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Biostimulants: Source for Sustainable Agriculture

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Abstract
The need for more agricultural production with fewer resources grows along with globalisation and population growth. Plant biostimulants are becoming a more attractive sustainable choice because of their natural origin and capacity to replace conventional agricultural methods. A biostimulant usually comes in the form of substances and/or microorganisms mixtures, helps a plant develop, become more resilient to biotic and abiotic challenges, and is often in the form of chemicals or mixes of microorganisms.

Keywords: sustainable agriculture, biostimulants

Introduction
Over the past 50 years, modern agricultural techniques have significantly increased crop yields. This is mostly due to the use of fertilisers, chemical pest control, irrigation, and the creation of hybrids. The widespread use of synthetic chemical pesticides and fertilisers in modern farming practises has led to a number of environmental issues, such as degraded soil quality and contaminated ground water. Current agriculture is also increasingly threatened by environmental issues including drought, high temperatures, and CO_2 brought on by global climate change. In order to fulfil the demands of our expanding population—which is expected to reach around 9 billion people by 2050—there is a rising need for global crop production. Global agriculture is shifting towards a more sustainable and environmentally friendly model as a result of growing demand and knowledge of the detrimental effects that existing agricultural practises have on the environment and human health (Ramakrishna et al. 2019). A number of technical advances have been put forth to improve agricultural production systems' sustainability by reducing the use of synthetic agrochemicals such as fertilisers and pesticides. Use of biostimulants would be a promising and eco-friendly breakthrough. "A biostimulant is a formulated product of biological origin that improves plant productivity as a consequence of the novel, or emergent properties of the complex of constituents, and not as a sole consequence of the presence of known essential plant nutrients, plant growth regulators, or plant protective compounds" (Yakhin et al. 2017).

Categories of biostimulants
Numerous categories of biostimulants are mentioned below:

Humic substances: Given their diverse and well-established biological actions, fulvic (FA) and humic (HA) acids have been identified as biostimulants. Humic substances are mainly resistant to microbial breakdown. They are extremely varied in their molecular combination and are composed of organic chemicals derived by the decay of deceased biota in soils. Proteins, polysaccharide residues, aromatic and aliphatic compounds, and amino acids make up humic acid. The carboxyl and hydroxyl functional groups of aromatic rings appear to be

significant in the nutritional status of plants as they form complexes with the essential nutrients' cations. Further advantages of humic acid have been demonstrated, including enhanced nutrient mobilisation, enhanced rate of photosynthetic, improved respiration, water balance, and increased concentration of photosynthetic pigments.

Fulvic acid is mostly composed of carboxylic groups (COOH), with modest levels of aromatic structures and substantial amounts of phenolic compounds. FA have a low molecular weight, thereby they can pass through membrane pores and form complexes with cations, that may facilitate nutrient transport into the cells by upregulating genes linked to lipid biosynthesis, K transporters, starch degradation, and metabolism of plant (Jindo et al. 2020; Baltazar et al. 2021).

Microorganisms: Microorganisms known as Plant Growth Promoting Bacteria (PGPB) interact with plants either directly or indirectly. This category includes both free-living soil bacteria and rhizobacteria that colonise the rhizosphere. These bacteria are thought to perform a number of tasks, including synthesising plant growth regulators and solubilizing inorganic nutrients into simpler forms that may be absorbed by roots. PGPB restrict the growth of pathogens while increasing crop yield and nutritional content. These have a number of positive effects on agriculture. As a green technology, PGPB is touted for lowering the need for chemical fertilisers in addition to improving soil health (Ramakrishna et al. 2019). Rhizobium species are known for their symbiotic associations with legumes, but they are also important because of their capacity to produce plant growth hormones, solubilize nutrients, reduce atmospheric nitrogen, and produce secondary metabolites.

Among the fungus, amongst the most auspicious species is found in the genus *Trichoderma*. Due to its capacity to enhance plant development, yield, and tolerance to abiotic stressors, a number of strains of *Trichoderma* spp. have garnered increased attention as biostimulants (Baltazar et al., 2021).

Algae: It has long been known that macroalgae (seaweeds) and microalgae are abundant sources of plant biostimulants. Macroalgae extracts contain a variety of biostimulatory substances including mineral elements, fatty acids, amino acids, vitamins, polysaccharides, phenolics, and traces of phytohormones that are efficacious in promoting growth and development of plant, nitrogen assimilation, photosynthetic activity, and resistance to abiotic stress. Microalgae offer an environmental friendly substitute for safeguarding, promoting crops, along with the added advantage of strengthening quality of soil through the regeneration of microbial interactions. When applied to the soil, harvested microalgal biomass is known to act as a slow-releasing biofertilizer and soil conditioner. In contrast, the application of cyanobacteria has been shown to have the potential to function as a biocontrol agent against plant diseases by activating enzymes related to plant defence and producing antimicrobial substances and hydrolytic enzymes (Kapoore et al. 2021).

Biochar: When applied to agricultural fields, biochar serves as a stable supply of carbon and is very resistant to deterioration. It has the ability to chelate with ions in the soil because of its porous and vast surface area. The application of biochar in agriculture has been linked to several advantages, such as enhanced plant yield, improved soil water retention, and nutrient retention (Sible et al. 2021).

Protein Hydrosylates: Proteins from different matrices, such as plant or animal sources, can be hydrolyzed chemically, thermally, or enzymatically to yield hydrolyzed proteins, which are a mixture of polypeptides, amino acids and oligopeptides. Glycine and proline and are the most frequent constituents in protein hydrolysate based on collagen, while glutamic acid is more common in biostimulants derived from plant sources. Protein hydrosylates have an effect on plant nutrition by chelating and creating complexes with soil micronutrients including Zn, Fe, Cu, and Mn. This helps the roots absorb and make nutrients available to the plant. Hydrolysates have chelating capabilities together with antioxidant and free radical

scavenging capabilities. Since peptides and amino acids may be used by microbes as sources of C and N, protein hydrosylates improves soil respiration as well as microbial biomass and activity (Nephali et al. 2020; Ma et al. 2022).

Plant extract: It is possible to acquire some biostimulants by extracting leaves, fruits, stems, flowers, and other plant components.These extracts include a wealth of bioactive substances that can stimulate certain physiological functions in plants, enhancing their overall performance (Ma et al. 2022).

Silicon: By complexing or co-precipitating harmful metalloids and metals in plant tissues as well as in soil, silicon reduces the toxicities of metals and metalloids while also promoting the activities of antioxidant system in plants (Nephali et al. 2020).

Biopolymers: Plants can become more resilient to infections and abiotic stressors by using chitin and chitosan to stimulate defence and stress response pathways. Moreover, chitin is a type of plant nutrient that is vital to plant growth because it may increase soil fertility and promote plant uptake of mineral nutrients (Xu and Mou 2018). The majority of chitosan's advantageous properties are linked to enhanced photosynthetic activity, resistance to abiotic stresses including salt, drought, and high temperatures, elevated activities of antioxidant enzyme and defence related genes expression (Shahrajabjan et al. 2021).

Conclusion

Plant biostimulants are being used in agriculture in place of more traditional techniques, and increasing amounts of study are illuminating their potential efficacy. Biostimulants can enhance development and growth of plant, along with the quality and nutritive value their output. They can also boost nutrient absorption, yield, and water content in plants.

References

1. Baltazar, M., Correia, S., Guinan, K.J., Sujeeth, N., Bragança, R. and Gonçalves, B. (2021). Recent advances in the molecular effects of biostimulants in plants: An overview. *Biomolecules*, **11**(8): 1096.
2. Jindo, K., Olivares, F.L., Malcher, D.J.D.P., Sánchez-Monedero, M.A., Kempenaar, C. and Canellas, L.P. (2020). From lab to field: role of humic substances under open-field and greenhouse conditions as biostimulant and biocontrol agent. *Frontiers in plant science*, **11**: 426.
3. Kapoore, R.V., Wood, E.E. and Llewellyn, C.A. (2021). Algae biostimulants: A critical look at microalgal biostimulants for sustainable agricultural practices. *Biotechnology Advances*, **49**: 107754.
4. Ma, Y., Freitas, H. and Dias, M.C. (2022). Strategies and prospects for biostimulants to alleviate abiotic stress in plants. *Frontiers in Plant Science*, **13**: 1024243.
5. Nephali, L., Piater, L.A., Dubery, I.A., Patterson, V., Huyser, J., Burgess, K. and Tugizimana, F. (2020). Biostimulants for plant growth and mitigation of abiotic stresses: A metabolomics perspective. *Metabolites*, **10**(12): 505.
6. Ramakrishna, W., Yadav, R. and Li, K. (2019). Plant growth promoting bacteria in agriculture: Two sides of a coin. *Applied Soil Ecology*, **138**: 10-18.
7. Shahrajabian, M.H., Chaski, C., Polyzos, N., Tzortzakis, N. and Petropoulos, S.A. (2021). Sustainable agriculture systems in vegetable production using chitin and chitosan as plant biostimulants. *Biomolecules*, **11**(6): 819.
8. Sible, C.N., Seebauer, J.R., and Below, F.E. (2021). Plant biostimulants: A categorical review, their implications for row crop production, and relation to soil health indicators. *Agronomy*, **11**(7): 1297.
9. Xu, C. and Mou, B. (2018). Chitosan as soil amendment affects lettuce growth, photochemical efficiency, and gas exchange. HortTechnology, **28**(4), 476–480.
10. Yakhin, O.I., Lubyanov, A.A., Yakhin, I.A. and Brown, P.H. (2017). Biostimulants in plant science: a global perspective. *Frontiers in plant science*, **7**: 2049.