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ROLES OF BIOSTIMULANTS IN PLANT GROWTH AND STRESS MANAGEMENT

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Abstract

It is already known that stresses are very common in plants. Plants being sessile are unable to escape stresses, leaving them fight alone against all odds. So, plants have natural adaptability and resistance to various stresses to some extent. Alongside, the pressure of more food production from less available soils and resources has been prominent since decades. Sometimes, shift in cultivation methods and adoption of new techniques are also not enough to face the challenge of increasing food production to meet the goal to end hunger globally. There need some special attentions out of which one could be use of biostimulants. Biostimulants refer to all those organic substances in the form of phytohormones, vitamins, amino acids, different organic acids, humic substances, polysaccharides and oligosaccharides etc. They have been in trend now for their multipurpose uses from growth stimulation to stress resistance in plants. Biostimulants act like bridging the lacking factor and help plants perform well, even under stressful conditions. Thus, a great future in agriculture relying on biostimulants of various kinds could be expected.

Key words: Plant growth, stresses, resistance, biostimulants

Introduction

Global warming, sea-level rise, soil salinization and reducing arable land are some of the greatest problems of agriculture today. Besides, biotic and abiotic stresses add the fuel to the growing plant. The consequences are quite obvious i.e. lesser growth, impaired physiological processes and yield reduction. There is a constant need to adopt growth enhancer under unfavourable conditions for the plant. In this regard, plant biostimulants are quite popular nowadays. Biostimulant is defined as any substance or microorganism excluding a nutrient, soil improver or pesticide, having the ability to promote growth, to increase nutrient use efficiency, to enhance stress tolerance and to obtain greater yield of plant through the induction of natural biological processes (du Jardin, 2015). In other terms, they are known as growth enhancers or metabolic enhancers (Schmidt 2003). Some of the well-known examples of biostimulants include mineral elements, amino acids, vitamins, amino acids, natural plant hormones, humic substances (HSs) and polyandoligosaccharides among others (Bulgari et al., 2014).

Classification and characteristics of biostimulants:

There are multiple categories of biostimulants. As biostimulants are not confined to a particular group of compounds, those are versatile and have diverse range of applications. According to the new regulation (EU; 2019/1009), any fertilizing product that improves the plant's nutritional processes independent of its own nutrient content can be considered as biostimulant, although, its target has been set to achieve one or more of the following characteristics in any combination in the plant and/or the plant rhizosphere –

i. Nutrient use efficiency

ii. Resistance to stress (both abiotic or biotic)

iii. Quality traits

iv. Nutrient availability in the soil or near rhizospheric zone

Plant biostimulants are classified into two major groups: (a) microbial biostimulants that include plant growth-promoting rhizobacteria (PGPR) like *Enterobacter* spp., *Pseudomonas* spp., *Arthrobacter* spp., *Acinetobacter* spp., *Ochrobactrum* spp., *Rhodococcus* spp., *Bacillus* spp., *Rouxiella badensis* and *Rahnella* spp. (Efthimiadou et al., 2020; Morales-Cede´no et al., 2021); and fungi such as *Trichoderma harzinum* (Harman 2000); and (b) non-microbial biostimulants that include non-microbial originated compounds such as different humic substances like humins, humic acid and fulvic acid; different amino acids; seaweed extracts like of *Ascophyllum nodosum*, *Macrocystis pyrifera* and *Ecklonia maxima* (Gupta et al., 2011); legumes derived protein hydrolysate; marine algae extracts (El Boukhari et al., 2020), biopolymers like chitosan (du Jardin 2015).

Advantages of biostimulants:

Biostimulants have been proved to contribute many beneficial effects for plants. Many studies reported enhanced antioxidant activities in plants under stress, be it biotic or abiotic. As opposed to the conventional fertilizers or pesticides, biostimulants have unique properties to affect crop growth and development in multiple ways based on both timing and location of application (Sible et al., 2021). Plant growth is positively affected by biostimulants in terms of physiological traits, yield traits and also stress resistance. Some important roles of biostimulants for different traits of plants have been discussed in table-1.

Table 1: Role of different biostimulants in improvement of different plant traits

Sl. No.	Biostimulants used	Name of the plant	Traits improved	References
1.	*Ascophyllum nodosum*	Grapevine	Increased leaf nutrient content, improved vine growth and berry quality	Sabir et al. 2014
2.	*Bacillus velezensis*	*Arabidopsis*	Reduced reproduction of *Myzus persicae*	Rashid et al., 2017
3.	Humates and lignosulfonates	*Zea mays L.*	Improved root growth, nitrogen metabolism and rate of photosynthesis	Ertani et al., 2019
4.	Bee-honey based biostimulant	*Allium cepa*	Increased biomass, water use efficiency, water content, membrane stability, photosynthetic pigments, and accelerated antioxidants and osmoprotectants enhancing salt stress tolerance	Semida et al., 2019
5.	*Paraburkholderia phytofirmans*	*Solanum tuberosum*	Heat stress mitigation	Sangiorgio et al., 2020
6.	*Bacillus thuringiensis*	*Citrus sinensis*	Increased nymphal mortality of the pest *Diaphorina citri*	Dorta et al., 2020

Conclusions

We are living in an era where agriculture is facing lots of challenges with minimum resources remaining. On the other hand, the huge target of producing more from lesser arable lands is in steadiness. To reach this target crossing all the barriers needs special attention which might come in the form of biostimulants. As the name suggests, biostimulants are biological substances of various kinds prepared with the purpose of stimulating growth and playing some supplementary roles in plants when applied under

different environmental conditions, created naturally or artificially. Biostimulants not only promote growth and yield traits, but they also help in mitigation of different stresses in plant. So, application of biostimulants should be considered to bring positive changes in plant in terms of growth, physiological processes and stress mitigation.

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