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Role of Bio Stimulant in Vegetable Crop Production

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INTRODUCTION

What is bio stimulant?

Bio stimulants include microbial inoculants, fulvic acid, humic acid, sea weed extracts, trace minerals, protein hydrolysates, amino acids, and other substances and/or microorganisms whose function, when applied to plants or the rhizosphere, is to stimulate natural processes to improve/benefit nutrient uptake, nutrient efficiency, abiotic stress tolerance, and crop quality, according to the European Bio Stimulant Industry Council (EBIC).

Why we need bio stimulant?

The sustainability of food and nutritional drift are seriously threatened by the depletion of natural resources and environmental imbalance brought on by modern agriculture methods. The need for food has been steadily increasing as a result of the world population's continuous growth (1.13% annually). These days, a big issue is the damaging effects of ecological concerns brought on by the careless use of chemical pesticides and fertilizers as well as the sustainable management of soil fertility. Unwanted alterations in the biological and chemical characteristics of soil have called into question not only the viability of food production but also the rising rate of hunger. In addition, the shifting climate has resulted in significant unanticipated expenses for farming methods. Growing food now is far more expensive than it was a few decades ago, both ecologically and financially. Cost-effective and ecologically friendly agriculture methods are crucial to addressing such circumstances. Given their low cost and environmentally friendly nature, bio-stimulants present a feasible solution in this situation.



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Importance of vegetable

A rich and comparatively inexpensive source of vitamins are vegetables. Vegetable eating boosts appetite, improves palatability and taste, offers fiber for digestion, and aids in the prevention of constipation. It is essential for neutralizing the acids created during the digestion of meals high in fat and protein. It also offers important roughages that facilitate the passage of food through the gut. Some of the vegetables are excellent providers of minerals (leafy vegetables, drumstick pods), carbohydrates (potato, sweet potato, etc.), proteins (peas, leafy vegetables, beans, etc.), vitamins A, B, and C (carrot, tomato, leafy vegetables), and vitamin C (green chillies, leafy vegetables, cole crops, and leaves of radish). A dietitian recommends consuming 75-125 g of green leafy vegetables, 85 g of other vegetables, and 85 g of roots and tubers together with other foods per day.

Status of vegetable production in India

India accounts for 15% of the global vegetable biomass and is the world's second-largest producer of vegetables, after China. It covers 6.2 million hectares and yields about 90 million tonnes of vegetables annually, or around 3 percent of all the land in the nation that is farmed. In India, more than forty varieties of vegetables from various families are cultivated. Despite this, there are still some problems in the industry that prevent India's vegetable sector from growing sustainably.

These issues are:

- Use of quality inputs
- Ecological issues
- Quality control
- Post-harvest management

Benefits of bio stimulants in vegetable production



Bio-stimulant and its role in vegetable production

Bio-stimulants, as opposed to chemical fertilizers, are mixes of one or more items such as microorganisms, trace elements, enzymes, plant hormones, and seaweed extracts designed to address severe nutritional deficiencies. Numerous metabolic activities, including photosynthesis, respiration, ion absorption, and nucleic acid synthesis, have been demonstrated to be impacted by it. Bio stimulants improve metabolism. raise antioxidant levels. improve nutritional

availability, increase water-holding capacity, and boost chlorophyll synthesis. In addition to its numerous benefits, the safe application of bio stimulants in agricultural techniques is suggested as a means of improving the nutritional value of food crops. Agricultural bio-stimulants are various formulations of chemicals, compounds, and microorganisms that are applied to plants or soils to boost crop vigour, quality, yield, and resistance to abiotic challenges. Through a variety of proven methods, it encourages plant growth and development from germination to maturity



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throughout the crop life cycle. Using biostimulants can result in improved germination and root growth, increased vigour and stress tolerance, and more effective energy and nutrient intake and transfer. Enhancing plant tolerance to abiotic stresses and their recovery, facilitating nutrient assimilation, translocation, and use, improving fruit seeding, sugar content, and colour, and enhancing soil fertility primarily through the growth of complementary soil microorganisms are all made possible by increasing the efficiency of the plant's metabolism. It is known that the bio-stimulants are environmentally benign substances that benefit plants. Specifically, they reduce the need for artificial fertilizers by

increasing the quantity of macro and micronutrients absorbed by plants, which has a favorable effect on root structure and plant development. with They interact the biochemical pathways demonstrate to hormone-like action and affect plant metabolism. То improve plant quality physiological processes characteristics, including glycolysis and nitrogen assimilation stimulants are manipulated. Bio have physiological and biochemical impacts on vegetables, but the underlying processes are frequently unclear. The reason for this is the variety of raw ingredients that go into producing vegetables.



Three characteristics set bio stimulants apart from conventional agricultural inputs:

(1) Operate through different mechanisms than fertilizers, no matter the presence of nutrients in the products.

(2) Act only on the plant's vigour and do not have any direct actions against pests or disease.

(3) Play a complementary role in cropping nutrition and crop protection (EBIC 2013).

Advantages of bio stimulant:

- Yield enhancement
- Quality enhancement
- Greater vigor
- Stress resistance
- Germination and development

- Nutrient assimilation and translocation
- Water use efficiency
- Metabolic process optimization
- Improves soil quality
- Eco-friendly
- Reduces dependence on chemical inputs
- Safe, healthy and nutritious food for consumer

Categories of plant bio stimulant:

The term "bio-stimulant" refers to a wide range of products and technologies with varying mechanisms of action that are derived from naturally occurring microorganisms, plant extracts, or other organic matter. The active ingredients found in bio-stimulant fall



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into three categories: fulvic aid and humic acid, microbes and seaweed extracts, and chitin and plant extract.

1) Humus and Humic Acids

Humic compounds are naturally occurring components of the organic matter in the soil that come from the breakdown of plant, animal, and microbial wastes caused by the soil microorganisms' use of these substrates for metabolic activity. Similar to soft brown coal, it is an organic substance, but the degree of oxidation makes it different. It has been demonstrated that fulvic acid and humic acid both positively affect plant development by improving soil water-holding capacity, surface water penetration, and infiltration for enhanced plant growth. Additionally, they improve the availability of potassium, phosphorus, and a few other crucial micronutrients. The effects of humic acids on plant morphology and physiology are significant. Nutrient ions are held in place by the humic acids, preventing leaching. Additionally, they serve as a barrier between plants and excessive fertilizer salt concentrations. Aside from this, humic acids have been demonstrated to increase the rates of germination and stimulate the formation of fibrous roots. Compared to applying nitrogen alone, using humic acid and nitrogen together has improved root development. By affecting metabolism, they also increase the amount of chlorophyll in plant leaves and boost stand uniformity.

2) Fulvic Acids

Fulvic acids are a type of humic material that is known for their potent organic electrolytes that aid in the dissolution of soil minerals and metals. Fulvic acids convert minerals into forms that are easily absorbed by plants. They improve vitamin, coenzyme, auxin, nutrition, and metabolism in plants more so than in the soil, all of which have a major positive impact on plant health. Furthermore, by increasing the quantity of carbohydrates that accumulate as soluble sugars in the cell, fulvic acids indirectly aid plants in resisting wilting. They raise the osmotic pressure on the cell membranes in response to drought stress. Finally, by making the cell membrane more permeable, fulvic acids contribute to improved nutrient absorption.

3) Cytokinins

Cell division in plants is facilitated by cytokinins. Reports have indicated that they enhance photosynthesis, encourage cell development, and increase the surface area of leaves, which leads to a higher generation of chlorophyll. Young seedlings have been treated with a low concentration of cytokinins to encourage the growth of lateral roots. Plant metabolism is elevated by their capacity to facilitate the transport of nutrients within plants.

4) Protein Hydrolysates and Other N-Containing Compounds

As byproducts of the agro-industry, protein hydrolases are essentially amino acid and peptide combinations obtained by enzymatic and chemical protein hydrolysis. These sources can be plant (crop wastes) or animal (e.g., epithelial tissues, collagen). Other nitrogenous compounds included in bio stimulants include betaines, polyamines, and "non-protein amino acids." It has been hydrolysates demonstrated that protein increased soil respiration, contribute to microbial biomass and activity, and overall soil fertility. Crops used for horticulture and agriculture have shown notable increases in production and quality attributes. There are some commercial products like Vacciplant, Elexa, Milsana, Chito Plant, and others that are made from protein hydrolysates of both plant and animal sources.

5) Beneficial Bacteria

In terms of taxonomic, functional, and ecological variety, there are two types of bio stimulants that are relevant to agriculture: first, mutualistic endosymbionts such as Rhizobium, and second, mutualistic rhizospheric-like "plant growth-promoting rhizobacteria" (PGPR). As biofertilizers, Rhizobium and allied species are sold commercially. The



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multipurpose PGPRs affect every facet of plant life, including morphogenesis and development, growth and nutrition. interactions with other species in agroecosystems, and reaction to biotic and abiotic stress. Plant growth-promoting rhizobacteria, or PGPR, are being used more often in vegetable crops and are thought to be extremely effective and sustainable for both optimal and poor agricultural output. These days, PGPR inoculants are thought to be a form of plant "probiotics," or effective boosters of immunity and nourishment for plants. One type of microbe that functions as a bio-stimulant in a variety of soil and plant interactions is called plant growth-promoting rhizobacteria (PGPR).

CONCLUSIONS

The use of bio-stimulants in vegetables is improving natural crucial to resource productivity and promoting sustainable food production, food and nutritional security while significantly reducing the use of synthetic fertilizers, agrochemicals, and environmental pollution. Through a variety of proven methods, it encourages plant growth and development from germination to maturity throughout the crop life cycle. A greater importer of plant bio stimulants is India. Research and extension are needed to improve the uptake of bio stimulants. Particularly, the need for understanding and awareness regarding the compatibility of commercial products with the conditions of Indian farmers and bio stimulant technology.