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ADMINISTRATION OF ALGAL BIO-FERTILIZERS TO CULTIVATION OF TOMATOES (*Lycopersicum esculentum* L.) UNDER GREENHOUSE CONDITIONS

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Abstract

The paper aimed to present the results of studying the administration of algal bio-fertilizers to cultivation of tomatoes (Lycopersicum esculentum L.) under greenhouse conditions. In the experiments were involved algae cyanophytes Anabaena variabilis and Nostoc gelatinosum, which are deposited in pure collection in laboratory of "Phycology". During the experiments was monitored soil pH, plant growth, the productivity of tomatoes and the total N from soil layer. Administration of algal bio-fertilizers Anabaena variabilis ensures the accumulation of more high levels of nitrogen in the soil, compared to other experimental variations. Bio-fertilizers administration contributes to stimulating growth of the stem height of tomato plants, increasing the number of seedlings of tomato to a 1 to 2.30 times and productivity tomatoes from 1.73 to 3.40 compared to the group in which was not given algal biomass. The highest results of tomatoes productivity were attested in variant with administering bio-fertilizers based of Nostoc gelatinosum biomass.

Key words*: algal bio-fertilizers, blue-green algae, productivity, nitrogen fixation, tomatoes.*

INTRODUCTION

According to the statistical report presented by the Food and Agriculture Organization of the United Nations (FAO) the index of fruit and vegetables production has increased worldwide. If in 1980 the fruit production index reaches about 58, then in 2000 it was 86 and in 2014 reached 127. At the same time, worldwide, is observed a significant increase the quantity of fertilizers, such as nitrogen (in 2009 to 64.9 kg/ha and a. 2014 to 85.8 kg/ha), phosphorus (in 2009 to 25.9 kg/ha and 2014 to 33.2 kg/ha), potassium (in 2009 to 18.2 kg/ha and 2014 to 20.4 kg/ha) (FAO, 2015). This worldwide increase the of fruit and vegetables production is due to the application of advanced technologies for cultivation, chemical fertilizers, seeds and transgenic seedlings that contributes to achieving harvest, but in many cases influences negative on the human body.

In such conditions it is necessary to develop and implement in practice new bio-fertilizers that would help to improve the harvest and soil quality and stimulate crop plants growth.

Bio-fertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants (Vessey, 2003). Bio-fertilizers are considered natural fertilizers made up of inoculum of organisms from bacteria, algae, fungi or combination of them, contributing to increasing availability of nutrients (Sahu, 2012).

Bio-fertilizers have been used in agriculture since ancient times and is mentioned in the writings of the classics of Greece and Rome, describing agricultural practices that improve harvest. The old civilization Maya manage the waters of Mexico, creating wetlands to maintain a complex mixture of algae cyano-phytes and other microorganisms, which were used in order to increase the content of nu-trients in the soil (Morrison et al., 2003; Malusa et al., 2016). At the moment, several species of algae are widely applied in agricultural practice as bio-fertilizers, which have bio-stimulating effect of crop plants growth.

The application of alga bio-fertilizers is effective and necessary because to their management is amended the structure of the soil. Is eliminated growth stimulating substances such as hormones (auxins and gibberellins). The use of bio-fertilizers adds to the maintenance of water in the soil due to the gelatin and reduced the salinity. Administration of algae contributes to increasing the concentration of phosphorus and nitrogen from the soil by fixing nitrogen from the atmosphere and organic acid excretion (Wilson, 2006).

A practical interest is using the algae as bio-fertilizers in the cultivation of tomatoes. Some researchers conducted in this regard have shown beneficial effects on marine algae *Nannochloropsis* biomass administration as bio-fertilizers in the cultivation of tomatoes. So, in batches with administration of algal bio-fertilizers was registered a lower growth of plant height, a lower harvest but of high quality, also and obtaining fruit with a more high sugar and carotenoids (Grunertae, 2016).

MATERIALS AND METHODS

In the experiments were involved algae cyanophytes *Anabaena variabilis* and *Nostoc gelatinosum*, which are deposited in pure culture collection in laboratory of "Phycology". These experiments were conducted in greenhouses, Company SRL „AŢ-Zim", which are located near the village Bardar, district Ialovei, Republic of Moldova. The research was conducted during the spring and summer. In experiments were used the following experimental groups: 1- administration of *Anabaena variabilis* living biomass (3 kg/ha), 2 - administration of *Nostoc gelatinosum* living biomass, 3 - control version where was not given algal biomass. Algal biomass was crushed, diluted in drinking water and administered to the surface of soil. Each experimented variant occupies an area of 20 m^2. Algae inoculation was made on the 15th day after planting seedling tomato sorts "Admiral". During the experiments was monitored plant growth, the quantitative analysis of tomato harvest, the total N in 0-20 cm soil layer (using the method colorimetric) (Минеев, и др., 2001) and soil pH (potentiometric method) (Терпелец и др., 2010). Soil moisture during the experiments varied from 16.07 to 22.79%.

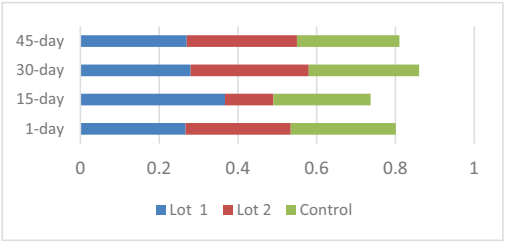

Figure 1. Changes of total nitrogen in the soil to the administration of algal bio-fertilizers, %

RESULTS AND DISCUSSIONS

As is known nitrogen-fixing algae are able to fix nitrogen when it is in deficiency and to consume when they are in sufficient quantities (Dobrojan et al., 2010; Stratulat, 2012).

Analyzing the changes in dynamics of total nitrogen in the soil, we note that both versions with administration of algal bio-fertilizers and also in control, the amount of nitrogen is not stable, which indicates that the consumption and nitrogen fixation is produced. In lots with administration of algal bio-fertilizers is attested the highest amounts of nitrogen in the soil compared with controls.

Administration of algal bio-fertilizers *Anabaena variabilis* ensures the accumulation of more high levels of nitrogen in the soil, compared to other experimental variations. At the same time, particularly in versions 1 and 2 the total soil nitrogen is accumulating after being consumed and produced, which demonstrates once again the contribution of algal bio-fertilizers in the soil with nitrogen refilling. This tendency indicates that nitrogen consumption by tomato plants is initiated the process of biological nitrogen fixation carried out by algal bio-fertilizers.

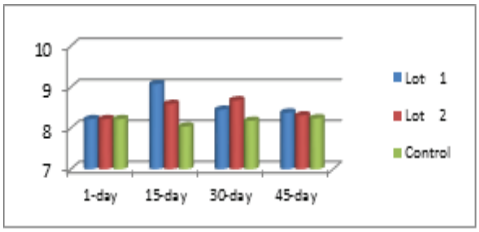

Figure 2. Changing the soil pH in the administration of nitrogen-fixing algae

Soil pH has changed over the period of analysis especially in the versions with administration

of bio-fertilizers and version control modifications are not essential. During the experiments it is observed that the pH of the soil tends to easy basification, especially versions with administration of bio-fertilizers. In groups 1 and 2 soil pH is slightly higher than in the control sample, in the period from the 15th until the 45th day. Values soil pH varies from one period to another and from one variant to another. However, the highest values of soil pH are observed in the group with bio-fertilizers administration consists of algae *Anabaena variabilis* biomass. This may be caused by accumulation of inorganic nitrogen in the soil.

Table 1. Influence of algal bio-fertilizers on tomato plant size, cm

Experimental lots	Analysis days; days of the administration of algal bio-fertilizers			
	15	30	45	60
Lot 1	26.01±1.39	48±4.15	79±5.93	128±8.25
Lol 2	22.11±1.43	48±4.44	76±7.30	129±9.25
Control	18±0.90	34±1.49	62±8.44	124±8.02

The analysis of increasing process found that the length of the stem shows some differences depending on the experimental variants, which shows the positive influence that manifests algal bio-fertilizers on growth processes of tomatoes. In the period from the 15th until the 45th day, the plants from variants with administration of algal bio-fertilizers are longer than those in the control group. The tallest plants were attested in lots 2 and 1, which reached values of 128±8.25 to 129±9.25 cm, being with 4-5 cm higher compared to control variant. Thus, we can conclude that administration of algae as bio-fertilizers contribute to boosting growth of tomato stems from 4.03 to 3.22% compared to the control group (Table 1).

Table 2. The influence of algal bio-fertilizers on the number of tomatoes on one plant

Experimental lots	The analyzed period (60th day after the administration of algal bio-fertilizers)
Lot 1	13±2.59
Lot 2	18,46±2.33
Control	8±1.39

Number of fruit presents a critical indicator of the productivity of tomatoes. Thus, the result of determinations made at the 60th day of analysis is observed that the administration of bio-

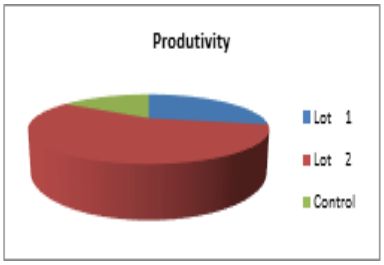

Figure 3. Productivity of tomatoes, kg/m^2

fertilizers, number of tomatoes to a seedling is higher than the control group. The highest number of fruit is found in the lot 2 (18.46±2.33) which is 1.42 times higher than in group 1 and 2.30 times higher compared to the control group.

Algal bio-fertilizers administration influence on the productivity of tomatoes. In the groups with bio-fertilizers administered the amount of tomato obtained from an area of 1 m^2 is 1.73 to 3.40 times higher than in the control variant. The highest results of tomatoes productivity were attested in variant with administering bio-fertilizers based of *Nostoc gelatinosum* biomass.

CONCLUSIONS

Administration of algal bio-fertilizers contributes to the accumulation and stabilizes the nitrogen in the soils involved in the cultivation of tomatoes. The soils algalization with bio-fertilizers contributes to slight change of soils pH to slightly alkaline direction. Bio-fertilizers administration contributes to stimulating growth of the stem height of tomato plants, increasing the number of seedlings of tomato to a 1 to 2.30 times and productivity tomatoes from 1.73 to 3.40 compared to the group in which was not given algae biomass. The most efficient algal bio-fertilizers from those tested, proved to be *Nostoc gelatinosum* biomass.

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