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Biostimulants: Innovation to Modern Agriculture

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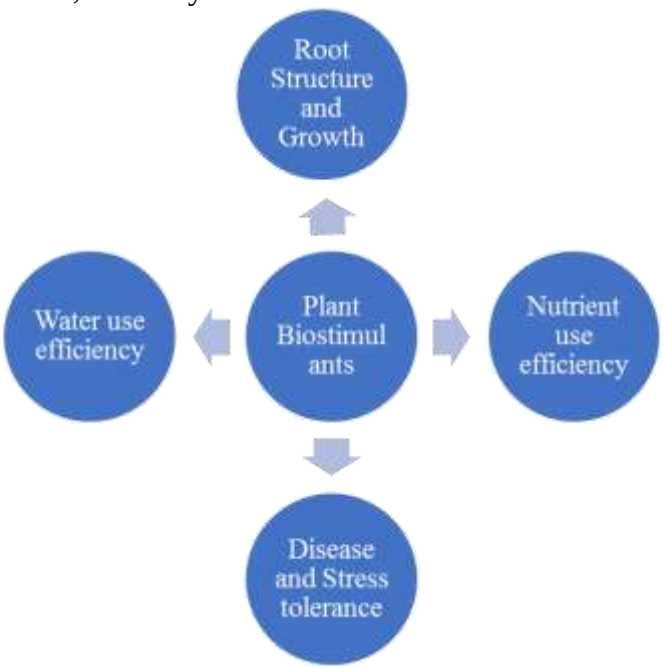
SUMMARY

Biostimulants are substances or organisms, or a combination of both, that stimulate the physiological activity of plants, leading to increased uptake and efficiency of nutrients, crop quality, and tolerance to stress related to biotic and abiotic factors. It helps to enhance the quality of the produce and optimize the crop productivity for sustainable production. Various extracts such as protein hydrolysates, seaweed, amino acids, biochemicals, microbial products, antioxidants, humic and fulvic acids, anti-transpirants, and their derivates are used as sources of biostimulants. The development and use of biostimulants have great potential in the agricultural sector by modifying physiological processes in plants to enhance growth and yield. This article deals with various aspects of biostimulants, including sources, mode of application, and their impact on crop production.

INTRODUCTION

Zhang and Schmidt first used the term biostimulant. Calvo defined in 2014 that all substances and microorganisms that are beneficial to the plant are considered biostimulants. A year later, in 2015, Du Jardin mentioned that the definition of biostimulants is based on what is not a biostimulant rather than what is. Plant biostimulants are those substances or microorganisms applied to plants to enhance nutrition efficiency, facilitate the uptake of nutrients, and improve the availability of confined nutrients in soil or rhizosphere abiotic stress tolerance like salinity, drought and thermal stresses; and quality traits. Du Jardin allocated the biostimulants into eight classes, some of them are; humic substances, complex organic materials, beneficial chemical elements, inorganic salts, seaweed extracts, chitin and chitosan derivatives, anti-transpirant and free amino acids, and considered other N-containing substances with microorganism a potential ninth category. Besides these classes; micronutrients, proteins, amino acids, and enzymes can be used as biostimulants.



Sources of Biostimulants

The most known components considered biostimulants are mineral elements, vitamins, amino acids, poly and oligosaccharides, and natural plant hormones. Some of the common sources are humic and fulvic acids, protein hydrolysates and other N-containing compounds, seaweed extracts, botanicals, chitin and chitosan derivatives, anti-transpirant and other biopolymers, inorganic compounds, beneficial fungi (i.e., mycorrhizal fungi), and beneficial bacteria. The biostimulants derived from extracts of food waste or industrial waste streams, composts and compost extracts, manures, agriculture residues, vermicompost, and sewage treatments fall under

another category. These by-products extracted biostimulants have been found to improve plant productivity, be involved in several plant physiological responses, increase the synthesis of secondary compounds, and enhance the activity of the enzyme phenylalanine amino lyase. Based on the main component and mode of action biostimulants are classified. Even though the classification does not provide the biological activity of the product, on the basis source of raw material biostimulants are classified into 3 categories;

Humic substances (HSs)

HSs are naturally occurring in soil organic matter owing to plant, animal, and microbial breakdown, as well as soil microorganism metabolism. Humic-based therapies have been shown to boost root growth and development in plants. This results in improved nutrient and water absorption, as well as increased resilience to environmental stress. They consist of humin, humic acid, and fulvic acid.

Seaweed extracts

Brown, blue, and red algae are the vast group of macroscopic, multicellular marine algae. Seaweeds and plants are used for biostimulant synthesis due to their hormone-like compounds and active mineral and chemical components, such as complex polysaccharides. Thus extracted biostimulants sprayed as foliar sprays improve plant growth, abiotic stress tolerance, photosynthetic activity, and resistance to fungi, bacteria, and viruses, resulting in higher agricultural output and productivity.

Hydrolysed proteins and amino acids products

Hydrolyzed proteins, which include amino acids, peptides, polypeptides, and denatured proteins, are produced by chemical, enzymatic, or thermal hydrolysis of plant or animal sources. They can enhance plant defense responses and resilience to various abiotic stresses.

Application Methods

Biostimulants can be used in the form of powders, granules, or solutions added to the soil or as liquid foliar application products. Those containing humic substances and nitrogen compounds are applied directly onto the soil, while other forms from the seaweed and plants are used as foliar applications. Some of the biostimulants are ready-to-use extracts or powders to make an aqueous solution. Foliar application of biostimulants protects plants against biotic and abiotic stresses.

Effect on Plants

Biostimulants are supposed to increase yields of ecological crops having a positive effect on yielding. The yield is considered based on fruit obtained from one plant per plot depending on the used biostimulants (dose, method of application, and plants applied). The improved quality of fruits and vegetables depends on the increased yield. Biostimulants influence the mechanical qualities of fruits and vegetables by hardening cell walls and lowering extensibility, depending on the variety. Biostimulants increasing the flexibility of cell walls extend the shelf-life of vegetables and fruits for consumption and storage. Along with this biostimulants can change the color and shape of vegetables and fruits. On the other hand, biostimulants applied externally induced photosynthesis process enhancing the nutrition of plants. It also increases the chlorophyll content in leaves increasing the efficiency of the photosynthesis process. Besides this application of biostimulants affects the chemical properties of vegetables and fruits including acidity, dry mass, or vitamin content. Biostimulants used in plant breeding can change the activity of enzymes and affect their antioxidant properties. It also increases the phenylalanine ammonia-lyase enzyme activity.

CONCLUSION

The application of biostimulants not only enhances plant growth but also mitigates the effect of abiotic stresses, and enhances tolerance properties and performances. They also support the cultivation of vegetables and fruits by introducing cultivation technologies. Continuous use of biostimulants can also limit the introduction of chemical fertilizers to the environment, thus reducing the pollution of soils, water, and air. The main advantage of biostimulant application is the positive impact on crop quality and performance without affecting the surrounding environment. Biostimulants are among the hot topics in agriculture and still require detailed research. The future of plant biostimulants should be driven from the laboratory to the field.

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