OPTIMIZING EGGPLANT SEED PRODUCTION TECHNOLOGY THROUGH USING BIOSTIMULANTS

OPTIMIZAREA TEHNOLOGIEI DE PRODUCERE A SEMINȚELOR DE PĂTLĂGELE VINETE CU AJUTORUL BIOSTIMULATORILOR

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Abstract.
This paper presents a state of arts on the influence of treatments with biostimulants on eggplant, based on the results of scientific research and technological practice in Romania and in the world. This study aims to introduce these biostimulants in the seed production technology of eggplant, in order to obtain a higher quantity of quality seed.
Key words: amino acids, biostimulant, seaweed, *Trichoderma*

Rezumat.
Prezenta lucrare prezintă stadiul actual al cunoașterii privind influența tratamentelor cu biostimulatori asupra plantelor de pătlăgele vinete, pe baza rezultatelor de cercetare științifică și practică tehnologică din țară și de pe plan internațional, având ca scop introducerea acestor biostimulatori în tehnologia de producere a semințelor, în vederea obținerii unei cantități mai mari de sămânță de calitate.
Cuvinte cheie: alge marine, aminoacizi, biostimulatori, *Trichoderma*

INTRODUCTION

The seed production of cultivated plants is a strategic activity for agriculture and horticulture, because it ensures the "raw material" for the establishment of any crop [Echim and Scurtu, 2020; Munteanu, 2003]. The eggplant (*Solanum melongena* L.) crop has became more and more popular in Romania, over the last 50-60 years, due to increasing preferences of consumers, as well as the fact that this species finds favorable crop conditions in our country, both in the field and in protected areas [Maier, 1969; Munteanu, 2003]. The average per capita consumption of eggplant in 2020 was 6.4 kg/capita, and is expected to increase over the next 15 years [Scurtu *et al*., 2020].

Currently, in Romania, as well as in the European Union, the marketing of seeds and propagating material, used for the establishment of crops, is carried out only under the auspices of the laws, respecting the norms of certified seed production, in order of mentaining constant the characteristics of cultivars [Echim

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and Scurtu, 2020; Stan and Stan, 2010]. Certain rules that ensure the conservation of the biological value of the cultivars are strictly followed, such as: crop location, crop rotation, isolation distances, biological purification works, fruit harvesting and seed extraction, conditioning and packaging. All these norms are respected within specific cultivation technologies for seed production [Stan and Stan, 2010].

The crop technology for seed production, including eggplant, consists of a flow of works and operations carried out in a certain order that takes into account the stage of plant development and the natural conditions of cultivation, as well as the precise technical indicators that optimally satisfies the requirements of the plants throughout the vegetation period, so that an economically efficient activity is done. The entire technological flow must end with a quantity of seed that strictly meets the qualitative characters for each biological category of seed, and some care works can be improved [Echim and Scurtu, 2020].

The use of biostimulants in seed production is little studied, but their potential in this branch of agriculture and horticulture should not be neglected. The present review aims to carry out a study of the specialized literature regarding the use of biostimulants in eggplant seed production, in order to introduce them into the seed production technology of this crop.

MATERIAL AND METHOD

This review intends to evaluate the possibilities to use different types of biostimulants in eggplant seed production, based on the current level of knowledge and the technical conditions from our country and from abroad, illustrated by international literature. To get this literature review, the internet and appropriate books were used.

RESULTS AND DISCUSSIONS

Biostimulants are considered to be any substance of natural, and sometime, synthetic, origin that has the ability to bring improvements to plants, in terms of growth, development, yield, resistance to biotic and abiotic stress factors by stimulating natural processes, but without being in fact fertilizers or pesticides (Du Jardin, 2015). Their composition and origin show great variability, being classified into several classes, such as plant extracts, different microorganisms beneficial to plants, hydrolyzed proteins, amino acids, enzymes, chitosan or some inorganic compounds [Bulgari *et al*., 2019; Du Jardin, 2015]. They can be used as a foliar or soil treatment [Drobek *et al*., 2019; Parađiković *et al*., 2019].

Results regarding the use of biostimulants based on seaweed to eggplant

Seaweed-based products consist of green, brown or red seaweed, most of which are available in the form of extracts [Battacharyya *et al*., 2015; Khan *et al*., 2009], but most commercial products are synthesized from brown seaweed, like *Ascophyllum nodosum*, *Ecklonia maxima*, *Fucus* spp. or *Laminaria* spp., [Khan *et al*., 2009]. Their valuable content is rich in macro and microelements and organic substances, such as vitamins or amino acids. These also present phytohormone-like activity [Battacharyya *et al*., 2015; Crouch and Van Staden, 1993; Khan *et al*.,

2009]. In the seed production process, the phytohormonal activity produced by cytokinins seems to play an important role [Van Staden, 1983]. At the same time, it must be taken into account that some auxins and gibberellins induce parthenocarpy in eggplant [Nothmann and Koller, 1975].

Studies conducted so far on the effects of seaweed treatments on eggplants have indicated positive results regarding the increase in plant height, leaf area, number of fruits and fruit size, both in field crops [Abd El-Gawad and Osman, 2014] and in protected areas [Khazaal and Rashed, 2018].

Seaweed treatments can be used to obtain quality eggplant seedlings by increasing root and stem mass, height and diameter of stem [Villa e Vila *et al*., 2024].

The increase of the number of fruits can also lead to the increase of the number of physiologically mature fruits, from which the seed can be extracted. Positive results were obtained regarding the increase of the number of fruits per plant by the use of green seaweeds treatments, such as *Ceratophyllum demersum* [Al-Saadi and Abohanah, 2020], brown seaweeds such as *Ascophyllum nodosum* [Pohl *et al*., 2018; Rasheed and Shareef, 2019], *Sargassum polycystum* [Jamili *et al*., 2022], *Laminaria digitata* [Constantin *et al*., 2023], *Gracilaria textorii, Hypnea musciformis* [Rao and Chatterjee, 2014].

Certain studies indicate that the size of the eggplant fruit can have a good influence on the amount of seeds and 1000 seeds weight [Badea *et al*., 1996]. Some treatments with seaweed led to an increase in fruit weight. Positive effects were shown by the treatments with brown seaweeds *Ascophyllum nodosum* [Rasheed and Shareef, 2019] *Gracilaria textorii, Hypnea musciformis* [Rao and Chatterjee, 2014], *Sargassum polycystum* [Jamili *et al*., 2022]. Treatments with seaweed influenced the size of eggplant fruits both in the open field [Jamili *et al*., 2022] and in plastic houses [Khazaal and Rashed, 2018].

At the same way, the germination of eggplant seeds can be improved with the help of presoaking treatments in seaweed solutions. Positive results were obtained by using of red seaweeds, such as *Laurencia obtusa* [Pandya and Mehta, 2022], brown seaweeds, such as *Sargassum wightii* [Sreelatha *et al*, 2018], *Gracilaria textorii, Hypnea musciformis* [Rao and Chatterjee, 2014], *Laminaria digitata* and *Ascophyllum nodosum* [Constantin *et al*., 2024].

It was found that treatments based on *Ascophyllum nodosum* led to an increase in fruit quality, by improving the content of sugars and anthocyanins [Pohl *et al*., 2019a]. Also, treatments with *Sargassum wightii* led to an increase in the content of total sugars, proteins and lipids [Sreelatha *et al*., 2019]. Other research found that treatments based on *Ascophyllum nodosum* have an important positive influence in increasing the number of medium- and long-styled flowers [Pohl *et al*., 2019b].

Results regarding the use of biostimulants based on beneficial microorganisms to eggplant

Biostimulants based on microbial inoculum can contain single culture or mixtures of cultures of microorganisms [Du Jardin, 2015]. Both beneficial bacteria and fungi can be part of the composition of these biostimulants. Among the bacteria we mention *Bacillus* spp, *Pseudomonas* spp, *Enterobacter* spp, *Streptomyces* spp or *Acinetobacter* spp., and among fungi – *Trichoderma* spp., *Glomus* spp, *Heteroconium chaetospira* [Drobek *et al*., 2019]. Their most important effect is the antimicrobial biocontrol of ceratin plant diseases [Drobek *et al*., 2019, Ongena and Jacques, 2008]. This aspect is important, because, in the practice of seed production, the plants with different diseases are removed [Ciofu *et al*., 2004; Echim and Scurtu, 2020].

Soil pathogens, such as *Verticillium dahliae* and *Fusarium oxysporum* f. sp. *melongenae,* can cause significant losses in eggplant crops. Certain Romanian cultivars have good tolerance to these diseases, but are not immune [Sovarel and Costache, 2018], which leads to the need for additional protection. Some species of *Bacillus* can be used for biocontrol of some important diseases like *Verticillium dahliae* [Li *et al*., 2008], *Fusarium oxysporum* [Altinok *et al*., 2013] or *Ralstonia solanacearum* [Sakthivel *et al*., 2019]. Also, *Trichoderma* spp. can be used to control *Fusarium oxysporum* [Abdel-Monaim *et al*., 2014] or *Rhizoctonia solani* [Faruk and Rahman, 2015]. Also, *Trichoderma* can be used in combination with *Bacillus* spp or *Pseudomonas* spp to control *Verticillium dahliae* [Bilginturan and Karaca, 2021].

Beneficial microorganisms also play an important role in plants growth and development. The number of fruits on plant increased following treatments with *Trichoderma viride* and *Trichoderma hamatum* [Abdel-Monaim *et al*., 2014]. Also, the weight of eggplant fruits increased following treatments with *Trichoderma viride* and *Trichoderma hamatum* [Abdel-Monaim *et al*., 2014].

The treatments applied to eggplant seeds indicate the potential of *Trichoderma harzianum* to increase eggplant seed germination percentage and germination speed index [Wu *et al*., 2017].

Studies show that seaweed-based biostimulants and beneficial microorganisms can be used together with beneficial effects on eggplant crops [Aydi- Ben-Abdallah *et al*., 2021].

Results regarding the use of biostimulants based on amino acids to eggplant

Amino acids are essential in the physiological processes of the plants, being basic components of cells. Amino acids play an important role in the processes of photosynthesis, can increase the vegetative mass of plants, can influnce the development of fruits and seeds or can increase plant resistance to drought and diseases [Baquir *et al.*, 2019; Rai, 2002]. Drought and high temperatures can lead to significant yield losses, even though eggplant is a species quite resistant to this type of abiotic stress [Chira *et al*., 2015].

Treatments with amino acids led to an increase in the weight of eggplant fruits [El-Nemr *et al*., 2015]. Also, the eggplant yield increased even in the case of water deficit [Bader *et al*., 2020].

Results regarding the use of biostimulants based on humic and fulvic acids to eggplant

Humic acids are formed following chemical and biological transformations of plant and animal organic matter, representing the main source of organic carbon. They comprise more than 60% of the organic matter of the soil. Fulvic acids are, like humic acids, a fraction of humic substances from soil. Fulvic acids remain soluble in aqueous solution at any pH value, but humic acids precipitate when the pH of the solution is lowered from alkaline pH to pH values of 1-2. Humic and fulvic acids can be used separately or together as fertilizers [Canellas *et al*., 2015].

Fertilizers based on humic acids gave positive results in foliar [Azarpour *et al*., 2012] and soil application [Shehab and Ibrahim, 2022], or the treatments methods can be combined [Paramasivan *et al*., 2015].

Fulvic acids can be used separately from humic acids, with good results at eggplant, but some studies suggest that the use combined of humic and fulvic acids leads to better results in this species than when they were used separately [Mammadova, 2023].

The use of treatments with the humic acids [Azarpour *et al*., 2012; Shehab and Ibrahim, 2022] or combination of humic and fulvic acids [Jaafar and Abbass, 2020] have a beneficial effect on the number of fruits in eggplant.

Also, humic acids have beneficial effects on the increase of fruit size, either alone [Azarpour *et al*., 2012; Shehab and Ibrahim, 2022] or combined with fulvic acids [Jaafar and Abbass, 2020].

Biostimulants from humic acids can also be combined with nitrogen-based fertilizers, with good results in eggplant [Azarpour *et al*., 2012].

Other positive results were also observed to usage of biostimulants with humic acids to eggplant seedlings, by increasing the weight of the seedlings, and also the level of macro and micronutrients [Dursun *et al*., 2002].

CONCLUSIONS

There is a wide variety of biostimulants available on the market, which can be easily applied, foliar or on the soil, depending on the applied technology.

The use of biostimulants in eggplant crops can lead to an increase in yield, fruit size and quality, and also can increase the resistance to biotic and abiotic stress factors.

The potential of their use in seed production has not been explored, but the results obtained in increasing the yield and quality of the eggplant fruits lead to the conclusion that they have high potential to be successfully used in seed production in this crop.

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