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Short Communication

Recent Advancements for Microorganisms Useful in Agriculture

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Microorganisms is believed to be the causative agent of various problems in human health but with the development of microbiological techniques these problems could be prevented to some extent by researchers who have successfully developed pathways for the use of the microorganisms in ways beneficial for the society. Microorganisms and their microbial based products play an important role in enhancing plant growth and crop yield by several mechanisms such as antibiosis and plant-microbe interaction thereby increasing the demand in market and using microorganism as a biological control in agriculture. The increases in world population demands sustainable agricultural production but however over exploitation of crops lead to the use of chemical fertilizers and pesticides resulting to a human health hazard. Microorganisms can be classified into two categories- some are beneficial microorganism that can improve agricultural production and some are negative microorganisms since they induce severe health problems. Crops are mainly affected by plant pathogens and pests causing diseases which can be avoided by following two approaches- integrated pest management through biological control agents that can protect crops and on the other hand plant growth promoting rhizobacteria which enhances growth of plants. Metabolic activities in microorganisms induce the secretion of certain chemical compounds which have beneficial effects such as they act as antibiotics or antifungal. Bio-pesticides and bio-fertilizers are formulations that control pests and replace chemical fertilizers to increase crop production. PGPR comprises a group of bacteria that colonize plant roots and produce secondary metabolites or plant hormones thus enhancing plant growth as well as controls diseases and induce systemic resistance. Some of the PGPR that have been studied are *Rhizobia*, *Mycorrhizae*, *Azospirillum*, *Bacillus*, *Pseudomonas*, *Trichoderma* and *Strptomyces*.

The most notable entomopathogenic bacterium that is used as natural bio pesticide is the *Bacillus thuringiensis* that control insect and plant pathogen widely used in the bio pesticide market and has a high capacity to produce products very much useful in the food, pharmaceutical, environmental and agriculture industries. *Bacillus sp.* maybe sometimes called as microbial factories as their metabolic activities gives rise to variety of biologically active compounds that possess commercial importance and promotes plant growth. Phytopathogens in plants that cause great economic losses in agricultural crops are eliminated by lipopeptides and other compounds functioning as antifungals are originally the antimicrobials generated by *Bacillus sp*. as a result of secondary metabolism. The mode of action of *Bacillus sp.* is by direct and indirect mechanisms where direct mechanism refers to the ability of the organism to supply nutrients from nitrogen, phosphorus, potassium or modulating plant hormones levels whereas the indirect method refers to the secretion of antagonistic substances to inhibit plant pathogen. Some of the biofungicides that are employed to control fungal diseases in plants are *B. amyloliquefaciens*, *B. licheniformis*, *B. pumilus* and *B. subtilis*. Some important examples that need mentioning are *Bacillus subtilis* B246 that is commercially registered as Avogreen is used as biocontrol agent against avocado pre and postharvest anthracnose disease and the other one is Ballad Plus and Sonata obtained from *Bacillus pumilus* produce antifungal amino acid sugar that facilitate the disruption of cell metabolism and destroys the cell wall of plant pathogen that inhibits crop growth. Bacteria, fungi and actinobacteria act as biocontrol agent against root diseases in agricultural and horticultural crops though sometimes soil can suppress the severity of the disease but a number of examples provide environmental benefits in controlling diseases in plants. Recently gain interest that needs mentioning is the concept of plant health management using probiotic organism where a particular microbial group capable of producing antibiotics to defend the disease caused by pathogen is supported by plants. Pseudomonas being a soil bacteria show remarkable responses to physical, chemical and nutritional conditions in soil and a wide variety of processes such as nitrogen

fixation, disease control, plant growth promotion and inhibition and bioremediation. Antibiosis is a mechanism which is responsible for their action against plant pathogen and a number of antimicrobial compounds such as 2,4-diacetylphloroglucinol (2,4-DAPG), phenazines (PHZ), pyrrolnitrin (PRN), pyoluteorin (PLT), hydrogen cyanide (HCN) and biosurfactant antibiotics. Moleculer techniques accompanied with biochemistry based characterization of chemicals lead to mechanisms such as genotypic and phenotypic diversity and interaction with pathogens determine activity in soil environment. Specialized cultivation methods has been implemented using pyrosequencing which targets the surface protein of plant pathogen and compliment the isolation efforts. Enhancement of activities of plant microbes that can benefit plants in many ways such as nutritional gains, ability to cope abiotic stress, prevent infection and diseases and overall improve global food production das maintaining stability is essential. Beneficial microorganisms portray a diverse nature and benefit plants and improve their survival. Bioengineering of synthetic microbial communities for plant growth promotion, disease control and stress tolerance presents a unique opportunity to represent a significant challenge. The emerging field of rhizosphere provide an opportunity to link between plant ecosystem and atmospheric processes thus increasing productivity in diverse and stressful environment. Microbial products to enhance crop yields and health are readily available commercially, and their quality also as efficacy has improved considerably over the past decades which are determined by their field performance of those products that continues to increase as most of the agricultural companies commit substantial research revenues to discovery and development of latest products. Soil type, microbiome, environmental conditions, pest presence and cropping system are all factors that would determine the benefits that a microbe may provide along with the crop being planted is another key consideration, as many plants colonized by specific bacteria are unable to take care of high populations when other crops are planted. Recent studies reveal that the complex, interconnected microbial communities associated with plants harbor discrete keystone species, termed “microbial hubs” that play a critical role in mediating communications between the plant and its microbiome. In-depth studies into the consequences of consortia and bacterial community structure on crop development will still expand our knowledge of the required effects the microbial community has on plants. The Agriculture Department of Government of India has implemented certain ecological approach such as pest management programs and provide long term management of pests instead of temporarily eradicating them. The main aim of the IPM is to balance costs, benefits and uplift agricultural qualities by improving farm implements and machineries. Global agriculture needs to double food production by 2050 in order to feed the world’s fastest growing population and at the same time reduce the use of organic fertilizer and pesticides so that beneficial interaction between plants and microorganism takes place and lead to mechanisms such as nitrogen fixation, absorption of major nutrients, promotion of plant health and suppression of diseases.

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