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Significance of Amino Acids as Plant Bio-Stimulant

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ABSTRACT

Bio-stimulants, also known as plant conditioners or bio-effectors, are chemicals, microorganism cultures, and material mixes that stimulate agricultural plant growth. These substances, which include biofertilizers and plant growth regulators, can be artificial or natural and are effective at low concentrations. They enhance plant growth, improve resilience to abiotic stress like drought, and reduce fertilizer needs, resulting in higher yields and quality products. Studies show bio-stimulants' efficacy in seedling development, stress-resistant growth, and saline environments. Key ingredients include hormones, humic acids, algal extracts, growth-promoting bacteria, and amino acids. Various researcher has used amino acids as bio-stimulants and found that these bio-stimulants can reduce the need of fertilizers and help in environment conservation. Present article discusses about the significance of amino acids as plant bio-stimulant.

INTRODUCTION

Bio-stimulants, also known as plant conditioners or bio-effectors, are chemicals, microorganism cultures, and material mixes that are used to stimulate agricultural plant growth. They can comprise biofertilizers and plant growth regulators that are artificial or natural [1, 2]. With the help of bio-stimulants, plants grow faster, become more resilient to abiotic conditions like drought, and require less fertilizer. These compounds work very well at low concentrations, supporting the optimal operation of the plant's essential functions and enabling high yields and high-quality products. Numerous studies have been done to find the effectiveness of bio-

stimulants in promoting seedling development, stress-sustained plant growth, and saline environment development, among other aspects of plant development. Bio-stimulant compositions have been made from a variety of basic ingredients, including hormones, humic acids, algal extracts, and bacteria that encourage plant development. Amino acids are one of the raw materials which can be used for the production of bio-stimulant [3].

TYPES OF BIO-STIMULANTS

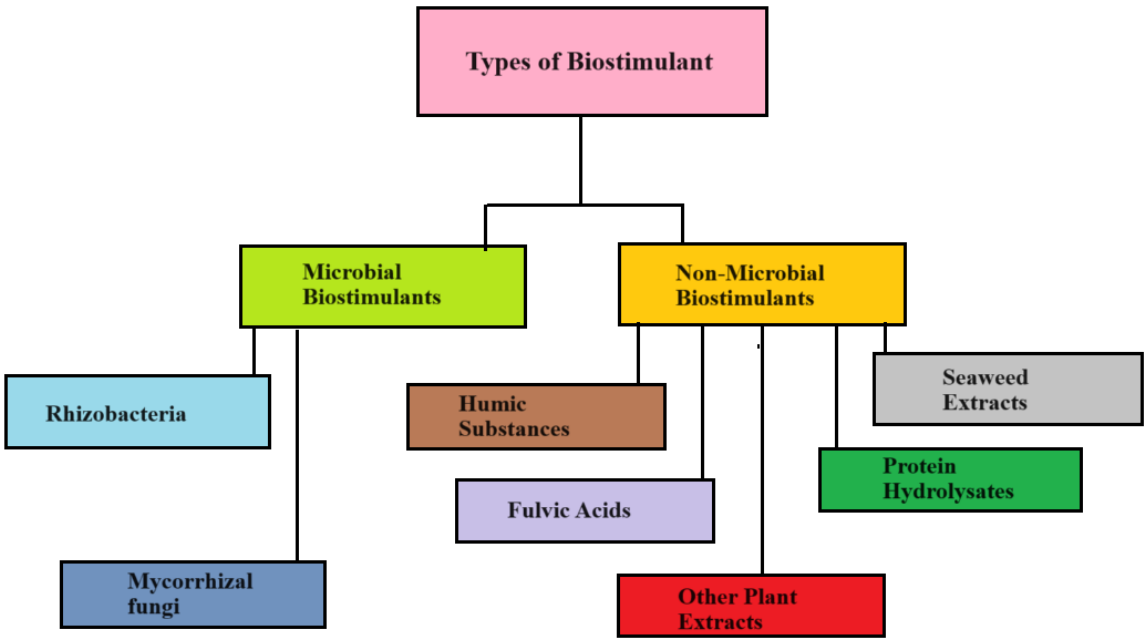

Figure 1. Showing Different Types of Bio-Stimulant

Rhizobacteria bio-stimulant boosts root growth and nutrient adsorption, and mycorrhizal fungi form symbiotic relationships with roots, increases water and nutrient uptake, while humic substances which are produced from decomposed organic matter; improves soil structure and nutrient availability and fulvic acids which are similar to humic acids but have lower molar mass, they enhance nutrient uptake and stress resistance. Seaweed extracts which contain hormones and minerals, activate growth and increase resistance to stress. Protein Hydrolysates are produced from animal or plant proteins; contain amino acids and peptides that boosts growth and stress tolerance, and other plant extracts have various bioactive compounds that increases growth and health.

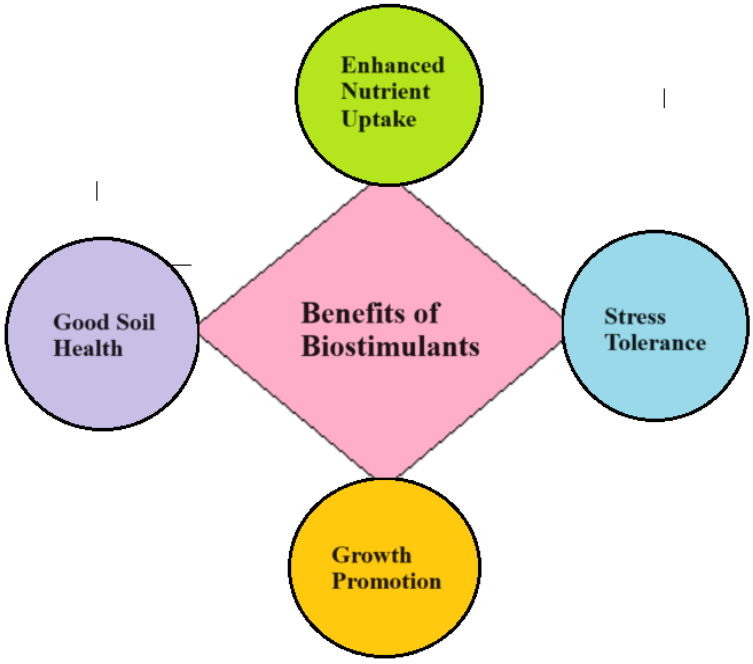

Figure 2. Picture Showing the Benefits of using Bio-Stimulants

Table showing different mechanisms of action of plant bio-stimulants with their functions.

S. No.	Steps	Function
1.	**Hormonal Regulation**	Encourage the synthesis of gibberellins, cytokinins, and auxins, which are plant hormones. Adjust hormone levels to promote development and growth.
2.	**Metabolic Enhancement**	Turn on the enzyme systems that are responsible for stress reactions and nutrient absorption. Boost energy efficiency and photosynthesis.
3.	**Microbial Interactions**	Bolster the rhizosphere's beneficial microorganism populations Improve plant-microbe symbiosis and suppress harmful microorganisms.

AMINO ACIDS AS PLANT BIO-STIMULANTS

Amino acids (AA) are the organic compounds which contain amino group and acidic group in the same molecule [4-9]. AA combine with other AA to produce peptides/proteins [10-12]. Since the proteins that AAs create are involved in almost every aspect of cell function, they are important for life. Certain proteins serve as structural supporters, while others work as enzymes or antibodies. Even though there are 100 of AA in nature, only a set of 20 AA are used to make proteins.

Table Showing Types of Amino Acids

Name	Abbreviation
Nonpolar Amino Acids	
Alanine	Ala
Glycine	Gly
Isoleucine	Ile
Leucine	Leu
Methionine	M et
Tryptophan	Trp
Phenylalanine	Phe
Proline	Pro
Valine	Val
Polar Amino Acids	
Cysteine	Cys
Serine	Ser
Threonine	Thr
Tyrosine	Tyr
Asparagine	Asn
Glutamine	Gln
Polar Basic Amino Acids (Positively Charged)	
Histidine	His
Lysine	Lys
Arginine	Arg
Polar Acidic Amino Acids (Negatively Charged)	
Aspartate	Asp
Glutamate	Glu

Plants can synthesise AA by obtaining "C" and "O_2" from the air, "H_2" from H_2O, and N_2 from the soil. By combining these key elements, plants produce amino acids via complex biochemical pathways such as photosynthesis [13]. In plants, enzymes catalyzes the synthesis of AA. The first step in AA synthesis is the formation of intermediates called keto acids. These intermediates are then converted into amino acids by a process called transamination. Amino acids play a vital role in plant function and health [14]. They are involved in the biosynthesis of proteins, enzymes,

hormones, and other essential molecules required for proper plant growth and development. Additionally, AA are essential for the uptake and utilization of minerals and other nutrients, and some are involved in photosynthesis while others help to transport nutrients around the plant. Amino acids also play a role in regulating gene expression and cell signaling. A variety of research groups have talked about the function of amino acids as bio-stimulants for plants. Slawomir Kocira [15] has talked about how applying a bio-stimulant can alter yield. He conducted fieldwork during the 2014–2016 crop season. During the growing season, he sprayed Terra Sorb Complex bio-stimulant once or twice at dosages of 0.3% and 0.5%. The "Terra Sorb Complex" is distinguished by a high (20%) concentration of free AA produced by enzymatic hydrolysis, which permits the preservation of their efficacy and completeness. The AA in Terra Sorb Complex include: aliphatic AA (Gly, Ala, Val, Leu, Ile, Pro), hydroxy-AA (Ser, Thr), S-containing AA (Cys, Met), aromatic AA (Phe, Trp, Tyr), acidic AA (Asp, Glu), and basic AA (His, Lys, Arg). According to research by Magdalena Drobek et al. [16], the commercial use of bio-stimulants would reduce the quantity of mineral fertilizers released into the environment, lowering air, water, and soil pollution. When it comes to global warming, this is particularly crucial. An average of 21% [73] of the global greenhouse effect can be attributed to agriculture worldwide, of which 13% [74] are related to the usage of artificial fertilizers. They have discovered that while the recently created biopreparation technologies might make a major contribution to environmental preservation, their main connection is to sustainable agricultural and horticultural production, which aims to produce food that is affordable, accessible, and of good quality. Numerous variables influence the impact of bio-stimulants, including the raw material and the process that gave rise to them, plant species, application technique, and climate. It is especially important to highlight the beneficial effects of plant hydrolysates and microbial consortiums on crop productivity and growth.

CONCLUSION

Bio-stimulants which come from a variety of organic and microbial sources, are essential for improving plant functioning. Bio-stimulants by reducing reliance on chemical fertilizers, helps to mitigate greenhouse gas emissions and environmental degradation. The potential of bio-stimulants to boost several aspects of plant development is highlighted by their wide composition, which includes humic compounds, amino acids, seaweed extracts, and helpful microbes. Studies showing the concrete advantages of bio-stimulants in raising crop yields and encouraging ecologically friendly agricultural practices include those conducted by Slawomir Kocira and Magdalena Drobek. As the agricultural sector continues to evolve, the integration of bio-stimulants can play a pivotal role in achieving high-quality, sustainable food production.

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