinski *et al.*, 1996).

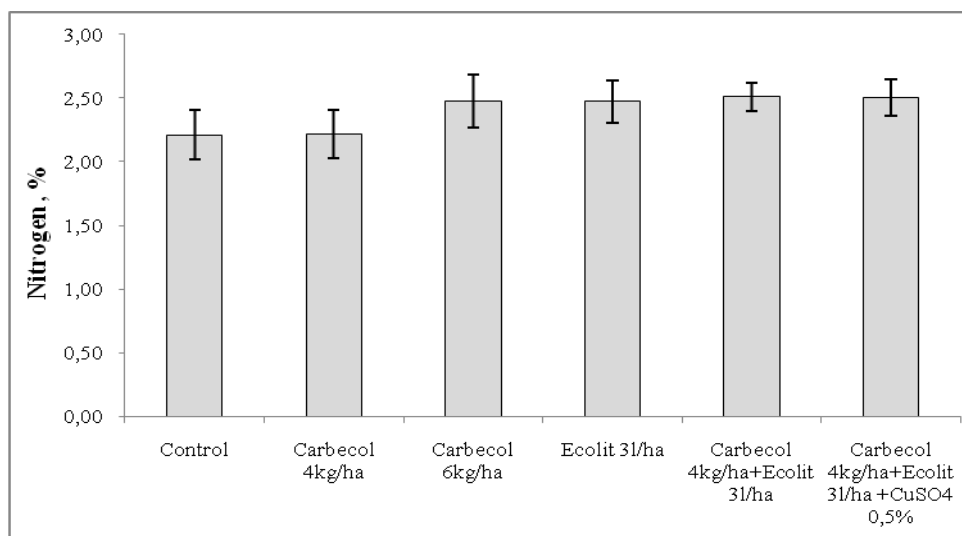


Fig. 1. Effect of treatments with Carbecol alone or in combination with Ecolit on the nitrogen contents in leaves of tomato plants. All values represent mean \pm SE

This nutrient, at physiological concentrations, significantly alleviates defense-related enzyme levels that can contribute to the growth and to the systemic resistance of crops against phytopathogens. The experimental results of our study revealed that treatments with biofungicide Carbecol, either alone or in combination with the biofertilizer Ecolit, had positive effects on nitrogen contents in tomato leaves (fig. 1). The treatment with Carbecol at a dose of 6 kg/ha increased this parameter to 2.47% compared to 2.21% registered in the control variant. Therefore, in that variant, the concentration of nitrogen in leaves increased by 11.8% compared to the untreated plants. The application of humic substances (Ecolit) also increased the tissue concentration of nitrogen. The enhancement of nitrogen uptake and metabolism in plants treated with humic substances has been well documented (Farnia and Moradi, 2015). In this study, the combined application of Carbecol and Ecolit did not change this trait compared to

the variant where they were used separately. Likewise, it is necessary to note that the nitrogen content in leaves in the variant with the integrated use of Carbecol, Ecolit and copper sulphate (0.5%) was slightly lower than in the other treated variants. This result was likely due to the biological dilution effect. Visually, it was observed that plants in this variant were better developed and appeared more vigorously. Our results are supported by similar findings obtained in previously conducted studies that highlight the potential use of humic substances in controlling plant diseases and nutrition (El-Ghamry *et al.*, 2009).

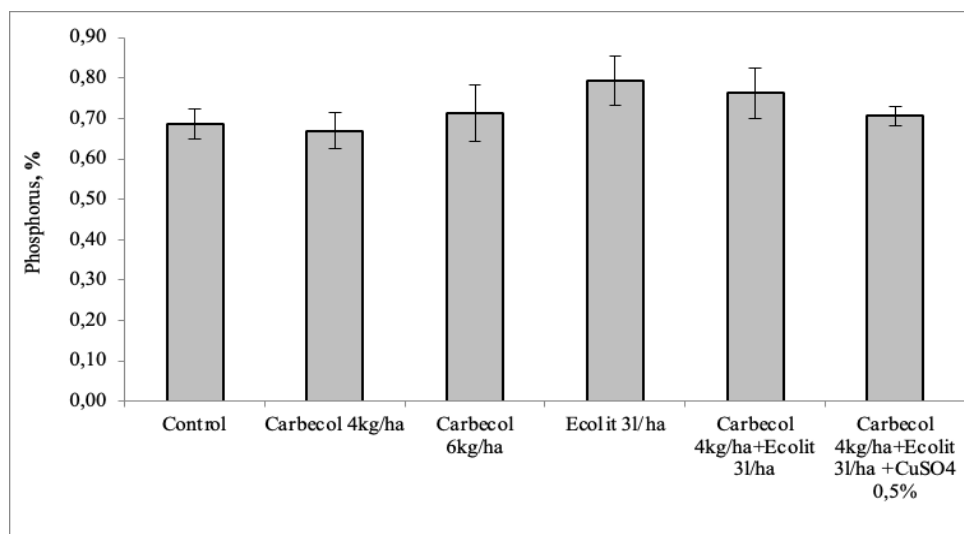


Fig. 2. Effect of treatments with Carbecol alone or in combination with biofertilizer Ecolit on phosphorus contents in leaves of tomato plants. All values represent mean \pm SE

Phosphorus is the second important nutrient, playing a role in many biochemical and physiological processes such as the synthesis of energy compounds, protein metabolism, and other vital functions of plants (Tripathi *et al.*, 2022). The effect of treatments on phosphorus content in tomato leaves is illustrated in figure 2. The analysis of the study's data regarding the phosphorus contents in leaves revealed that this parameter did not change under the treatment of Carbecol at a low dose (4 kg/ha). An increase in the content of phosphorus in leaves was observed in the variant with the application of the biopesticide Carbecol at a higher dose (6 kg/ha). However, the highest content of phosphorus in leaves was registered in treatment with the biofertilizer Ecolit (fig. 2.). In this variant, the increase in phosphorus concentration was 16% compared to untreated plants. We suppose that the better uptake of the nutrient was due to a stronger root system, which, in turn, stimulated nutrient uptake. Similar others researchers have shown that the use of humic and fulvic acids significantly increases the uptake of mineral elements by crops (Farnia and Moradi, 2015).

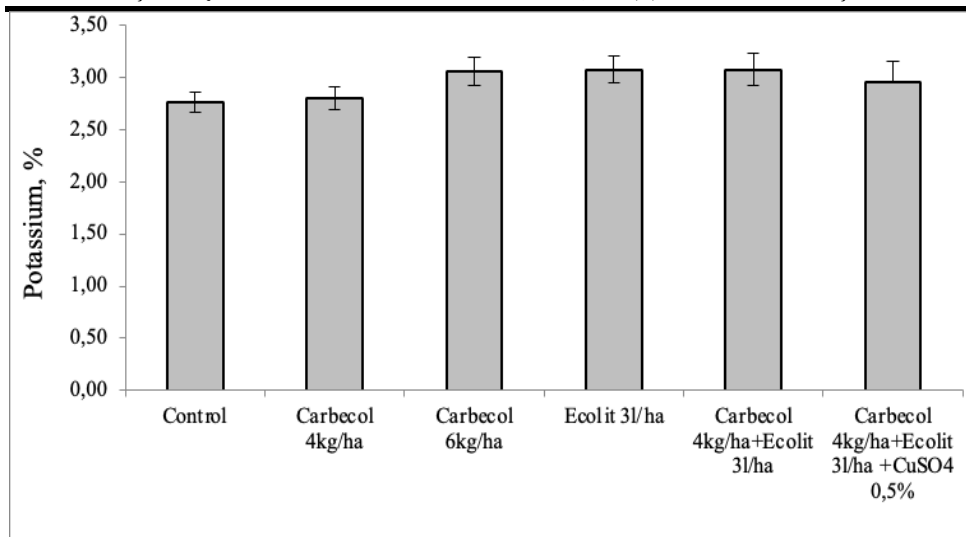


Fig. 3. Effect of treatments with Carbecol alone or in combination with biofertilizer Ecolit on potassium contents in leaves of tomato plants. All values represent mean \pm SE

Potassium (K) is an essential plant nutrient when it is present in optimum concentrations. Adequate K nutrition increases the plant's polyphenolic concentrations, which serve as triggers for the defense mechanism against attacks by different pathogens (Amtmann *et al.*, 2008). The high susceptibility of K-deficient plants to various parasitic diseases is directly related to these metabolic functions. The contents of potassium in leaves of tomato in relation to treatments are presented in figure 3. The application of Carbecol or Ecolit alone had a beneficial impact on the potassium status of plants compared to untreated tomato plants. A similar effect was observed in the variant with the combined application of Carbecol and Ecolit, where this physiological parameter increased by 11.6%. It is necessary to note that the minimum disease incidence of late blight was observed in tomato plants raised in the variant with the integrated administration of Carbecol+Ecolit+cooper sulphate (data are not shown). The beneficial influence caused by ecological treatments was observed in terms of fruit production of tomato (Rotaru and Todiras, 2022). Therefore, the higher productivity occurred due to the improved physiological performance of plants, particularly through improved plant nutrition and reduced attack by phytopathogens.

CONCLUSIONS

1. The application of the biofungicide Carbecol and the biofertilizer Ecolit exerts beneficial effects on plant nutrition in tomato through increased nutrient contents in leaves, such as nitrogen, phosphorus and potassium.

2. The integrated use of Carbecol and biofertilizer Ecolit could represent a sustainable approach to protecting plants against phytopathogen attacks, as well

as improving nutrient contents and the productivity of tomato. Additional field research is needed to confirm these positive effects observed in the greenhouse experiment.

Acknowledgments: The research was financed by the National Agency for Research and Development of the Republic of Moldova, project 20.80009.5107.19.

REFERENCES

1. Ali M.Y., Sina A.A.I., Khandker S.S., Neesa L., Tanvir E.M., Kabir, A., Khalil, M.I., Gan S.H., - 2021 - *Nutritional composition and bioactive compounds in tomatoes and their Impact on human health and disease: A Review*. Foods, 10,45. <https://dx.doi.org/10.3390/foods10010045>.
2. Amtmann A., Troufflard S., Armengaud P., 2008 - *The effect of potassium nutrition on pest and disease resistance in plants*. *Physiology Plantarum*, 133, p. 682–691.
3. Blachinski D., Shtienberg D., Dinoor A., Kafkafi U., Sujkowski L.S., et al., 1996 - *Influence of foliar application of nitrogen and potassium on Alternaria diseases in potato, tomato and cotton*. *Phytoparasitica*, 24, p. 281–292.
4. El-Ghamry A.M., Abd El-Hadi K.M., Ghoneem K.M., -2009 - *Amino and humic acids promote growth, yield and disease resistance of faba bean cultivated in clayey soil*. *Australian Journal of Basic Applied Sciences*, 3(2), p. 731-739.
5. Farnia A., Moradi E., 2015 - *Effect of soil and foliar application of humic acid on growth and yield of tomato (Lycopersicum esculentum L.)*. *International Journal of Biology, Pharmacy and Applied Sciences*, 4(10), p. 706–716.
6. Huber D.M., Graham R.D., 1999 - *The role of nutrition in crop resistance and tolerance to disease*, in *Mineral Nutrition of Crops Fundamental Mechanisms and Implications*, ed. Z. Rengel (New York, NY: Food Product Press), p. 205–226.
7. Mineev V.G., 1989 - *Manual practicum of agrochemistry*. M., 320p.
8. Ojha R.K., Jha S.K., 2021 - *Role of mineral nutrition in management of plant diseases*, in *Farmers' Prosperity through Improved Agricultural Technologies*, p. 241–261.
9. Pathak V.M., et al., 2022 - *Current status of pesticide effects on environment, human health and its eco-friendly management as bioremediation*. A comprehensive review. *Frontiers in Microbiology*, doi: 10.3389/fmicb.2022.962619.
10. Rotaru V., Todiras V., 2022 - *Effect of ecological product Carbecol and biofertilizer Ecolit on management of late blight (Phytophthora infestans) and productivity of tomato (Solanum esculentum) plants*. *Annals of the University of Craiova, Agriculture, Montanology, Cadastre Series*, 52/1, p. 328-333.
11. Scheuerell S.J., Mahaffee W.F., 2004 - *Compost tea as a container medium drench for suppressing seedling damping-off caused by Pythium ultimum*. *Phytopathology*, 94, p.1156-1163.
12. Tripathi R., et al., 2022 - *Plant mineral nutrition and disease resistance: A significant linkage for sustainable crop protection*. *Frontiers in Plant Sciences*, 13:883970. doi: 10.3389/fpls.2022.883970.
13. Walters D.R., Bingham I.J., 2007 - *Influence of nutrition on disease development caused by fungal pathogens: implications for plant disease control*. *Annals of Applied Biology*, 151, p. 307–324.