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THE DETERMINATION OF THE INFLUENCE OF THE ASFAC BCO-4 BIOSTIMULATOR, MESSIS BOR FERTILIZER, AND EFUSIO ADJUVANT ON *LYCOPERSICON ESCULENTUM L.*

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INTRODUCTION

Many countries are currently facing the phenomenon of soil degradation, with low levels of mineral nutrients available to plants or on the contrary with a high degree of toxicity due to heavy metals and other categories of pollutants.

Poor soil fertility coupled with mismanagement of fertilizers, as well as the lack of plant genotypes with tolerance to nutrient deficiencies or toxicity are major constraints that contribute to food insecurity, malnutrition, and ecosystem degradation. Thus, approx. 60% of cultivated soils have problems related to nutrient deficiencies but also toxicity (heavy metals), and about 50% of the world's population suffers from micronutrient deficiencies (Cakmak, 2002; A. D. Chitimus et al. 2011).

Foliar fertilization can help increase the absorption of nutrients from the soil. This notion is based on the belief that foliar fertilization causes the plant to pump more sugars and other exudates from its roots into the rhizosphere. Beneficial microbial populations in the root zone are stimulated by the increased availability of these exudates. In turn, this improved biological activity increases the availability of nutrients, disease-suppressing biochemicals, vitamins, and other beneficial factors for the plant (Kuepper, 2003; Fernandezet al., 2013).

Extra-root fertilization is more effective during flowering and fruit formation, and absorption at the leaf level is achieved especially on the underside of the leaf tongue, because the cuticle is thinner, and near the fine nerves (Ra□i I.V. et al., 2008).

Tomatoes (*Lycopersicon esculentum L.*) are food-valuable species due to their high content of mineral salts, vitamins (A, B1, B2, B6, K, C, PP, E), antioxidants and amino acids. They are rich in bases and therefore act as an alkalizer for the human body (Coifu et al., 2004). These are thermophilic species that make good use of fertile, irrigated, and sunny lands (Călin, 2010; Ciofu et al., 2004; Sato et al., 2006).

Tomatoes have high requirements for nitrogen (N) and potassium (K), medium requirements for magnesium (Mg), and low requirements for phosphorus (P) (Călin, 2010). Nutrient consumption differs depending on the variety, vegetation phase, and cropping system. Also, calcium and magnesium fertilizers can be used at tomatoes to delay the ripening of adult-green tomato fruits and to extend the shelf life of ripe ones (Nuguemezi, Tatchago, 2010).

Potassium (K) is an essential element in tomato nutrition because it is involved in metabolic processes, such as protein synthesis, enzyme activation, transport processes. The development of fruit in tomatoes is often accompanied by depletion of leaf potassium both to the detriment of the plant and the quality of the fruit. As the tomato plant grows, the absorption of potassium increases to a relatively greater extent than that of other nutrients. To obtain quality fruit, potassium deficiency must be combated. Potassium fertilization in tomato crops has been shown to lead to higher fruit quality (Peyvast et al., 2009).

MATERIAL AND METHODS

Study area

The experiments were conducted in two locations in Bacău County, in Gioseni commune located in the Central-Eastern part of the county, and at the Bacău Vegetable Growing and Development Research Station, located in the Eastern part of the municipality.

Three varieties of tomatoes were studied

- **Crystal**, hybrid, semi-early variety with undetermined growth, intended for cultivation in greenhouses and solariums, yielding globular fruits with an average weight of 160-180g;
- **Oxheart**, Romanian variety with undetermined growth, with large fruits in the shape of a buffalo heart;
- **Bacuni**, an early variety with medium vigor and a production capacity of 100-110t / ha. It produces round fruits with an average weight of 90-110g,

with good firmness. Over 75% of the production is included in the 1st and extra quality degree.

Applied products:

ASFAC BCO-4, (ROMCHIM PROTECT SRL),"the biostimulator that realizes a partnership with the sun for the wellbeing of the crops", is an appreciated product, with remarkable results, that has auxin composition that contributes to the growth of plants but also of crop yield (Ra□i I. V. et al. 2015; Delian et al., 2018).

MESSIS BOR (ROMCHIM PROTECT SRL),"the ideal fertilizer for malnourished plants", is a foliar product that participates in plant metabolism by stimulating the absorption of macro and microelements. It is appreciated because it has a remarkable influence on vegetative growth, leading to increased vigor and plant resistance.

EFUSIO (ROMCHIM PROTECT SRL), "the bridge between foliar fertilizers and plants", is a wetting and spreading adjuvant that improves the dispersion of the substances with which it is mixed, on the entire surface of the leaf.

The Crystal and Oxheart varieties were sown in Gioseni commune on March 4th and the first treatment was administered 57 days after sowing. The second treatment was performed 10 days after the first treatment. The treatments were administered with a garden pressure sprayer. Treatments were applied to tomatoes or administered on plants that had been planted in the solarium the previous day. Two versions of treatments were applied to the Crystal variety, and six versions of treatments to the Oxheart.

Bacuni was sown at the Bacău Vegetable Research and Development Station and the treatments were administered on tomatoes planted in unprotected space (in the field). MESSIS BOR is not recommended for application during flowering and for this reason, only one treatment was performed. The treatment was applied 66 days after sowing. Six treatment options were administered at tomatoes in the field.

The concentrations were chosen according to the indications on the packaging and according to the indications in the technical data sheets of the products, more precisely 1L of ASFAC BCO-4 dissolved in 300-600 L water per 1 hectare, 2L of MESSIS BOR dissolved in 200-600 L of water per 1 hectare and 250 ml of EFUSIO per 1 hectare. In this experiment, the products were dissolved in 0.5 L of water.

ASFAC BCO-4 is devoid of toxicity, being the only non-toxic fertilizer that can be applied at any stage of vegetation even during flowering. When applied excessively, the risk is zero because it does not produce etiolation, turgidity, burns, or necrosis on leaf margins (Andrei et al., 2016; Răducanu et al., 2016).

RESULTS AND DISCUSSIONS

Following the biometric measurements performed at the beginning of the experiment, we found that the plants had a stem length between 14 cm and 19.5 cm (Table 1).

Table 1. Stem length at the beginning of the tomato experiment (Bacuni)

Stem length at the beginning of the tomato experiment (cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	14	15	14.5	14	15	13.5	15
Maximum	19.2	19	19.5	19	19	18.5	18.5
Mean	17.1	17.2	17.2	17.3	17.2	17	17.2

- leaf length between 10 and 12.8 cm (Table 2).

Table 2. Leaf length at the beginning of the tomato experiment (Bacuni)

Leaf length at the beginning of the tomato experiment (cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	10,5	10	10	10	10	10	10.6
Maximum	12	12	12.5	12.5	12.5	12.5	12.8
Mean	11.4	11.3	11.3	11.6	11.3	11.4	11.5

- width of the leaflets between 2 and 3.8 cm (Table 3)

Table 3. Leaflet width at the beginning of the tomato experiment (Bacuni)

Leaflet width at the beginning of the tomato experiment (cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	2	2	2	2	2	2	2
Maximum	3.5	3.8	3.5	3.5	3.5	3.6	3.5
Mean	2.5	2.7	2.6	2.5	2.4	2.6	2.5

Following the biometric measurements performed on tomatoes at 20 days after the administration of the treatments, we found that there were no significant differences in the length of the stem between the control sample and the treated variants (Table 4).

Table 4. Stem length at 20 days after treatments

Stem length at 20 days after treatmentsat tomatoes (cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	24	28	30	26	30	30	26
Maximum	35	36	36	34	35	34	35
Standard deviation	3.8	2.5	2.3	2.7	2	1.7	2.8
Mean	28.9	32.9	32.1	28.9	32	31.4	29.8

Following the biometric measurements performed on tomatoes 20 days after the treatments, we found that there were no significant differences in leaf length between the control sample and the treated variants. The length of the leaves had values between 14 cm and 21 cm (Table 5)

Table 5. Leaf length at 20 days after treatmentsat tomatoes

Leaf length at 20 days after treatments at tomatoes(cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	15	16	16	14	16	17	16
Maximum	18	21	20	18	21	21	21
Mean	16.4	18.1	18.1	15.8	18.4	18.5	18.1

Following the biometric measurements performed on tomatoes at 20 days after the administration of the treatments, we found that there were no significant differences in the length of the leaflet between the control sample and the treated varieties. The length of the leaflets had values between 6cm and 9 cm (Table 6).

Table 6. Leaflet length at 20 days after administration of treatments at tomatoes (Bacuni)

Leaflet length at 20 days after administration of treatments at tomatoes (cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	6	6	7	6	7	7	7
Maximum	8	9	9	8	9	9	9
Mean	6.7	7.5	8.1	6.6	7.8	7.6	8.3

Following the biometric measurements performed on tomatoes at 20 days after the administration of the treatments, we found that the average width of the leaflets in the control sample was 3.1 cm;3.8 cm in the variant treated with ASFAC BCO-4; 3.8 cm in the variant treated with MESSIS BOR; 3.1 cm for the variant treated with ASFAC BCO-4 and MESSIS BOR;4 cm for the variant treated with ASFAC BCO-4, MESSIS BOR and EFUSIO;3.5 cm for the variant treated with ASFAC BCO-4 and EFUSIO; and 4 cm at plants treated with MESSIS BOR and EFUSIO (Table 7).

Table 7. Leaflet width 20 days after treatment of tomatoes

Leaflet width 20 days after treatment of tomatoes (cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	2	3	3	2	3	3	3
Maximum	4	4	4	4	5	4	5
Mean	3.1	3.8	3.8	3.1	4	3.5	4

Both the average leaflet length and their average width did not differ significantly between the control sample and the treated variants.

Following the measurements made at the level of the inflorescences at 20 days after the administration of the treatments (Table 8), the lowest number of flowers was recorded at Crystal at the control sample and the highest number of flowers at the variant treated with ASFAC BCO-4. At Oxheart there were no significant differences in flowers.

The number of flowers at 20 days after the administration of treatments at tomatoes (Bacuni) had values between 5 and 17 (Table 9). The average number of flowers at 20 days after the administration of treatments at tomatoes (Bacuni) was 9.3 in the control sample;11.9 in the variant treated with ASFAC BCO-4;9.9 in the variant treated with MESSIS BOR;9.5 in the variant treated with ASFAC BCO-4 and MESSIS BOR; 10.3 in the variant treated with ASFAC BCO-4, MESSIS BOR and EFUSIO; 10.1 in the variant treated with ASFAC BCO-4 and EFUSIO; and 11.2 in the variant treated with MESSIS BOR and EFUSIO 11.2.

Table 9. Number of flowers at 20 days after treatmentsat tomatoes

Number of flowers at 20 days after treatmentsat tomatoes (cm)							
	BM	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
Minimum	5	8	7	8	7	8	9
Maximum	15	17	16	11	14	14	16
Mean	9.3	11.9	9.9	9.5	10.3	10.1	11.2

The number of open flowers at 20 days after the administration of the treatment registered significant differences at the Crystal variety. The average number of open flowers in the control sample was 0.9; 4.0 in the variant treated with ASFAC BCO-4 and MESSIS BOR; 4.1 in the variant treated with ASFAC BCO-4 and MESSIS BOR and EFUSIO.

At Oxheart, the average number of open flowers was 0.2 in the control sample; 0.6 in the ASFAC BCO-4treated variant; 0.5 in the MESSIS BORtreated variant; and 0.4 in the variant treated with ASFAC BCO-4 and MESSIS BOR; 0.9 for ASFAC BCO-4, MESSIS BOR and EFUSIO; 0.4 for ASFAC BCO-4 and EFUSIO; and 0.7 for MESSIS BOR and EFUSIO (Table 10).

Table 8. Number of flowers in the first inflorescence at 20 days after treatment

Number of flowers in the first inflorescence at 20 days after treatments										
	Crystal			Oxheart						
	CM	C1	C2	LM	L1	L2	L3	4	L5	L6
Minimum	3	6	4	3	2	2	2	2	2	3
Maximum	5	9	7	7	7	4	6	6	8	6
Mean	4	6.8	5.9	4.4	4	3.4	3.5	4.4	4	3.9
Standard deviation	0.8	0.9	0.9	1.0	1.4	0.6	1.3	1.3	1.9	1.2

Table 10. Number of open flowers in the first inflorescence at 20 days after treatments

Number of open flowers in the first inflorescence at 20 days after treatments										
	Crystal			Oxheart						
	CM	C1	C2	LM	L1	L2	L3	L4	L5	L6
Minimum	0	3	2	0	0	0	0	0	0	0
Maximum	3	6	5	2	2	2	2	3	2	2
Mean	0.9	4	4.1	0.2	0.6	0.5	0.4	0.9	0.4	0.7
Standard deviation	1.1	1.0	1.1	0.6	0.9	0.7	0.6	0.8	0.6	0.9
Percentage	22.5 %	58.8%	69.9%	4.5%	15%	14%	11.4%	20.4%	10%	17.9%

Table 12. Flowers forming fruit in the first inflorescence 40 days after treatments

Number of flowers forming fruit in the first inflorescence 40 days after administration of treatments										
	Crystal			Oxheart						
	CM	C1	C2	LM	L1	L2	L3	L4	L5	L6
Minimum	0	3	3	1	1	0	0	0	1	0
Maximum	4	6	10	3	4	3	3	4	6	4
Mean	1,3	4,8	4,8	2	2,1	2	1,7	2,3	2,4	2,4
Standard deviation	1,5	1,0	2,2	0,6	0,8	0,9	0,8	1,1	1,5	1,2
Percentage	22,8%	70,5%	70,5%	41,6%	51,2%	57,1%	45,9%	52,2%	46,1%	55,8%

The number of open flowers at 20 days after the administration of treatments at tomatoes (Bacuni) was 6.6 in the control sample; 9.3 in the variant treated with ASFAC BCO-4; 7.8 in the variant treated with MESSIS BOR; 5.8 for ASFAC BCO-4 and MESSIS BOR; 6.4 for ASFAC BCO-4, MESSIS BOR and EFUSIO; 7.5 for ASFAC BCO-4 and EFUSIO; and 8.3 for the variant treated with MESSIS BOR and EFUSIO (Table 11. At B3 and B4 there were obtained the lowest results because after heavy rain the plants were bent by the wind.

Table 11. Number of open flowers 20 days after treatmentsat tomatoes

Number of open flowers 20 days after treatments at tomatoes							
	BM	B1	B2	B3	B4	B5	B6
Minimum	4	7	5	4	4	5	6
Maximum	9	13	13	7	8	12	13
Mean	6.6	9.3	7.8	5.8	6.4	7.5	8.3
Percentage	70.9 %	78.1 %	78.7 %	61 %	61.2 %	74.2 %	74.1 %

The number of flowers forming fruit from the first inflorescence at 40 days after the administration of the treatments registered significant differences between control and experiment variants, at Crystal. The average number of flowers related to the control sample was 1.3; 4.8 for the variety treated with ASFAC BCO-4 and MESSIS BOR; and 4.8 for the variant treated with ASFAC BCO-4, MESSIS BOR and EFUSIO.

At Oxheart, the average number of flowers forming fruit was 2 in the control sample; 2.1 in the variant treated with ASFAC BCO-4; 2 in the variant treated with MESSIS BOR; 1.7 in the variant treated with ASFAC BCO-4 and MESSIS BOR; 2.3 for ASFAC BCO-4, MESSIS BOR and EFUSIO; 2.4 for ASFAC BCO-4 and EFUSIO; and 2.4 for MESSIS BOR and EFUSIO (Table 12).

CONCLUSIONS

The results showed that

- the use of the biostimulator ASFAC BCO-4, of the fertilizer MESSIS BOR and the adjuvant EFUSIO did not have a significant impact on the dimensions of the leaf mass, instead, they had an impact on the inflorescences in all cases analyzed (Fig. 1-3);
- the Crystal variety showed the greatest differences between the control and the treated varieties, both in terms of the number of flowers in the inflorescences, their opening and fruit formation;
- at the Oxheart variety, there were no significant differences between the control and the experiment variants treated in terms of the size of the leaves and stem as in Crystal, instead, there were differences in terms of the number of open flowers in the first inflorescence.

ABSTRACT

Improper or excessive use of fertilizers can even contaminate the aquifer through the phenomenon of leaching, so the optimal alternative for agriculture is the use of foliar fertilizers. The agricultural sector must not be a source of environmental pollution, which is why we need innovative products with low toxicity that are environmentally friendly.

The objective of this paper was to test an ASFAC BCO-4 biostimulator, MESSIS BOR fertilizer and EFUSIO adjuvant on 3 tomato varieties: Crystal, Oxheart, and Bacuni.

The results showed that in all the variants tested, the products used did not have a significant impact on the size of the leaf mass, but had an impact on the inflorescences in all cases analyzed.

Fig. 1. Tomatoes Crystal (flowers and fruits)

Fig. 2. Tomatoes Oxheart (flowers and fruits)

Fig 3. Tomatoes Bacuni (flowers and fruits)

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REFERENCES

1. AMBARUS SILVICA, BREZEANU CREOLA, BREZEANU P. M., CALIN MARIA, CRISTEA TINA OANA, 2014 – *Realizări ştiinţifice în 40 ani de activitate la Staţiunea de Cercetare Dezvoltare pentru Legumicultură Bacău*, Volum omagial, Alma Mater Publishing House, Bacău [Scientific achievements in 40 years of activity at the Research Station Development for Vegetable Cultivation Bacău, Volumomagial, Alma Mater Publishing House Bacau];
2. ANDREI SIMONA, RAŢI I. V., RĂDUCANU DUMITRA, BĂDĂLUŢĂ NICOLETA, 2016 - *Determination Of Nutritional Actions Of Asfac Bco-4 Stimulator In Fruit Trees Culture In Ecological System*, Studii şi Cercetări Biologie ale Universită□ii "Vasile Alecsandri" din Bacău, 25/1, p.32 -37, https://pubs.ub.ro ;
3. CAKMAK, I., MARSCHNER, H., BANGERTH, F., 1989 - *Effect of Zinc Nutritional Status on Growth, Protein Metabolism and Levels of Indole-3-acetic Acid and other Phytohormones in Bean (Phaseolus vulgarisL.)*. Journal of Experimental Botany, 40(3), p. 405–412;
4. CĂLIN MARIA, 2010 – *Ghidul cultivării legumelor în agricultură ecologică*, Alma Mater Publishing House, Bacău , p.136-161 [Cultivation guide vegetables in organic farming, Alma Mater Publishing House, Bacău, p.136-161];
5. CHIŢIMUŞ ALEXANDRA DANA., NEDEFF V., LAZĂR G., 2011 - Actual stage in the soil remediation, Journal of Engineering Studies and Research,Vol 17, No 4, Alma Mater Publishing House, Bacau, pp. 24-31;
6. CIOFU RUXADRA, NISTOR S., PELAGHIA CHILOM, APAHIDEAN S., HORGOŞ, V., LAUER K. F., ANSTASIU N., 2004 - Tratat de legumicultură, Ceres Publishing House,p. 603-674 [Treaty of vegetable growing, Ceres Publishing House, p. 603- 674];
7. DELIAN ELENA, LUPU CARMEN, SĂVULESCU ELENA, 2018 - *Effect Of Different Priming Treatments On Seeds*

Germination And Early Seedlings Growth Of Tomato, Current Trends in Natural Sciences Vol. 7, Issue 13, pp. 38-46 https://natsci.upit.ro;
8. FERNÁNDEZ, V., SOTIROPOULOS, T., AND BROWN, P. H., 2013 - *Foliar Fertilisation: Principles and Practices*. Paris: International Fertilizer Industry Association (IFA);
9. KUEPPER G., 2003 - *Foliar fertilization, Appropriate Technology Transfer for RuralAreas*,https://scholar.google.com;
10. NUGUEMEZI J. A., TATCHAGO V., 2010 - Effects of Fertilizers Containing Calcium and/or Magnesium on the Growth, Development of Plants and the Quality of the Tomato Fruits in the Western in the Highlands of Camerooon, Science Alert Vol 5, p. 821-831, https://scialert.net;
11. PEYVAST G., OLFATI J. A., RAMEZANI-KHARAZI P., KAMARI-SHAHMALEKI S., 2009 - *Uptake of calcium nitrate and potassium phosphate from foliar fertilization by tomato*, iJournal of Horticulture and Forestry Vol. 1(1) 007-013 https://www.researchgate.net ;
12. RAȚI I. V., BĂDĂLUȚĂ NICOLETA, 2008- *Fiziologiaplantelor: note de curs*. Alma Mater Publishing House, Bacău [Plant physiology: course notes.Alma Mater Publishing House, Bacău];
13. RĂDUCANU DUMITRA, RAȚI I.V., BĂDĂLUȚĂ NICOLETA, 2016 - *Research Regarding The Influence Of Asfac Bc04 Biostimulator On Cherry – Tree Nana Variety*. StudiișiCercetări, Biologie ale Universită□ii ”VasileAlecsandri” din Bacău 25/1, p.55 -58 ;
14. SATO, S., KAMIYAMA, M., IWATA, T., MAKITA, N., FURUKAWA, H., IKEDA, H., 2006 - *Moderate Increase of Mean Daily Temperature Adversely Affects Fruit Set of Lycopersicon esculentum by Disrupting Specific Physiological Processes in Male Reproductive Development,* Annals of Botany, 97(5), p.731–738, https://academic.oup.com;
15. ***FIȘĂ TEHNICĂ ASFAC-BCO 4 https://www.romchimprotect.ro
16. ***FIȘĂ TEHNICĂ MESSIS BOR https://www.romchimprotect.ro

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