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Role of Soil Microbes in Disease Control and as a Probiotics

Jyoti Dalal[1], Pushaplata[1], Ankur[1,] Amit Kumar[1] and Parvatisharma*
Department of Zoology, Chaudhary BansiLal University, Bhiwani, Haryana, India
[1] Research Scholar, Department of Zoology, Chaudhary BansiLal University, Bhiwani, Haryana.[127021]
*Assistant Professor, Department of Zoology, Chaudhary BansiLal University, Bhiwani, Haryana. [127021]

Abstract:- Microbes are used in variety of ways due to their unique properties. Microbes have potential to use in biocontrol agents and used as probiotics in clinical prospective. The main bacterial species *Bacillus* and *Pseudomonas*use as controlling agent of various vector borne diseases in plants and animals. Soil microbes helpful checking soil health and soil quality also. Microbes utility is varies with their use in different prospective.

I. INTRODUCTION

Human population is continuously increasing, and the resources are limited therefore to meet the demand and to feed the billions of people it is important to increase the food production capacity. It also involves the increased production of plant based food but as we know land for agriculture is limited because most of land is now inhabited by human. So, there is need to increase the yield of crops many times, in the limited space, for which farmers are using many agrochemicals that can double the crop production. The use of agrochemicals to control plant diseases is currently the most prevalent technique. But the agrochemicals are the measure cause of deteriorating the soil quality and causing the environmental pollution. Thus agrochemicals should be replaced by some kind of biological agent such as microorganisms.

Biological control is a pesticide-free alternative that involves the use of bacterial endophytes in the bio control of a wide range of plant illnesses. Endophytic bacteria are endosymbiotic bacteria that reside in the spaces between and within all plant parts and do not cause sickness. Mutalism, cannibalism, commensalism, and trophobiotic partnerships are among the many types of connections they create in nature (Muthukumar et al., 2017).Plant growth enhancement, phytoremediation, phosphate solubilization, nitrogen fixation, plant metabolic modulation, and phytohormonesignalling are all possible roles for endophytic bacteria in helping plants adapt to biotic and abiotic stress. Endophytes are gaining popularity in agriculture due to their potential to promote plant development in adverse conditions such as cold, drought, or contaminated soil structure, as well as to confer disease resistance in plants.

A. Microbes as biopesticide

They are made up of naturally occurring or genetically modified bacteria, fungi, algae, viruses, and protozoans. Chemical insecticides can be replaced with more effective microbial control agents. A microbial toxin is a biological toxic substance produced by a microorganism, such as a bacterium or fungus. The pathogenic effects of such microorganisms on the target pests are largely species specific. The activity of microbial entomopathogens is induced by pathogen penetration through the insect's integument or gut, followed by pathogen development, which causes the host, such as insects, to die (Burges, 1981). Bacteria such as *Bacillus thuringiensis*, found more effective against *Aedesaegypti*, while *Bacillus sphaericus*, found effective against *Culexquinquefasciatus*(Lacey *et al*., 2001).

Bacillus spp. produce a wide range of compounds that aid in the biocontrol of plant diseases and the encouragement of plant development, making them ideal for agricultural and biotechnology applications.Bacillus produces metabolite products such as antibiotics, cell wall hydrolases, and siderophores.Bacillus species also promotes disease resistance in plants by causing systemic resistance. It is a natural alternative to synthetic pesticides and fertilisers for plant growth promotion.Bacillus species can replace agrochemicals (synthetic pesticides and fertilisers) in plant growth enhancement by promoting the uptake of specific nutrients from the environment by nitrogen fixation and phosphate solubilization or through manufacture of plant hormones (Borriss, 2011).

B. Bacillus induced disease resistance in plants:

Bacillus species is the most studied rhizobacteria that cause ISR (Induced systemic response) in plants, as well as imparting resistance to multiple diseases in the same plant (Kloepper et al., 2004) as shown in table 1.

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Bacteria	Target species (Pest)	Infectious disease control	Reference
Bacillus sp.	*Pyriculariaoryzae* *Colletotrichumcapsica* *Rhizoctoniasolani* *Fusariumoxysporum* *Plasmoparahalstedii*	Blast disease of rice Anthracnose of chili Root rot of soybean Wilt of soybean Downy mildew of sunflower	Rais*et al*., 2017 Jayapala *et al*., 2019 Jain *et al*., 2017 Nandeeshkumar *et al*., 2008
Bacillus subtilis	*Rhizoctoniasolani* *Alternariasolani*, *Phytophthorainfestans* *Fusariumoxysporum* f. sp. *cucumerinum*	Sheath blight of rice Early and late blight of tomato Root rot of cucumber	Spaepen*et al.*, 2007 Chowdappa *et al*., 2013 Chen *et al*., 2010

Table 1: Role of Bacillus species in controlling various diseases in plants

II. SOIL MICROBE AS PROBIOTICS

Some of the soil bacteria has to assign with different job to boost up soil quality and plant health (Berg et al., 2017). The main function of Bacteria in soil: to supply nutrients to crop, to stimulate plant growth by production of phytoharmones, to check and control activity of plant pathogens, to improve soil health and quality (Fitzpatrick et al., 2019). Along with above mentioned functions soil bacteria also have property to use as a great source of probiotics for humans in health sector (Baker et al., 2011). Soil-based probiotics are good and beneficial bacteria in the soil that have evolved in contact with humans. In recent times, humans were exposed to soil and soil-based organisms daily by eating, farming, and hunting(Haas and Keel, 2003). The most studied soil-based probiotics are species in the genus Bacillus. In **Soil-based probiotics such as Bacillus subtilis are a part of our normal soil microbiome (Berg et al.; 2014)**. These bugs are commonly referred to as spore-forming probiotics because they are encapsulated with a hard shell, or endospore, making them very stable and highly resistant to extreme conditions (Fierer, 2017). Bacillus subtilis has shown some benefit in clinical trials for constipation treatment (Jenmin Huang, 2008). Bacillus subtilis form spores that can survive harsh conditions, like stomach acid, irradiation, and high temperatures (Ahmad et al.; 2011). This category of bacteria is also sometimes called spore-forming bacteria. Like other commercially clinically used probiotic bacteria, soil-based probiotics help maintain digestive health and regulate the immune system (Kong et al.; 2018) as shown in fig.1. Unlike other types of probiotics, they appear to colonize the digestive tract.Bacillus coagulans is the second most studied soil-based probiotic(R. S. *et al.; 2019)*. In nine clinical trials, B. coagulans was shown to have a positive effect on diarrhea, bloating and abdominal pain, acidity, and constipation (Qifan Xiao et al; 2013).

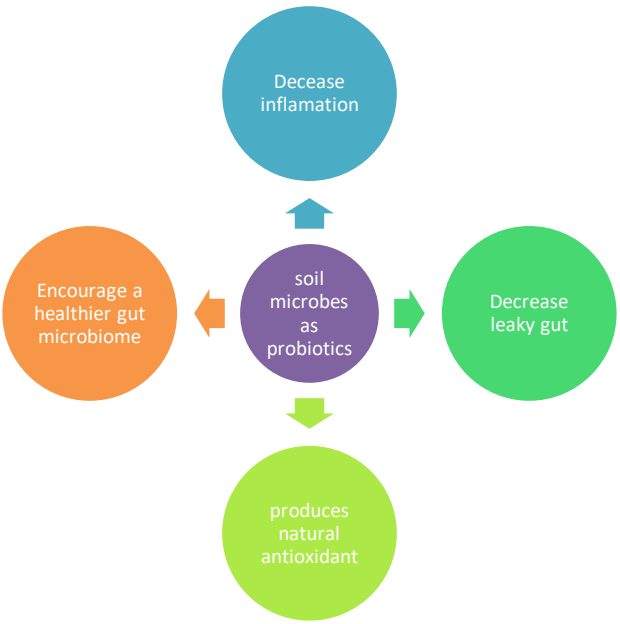

Fig. 1: Function and Role of soil microbes as probiotics

Bacillus clausii has been shown in clinical trials to reduce side effects from H. pylori treatment, including nausea, diarrhea, and pain. It has also been shown to decrease acute diarrhea and to help in the treatment of SIBO (Gabriella Casula et al; 2002).Bacillus licheniformis reduced the risk of gastrointestinal side effects from radiotherapy treatment, such as nausea, diarrhea, and vomiting. Hence, soil microbiota play diverse role in maintaining ecological balance.

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III. CONCLUSION

Use of microbes incrop production improvementthrough different mechanisms of biological control of insect pests, their use as biofertilization and stimulation of plant against the pathogensare gaining importance nowadays. Use of the microbes are beneficial in both ecologicaland economical terms. *Bacillus* is commonly used species that control various infectious diseases of plants and also act as probiotics.The ability of microbes to exhibit beneficial traits depends on the interaction with plant and/or pathogen, and the environment. It is necessary to increase the number of practically important speciesof *Bacillus* and find advanced methods for their rapid and comprehensive research and efficient application. Along with their probiotic effects these microbes can be future effective soil and crop nutrient quality improvement source.

REFERENCES

[1.] Borriss, R. (2011). Use of plant-associated Bacillus strains as biofertilizers and biocontrol agents in agriculture. In *Bacteria in agrobiology: plant growth responses* (pp. 41-76). Springer, Berlin, Heidelberg.

[2.] Burges, H. D. (1981). *Microbial control of pests and plant diseases 1970-1980*. Academic Press.

[3.] Casula, G., & Cutting, S. M. (2002). Bacillus probiotics: spore germination in the gastrointestinal tract. *Applied and environmental microbiology*, *68*(5), 2344-2352.

[4.] Chowdappa, P., Kumar, S. M., Lakshmi, M. J., &Upreti, K. K. (2013). Growth stimulation and induction of systemic resistance in tomato against early and late blight by Bacillus subtilis OTPB1 or Trichodermaharzianum OTPB3. *Biological control*, *65*(1), 109-117.

[5.] Huang, J. M., La Ragione, R. M., Nunez, A., & Cutting, S. M. (2008). Immunostimulatory activity of Bacillus spores. *FEMS Immunology & Medical Microbiology*, *53*(2), 195-203.

[6.] Jain, S., Vaishnav, A., Kumari, S., Varma, A., Tuteja, N., &Choudhary, D. K. (2017). Chitinolytic Bacillus-mediated induction of jasmonic acid and defense-related proteins in soybean (Glycine max L. Merrill) plant against Rhizoctoniasolani and Fusariumoxysporum. *Journal of Plant Growth Regulation*, *36*(1), 200-214.

[7.] Jayapala, N., Mallikarjunaiah, N. H., Puttaswamy, H., Gavirangappa, H., &Ramachandrappa, N. S. (2019). Rhizobacteria Bacillus spp. induce resistance against anthracnose disease in chili (Capsicum annuum L.) through activating host defense response. *Egyptian Journal of Biological Pest Control*, *29*(1), 1-9.

[8.] Khan, A. R., Ullah, I., Waqas, M., Shahzad, R., Hong, S. J., Park, G. S., ...& Shin, J. H. (2015). Plant growth-promoting potential of endophytic fungi isolated from Solanumnigrum leaves. *World Journal of Microbiology and Biotechnology*, *31*(9), 1461-1466.

[9.] Kloepper, J. W., Ryu, C. M., & Zhang, S. (2004). Induced systemic resistance and promotion of plant growth by Bacillus spp. *Phytopathology*, *94*(11), 1259-1266.

[10.] Lacey, L. A., Frutos, R., Kaya, H. K., & Vail, P. (2001). Insect pathogens as biological control agents: do they have a future?. *Biological control*, *21*(3), 230-248.

[11.] Muthukumar, A., Udhayakumar, R., &Naveenkumar, R. (2017). Role of bacterial endophytes in plant disease control. In *Endophytes: Crop productivity and protection* (pp. 133-161). Springer, Cham.

[12.] Muthukumar, A., Udhayakumar, R., &Naveenkumar, R. (2017). Role of bacterial endophytes in plant disease control. In *Endophytes: Crop productivity and protection* (pp. 133-161). Springer, Cham.

[13.] Nandeeshkumar, P., Ramachandrakini, K., Prakash, H. S., Niranjana, S. R., &Shekar Shetty, H. (2008). Induction of resistance against downy mildew on sunflower by rhizobacteria. *Journal of Plant Interactions*, *3*(4), 255-262.

[14.] Rais, A., Jabeen, Z., Shair, F., Hafeez, F. Y., & Hassan, M. N. (2017). Bacillus spp., a bio-control agent enhances the activity of antioxidant defense enzymes in rice against Pyriculariaoryzae. *PloS one*, *12*(11), e0187412.

[15.] Vassileva, M., Flor-Peregrin, E., Malusá, E., &Vassilev, N. (2020). Towards better understanding of the interactions and efficient application of plant beneficial prebiotics, probiotics, postbiotics and synbiotics. *Frontiers in plant science*, *11*, 1068.

[16.] Wang, J., Mendelsohn, R., Dinar, A., Huang, J., Rozelle, S., & Zhang, L. (2009). The impact of climate change on China's agriculture. *Agricultural Economics*, *40*(3), 323-337.

[17.] Wang, M., Liu, P., Kong, L., Xu, N., & Lei, H. (2021). Promotive effects of sesamin on proliferation and adhesion of intestinal probiotics and its mechanism of action. *Food and Chemical Toxicology*, *149*, 112049.