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Microbial Inoculants for Enhancing Human Health and Crop Quality

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INTRODUCTION

The nutritional content of agricultural goods as well as the health of farm workers and consumers are negatively impacted by current agricultural techniques, which rely extensively on synthetic chemicals (such as fertilisers, pesticides, insecticides, etc.). The excessive and careless use of these pesticides has led to food poisoning, weed and disease resistance, and unfavourable environmental effects, all of which have a considerable negative influence on human health. The use of these chemical inputs encourages the build-up of hazardous substances in soils. Most crops take up chemical substances from the soil. Numerous synthetic fertilisers contain acid radicals, such as HCl and sulfuric radicals, which make the soil more acidic and have a negative impact on the health of the soil and plants. Some plants can also absorb highly resistant substances. Such crops can cause systemic illnesses in humans if consumed continuously. Many pesticides and herbicides already have potential to cause cancer. The search for new and improved technology to improve both the quality and amount of crops without endangering human health has been sparked by the growing knowledge of the health problems associated with the eating of low-quality crops.

Microbial inoculants, which can function as biofertilizers, bioherbicides, biopesticides, and biocontrol agents, are a dependable substitute for the usage of chemical inputs. Microorganisms are capable of promoting plant development, controlling pests and diseases, and eliminating weeds. Beneficial microorganisms are given to the soil or the crop as microbial inoculants to increase crop health and productivity. Microbial inoculants are commonly employed to manage pests, enhance the quality of the soil and crop, and ultimately improve human health. Microbial inoculants are made up of a variety of microorganisms that collaborate with soil organisms to enhance soil fertility and health, which in turn benefits human health.

The use of microbial inoculants can reduce the detrimental effects of chemical input and, as a result, improve the quantity and quality of agricultural output. Plant nutrients are delivered to plants through a more sustainable way via microbial inoculants, which are also favourable to the environment. Chemical fertiliser application can be decreased with the aid of microbial inoculants. Microbial inoculants may consist of fungi, bacteria, and algae.

Chemical fertilisers and insecticides can potentially be replaced with microbial inoculants because they are environmentally beneficial. They are made up of active microorganism strains that either directly or indirectly promote microbial activity, improving the mobility of nutrients from the soil. They could be microbial biocontrol agents, biofertilizers, or phytostimulants. They act as defences against a variety of diseases and are efficient bio-herbicides.

Agricultural chemical inputs are currently posing serious public health issues as a result of an increase in the number of people engaged in farming, living nearby agricultural areas, and purchasing tainted farm goods. Agro-chemical runoff is a significant cause of surface-water contamination. Chemical fertiliser overuse and misuse lead to soil washing and water contamination in streams, lakes, and the ocean. Agricultural chemical inputs enter human body systems primarily through three routes: (1) oral consumption, (2) skin infiltration, and (3) breathing. In the human body as well as in food such as vegetables, meat, and fruits, pesticides have demonstrated long-term resistance. Prolonged exposure to agrochemicals can have detrimental effects on a lot of people, even at modest doses. The illnesses include heart and dermatological conditions as well as musculoskeletal and respiratory issues. Farm owners, operators, family members, and staff all experience these ailments.

Consistent soil fertility maintenance is crucial because agricultural productivity must rise to fulfil the rising global population's demand for food. A possible alternative method to improve food production without endangering human and environmental health is biofertilizers, which are composed of living bacteria. All creatures that provide or enable plants to access a variety of nutrients are considered biofertilizers. Examples include nitrogen fixers, phosphorus, potassium, sulphur, and mycorrhiza solubilizers, among others.

Fresh vegetable nutrition is enhanced by biofertilizers by raising antioxidant activity, total phenolic compounds, and chlorophyll levels. The total phenolic content of spinach inoculated with various biofertilizers was reported to be 58.72 and 51.43% greater than the uninoculated control. These secondary metabolites have anti-cancer, anti-neurodegenerative, and anti-cardiovascular properties.

Azolobacter chroococcum and *Glomus fasciculatum* were used to inoculate lettuce, which also resulted in an increase in the amount of phenolic compounds, anthocyanins, and carotenoids in the vegetable overall. In lettuce co-inoculated with *G. fasciculatum* and *Glomus mosseae*, higher flavonoid content (antioxidant) levels were found (48.02 and 40.46%). Arbuscular Mycorrhizal Fungi (AMF) have been shown to produce antioxidants. Inoculated soybean seedlings with rhizobacteria showed a 75% increase in phenolic acid production. After inoculating *Begonia malabarica* and *Calamus thwaitesii* with *G. mosseae*, *Bacillus coagulans*, and *Trichoderma viride* production of secondary metabolites like phenols, tannins, ortho-dihydroxy, flavonoids, phenols, and alkaloids. Other researchers have identified ferulic acid, flavonols (quercetin, kaempferol), caffeic acid, flavones (luteolin), coumaric acid, isorhamnetin-3-gentiobioside-7-glucoside, and chlorogenic acid as health-promoting chemicals produced by biofertilizers.

A feasible alternative to the harmful health impacts brought on by consuming food products grown with the use of agrochemicals such pesticides, inorganic fertilisers,

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herbicides, etc. is the production of food using microbial inoculants. The use of microbial inoculants in sustainable agriculture will be greatly influenced by our understanding of the mechanisms by which they work. Chemicals can be kept out of agriculture and, thus, out of people's food. Microbial inoculants can be used as biocontrol agents and bio-herbicides to control pests and weeds. One of the best ways to increase farm output and food quality sustainably is to use natural resources, especially beneficial microbes. Future generations will have access to a healthy food supply thanks to microbial inoculant technology.