# THE INFLUENCE OF BIOSTIMULATORS ON GERMINATION AND GROWTH IN BITTER CUCUMBER (*MOMORDICA CHARANTIA*)

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***Abstract.*** *Momordica charantia, popularly known as bitter melon, bitter gourd or balsamic pear is a tropical and subtropical climbing plant belonging to the Cucurbitaceae family. The high content of bioactive compounds has given the species a special importance in traditional medicine, being used in the fight against diabetes, cancer and also as a powerful antioxidant. The continuous growth of the global population requires an intensification of plant food production to meet the ever-expanding demand. Biostimulants are substances or microorganisms that, when applied in small amounts, stimulate natural plant processes such as nutrient uptake, growth and stress resistance. The present work aims to identify the role of an algae-based biostimulator in the germination and growth of bitter cucumber. To carry out the experiment, five genotypes of Momordica charantia were used, of which two Romanian varieties (Brâncusi and Rodeo) and three experimental lines (Line 1, Line 3 and Line 4) were treated with the Algevit biostimulator during the germination period and until the emergence the first two true leaves (Phenophase 102 BBCH). It was found that the germination rate increased in the treated variants by up to 15% in the genotype Line 4 and in the case of the vitamin C content it had very significant increases of over 50% in the case of Line 3 and Line 1.*

***Keywords:*** *Momordica charantia, biostimulator, germination, vitamin C*

## INTRODUCTION

*Momordica charantia*, popularly known as bitter melon, bitter gourd or balsamic pear is a tropical and subtropical climbing plant belonging to the Cucurbitaceae family [1]. The plant is cultivated both for its many medicinal properties and as a food, widely in China, India and Southeast Asia [2]. The plant as a whole contains more than 60 active substances that are active against more than 30 diseases, including cancer and diabetes [3]. Numerous studies have demonstrated the blood glucose-lowering potential of bitter cucumber consumption. This hypoglycemic effect is conferred by momordicin, a bioactive substance called vegetable insulin [4][5]. Bitter cucumber fruits are rich in vitamins such as: vitamin A, vitamin C, vitamin E, folic acid, niacin and riboflavin. It also presents considerable amounts of magnesium, phosphorus, potassium, iron and zinc [6]. There are also fatty acids identified in *Momordica charantia* including lauric, myriatic, palmitic, stearic and linoleic acids [7]. Vitamin C is one of the most abundant vitamins in the plant, giving it a strong antioxidant effect [8].

The continuous growth of the global population requires an intensification of the production of vegetable food, to satisfy the continuously expanding demand [9]. In this context, the use of classic fertilizers is becoming increasingly problematic, both because of the negative impact on the environment and their limited long-term effectiveness [10]. Replacing them with sustainable alternatives, such as biostimulants, is essential to increase crop productivity, while optimizing soil health and reducing the ecological footprint of modern agriculture [11]. Biostimulants are substances or microorganisms that, when applied in small amounts, stimulate natural plant processes such as nutrient uptake, growth and stress resistance. Their importance lies in the ability to improve the metabolic efficiency of plants, contributing to sustainable development and increasing agricultural productivity without negatively affecting the environment [12].

The purpose of this work is to determine the effects of biostimulators on the germination and growth processes of bitter cucumber.

## MATERIAL AND METHODS

Seed treatment using biostimulants of natural origin is one of the most innovative and promising strategies to improve seed germination, seedling establishment, growth and development under abiotic stress conditions [13]. The plant material was represented by the germinated seeds of bitter cucumber and plants with the first two fully developed true leaves. Thus, seeds of equal size from 5 bitter cucumber genotypes were used, of which two Romanian varieties (Rodeo and Brâncusi) and three experimental lines (Line 1, Line 3 and Line 4). They were sterilized with 5% sodium hypochlorite for 15 minutes and then rinsed 4 times with distilled water. 100 seeds were placed in Petri dishes. A control was used for each genotype (seeds were not treated) and 0.5% biostimulant treatment was applied for each genotype. 3 Petri dishes (300 seeds) were used for each control and each treatment. The experience was carried out in the greenhouse of the Research Institute for Agriculture and the Environment (ICAM) belonging to the "Ion Ionescu de la Brad" University of Life Sciences, Iași, Romania. The temperature was 28 °C during the day – 20 °C at night; 14 hours day – 10 hours night; relative humidity of 70% and light intensity 250 µM m-2s-1. Seed germination was monitored over a period of 10 days. The seeds were watered with an initial amount of 30 ml of water. For the treated seeds, a quantity of 5 ml of Algevit biostimulator was applied at intervals of 3 days starting from the second day. Control seeds were watered with the same amount of water. The germination rate was determined for these.

After the seeds germinated, they were moved to the alveoli where they grew up to phenophase 102 of the BBCH scale (equivalent to the appearance of the first two true leaves). During this period the same treatments were applied. After harvesting the leaves, the amount of vitamin C was analyzed.

Germination rate is the percentage of seeds that germinate. This is calculated by dividing the number of germinated seeds by the total number of seeds sown, multiplied by 100. After the seeds germinated, they were moved to the alveoli where they grew up to phenophase 102 of the BBCH scale (equivalent to the appearance of the first two true leaves). During this period the same treatments were applied. After harvesting the leaves, the amount of vitamin C was analyzed.

Germination rate is the percentage of seeds that germinate. This is calculated by dividing the number of germinated seeds by the total number of seeds sown, multiplied by 100.

$GR = n/N \times 100\ \%$

n - is the germination number

N - represents the total number of seeds tested

## RESULTS AND DISCUSSION

According to Figure 1, the amount of ascorbic acid showed a general tendency to increase in plants treated with biostimulator compared to the untreated control. Among the genotypes studied, in the case of control plants, the highest value of vitamin C was recorded in Line 3 (145.6 mg/100 g) and the Rodeo variety (159.97 mg/100 g) and the lowest value was recorded in the Brâncuşi variety (136.05 mg /100 g). The high amount of ascorbic acid is an important parameter in the identification of stress-tolerant genotypes. The high value of vitamin C highlights a strong antioxidant property of the genotypes, which can help the plant in the fight against reactive oxygen species (ROS) encountered with the installation of abiotic stress [14].

The low amount of vitamin C recorded in the Brâncusi variety is consistent with our previous analyses, highlighting a weak resistance of the genotype to stress conditions.

In the variants treated with the Algevit biostimulator, the highest values were recorded in the genotype Line 3 (236.89 mg/100 g) followed by Line 4 (199.19 mg/100 g) and the lowest value of vitamin C was observed in the Brâncuși variety (137.91 mg/100g). The most pronounced increase in the amount of ascorbic acid was recorded in genotype Line 3 where the values obtained in the treated variant were 62.69% higher than the untreated control, followed by genotype Line 1 which showed an increase of 52.78%. These values of the amount of vitamin C highlight a good result of biostimulator treatments on the genotypes. Compared to these differences, the smallest increase between the values was registered in the case of the Brâncusi variety (1.03%). The high values of the variants treated with biostimulator can be explained by the increase in photosynthetic intensity determined by biostimulators based on seaweed, a category in which Algevit also belongs. A more intense photosynthetic process can stimulate the increase in vitamin C content due to its role in carbohydrate metabolism. Also, the high content of amino acids, vitamins and nutrients of the biostimulator can improve the metabolism of the plant by causing high amounts of vitamin C [15]. Similar values of vitamin C were reported in the literature by Goo et al in 2016. Vitamin C is one of the abundant compounds in the bitter cucumber plant. It was pointed out that the leaf contains between 170 and 250 mg/100 g DW and the fruits contain an average of 2022 mg/100 g DW, the values being higher in young fruits [8].

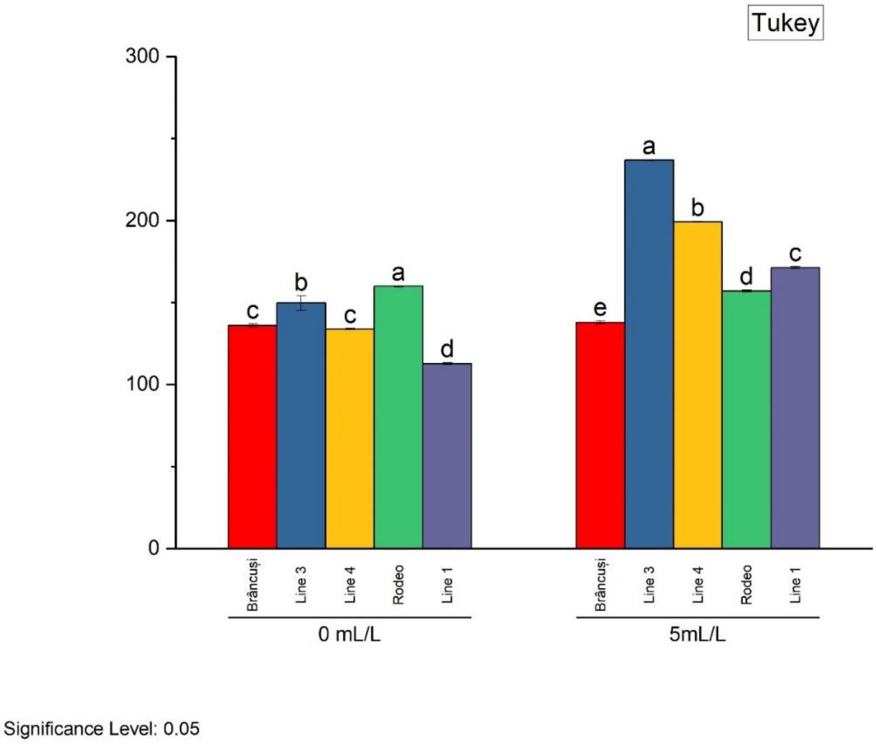


Figure 1. The effect of the Algevit biostimulator on the vitamin C content of bitter cucumber genotypes in phenophase 102 of the BBCH scale. Error bars represent the standard deviation and letters on the graph are plotted using Tukey's post hoc test with a significance level of p<0.05. The letters represent the actual differences observed on the graph.

The germination of seeds represents the process by which they initiate a new cycle of ontogenic development, when favorable medium conditions are ensured [16]. Bitter cucumber has an average germination rate between 70-90% [17]. The control variants of the studied genotypes fell within the values from the specialized literature, presenting the lowest germination rate in the Brâncusi variety (78%) and the highest germination rate value in Line 3 (93%). The values of the germination rate for the control variant highlight the fact that the experience was carried out under optimal conditions. The varieties treated with the Algevit biostimulator showed a higher germination rate compared to the untreated control in all genotypes except the Rodeo variety where a slight decrease in germination was observed. The highest increase was recorded in the Line 4 genotype which showed a 15% higher germination rate than the untreated control. The Brâncusi variety also had a significant increase in the germination rate compared to the control (14%). The Algevit biostimulator is recommended as beneficial in the seed germination process but also for a higher production. According to the analyzes carried out, the beneficial role of substances extracted from seaweed can be found on the germination of bitter cucumber seeds. The high content of vitamin C highlights its role in photosynthesis and therefore in the growth and development of bitter cucumber.

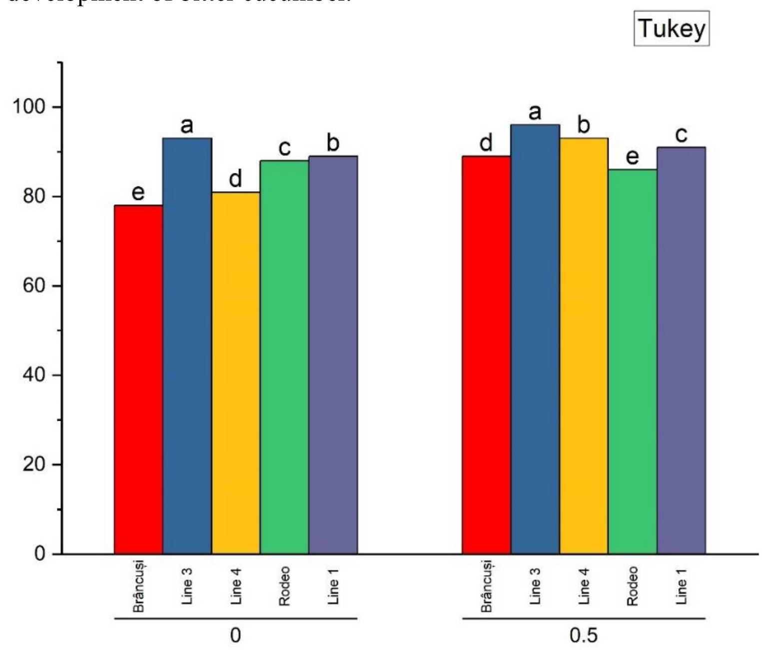


Figure 2. The role of the Algevit biostimulator on the germination rate of the 5 bitter cucumber genotypes made on day 10 from the start of the experiment. Letters represent actual differences between values and are plotted according to Tukey's post hoc test with a significance level of $p<0.05$.

Through the Pearson correlation test, it was possible to highlight a positive correlation between the two analyzes carried out, both in the case of control variants for each studied genotype and in the variants subjected to treatment with the biostimulator Algevit (Figure 3).

Very strong linear correlations were noted in the control variants of all genotypes except Line 4 where a weak correlation was observed (r = 0.39). This low value can be explained by the different behavior of the genotype in the case of germination versus growth. In the variants treated with biostimulator, the best correlations between germination and vitamin C were recorded in the genotypes Line 4 (r = 0.98) and Rodeo (r = 0.98), where it can be seen that the two determinations carried out are closely influenced by each other.

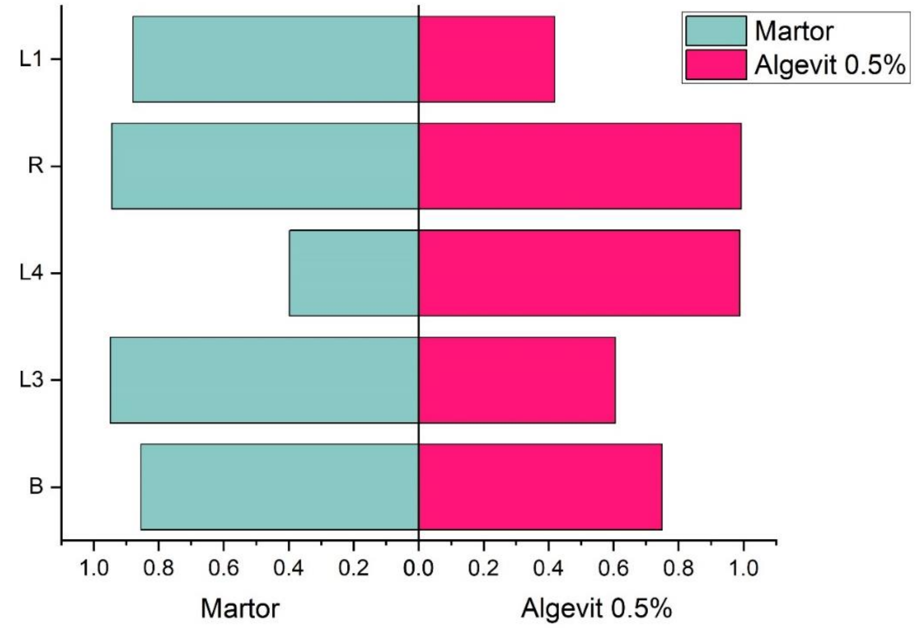


Figure 3. Visualization scheme of the Pearson correlation coefficient made to observe the linear correlation between the analysis of the germination rate and the amount of vitamin C for the control variants and those treated with the Algevit biostimulator.

## CONCLUSIONS

Following the analyzes carried out, a general tendency to increase the amount of vitamin C when applying the Algevit biostimulator was highlighted, due to its composition in seaweed extracts with a role in increasing the photosynthetic intensity and therefore the secondary metabolites involved in the photosynthesis process.

The germination rate in the variants treated with the biostimulator was higher compared to the untreated control, thus demonstrating the role of the biostimulator in the germination of bitter cucumber seeds.

According to the Pearson correlation coefficient but also the Tukey test applied to the graphs, it can be concluded the positive role of the Algevit biostimulator for (*Momordica charantia*) crops, thus being able to recommend the biostimulator for bitter cucumber crops.

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