Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 02, Issue: 03 (MAY-JUNE, 2022)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Role of Rhizospheric Microbiome in Organic Farming System

(*Kailash Chand Kumawat and Nikita Kumari)

Department of Industrial Microbiology,
Jacob Institute of Biotechnology and Bio-engineering, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India
*kailash.kumawat@shiats.edu.in

Sustainable agriculture is a type of agriculture that focuses on producing long-term crops and livestock while having minimal effects on the environment. This type of agriculture tries to find a good balance between the need for food production and the preservation of the ecological system within the environment. In addition to producing food, there are several overall goals associated with sustainable agriculture, including conserving water, reducing the use of fertilizers and pesticides, and promoting biodiversity in crops grown and the ecosystem. Sustainable agriculture also focuses on maintaining economic stability of farms and helping farmers improve their techniques and quality of life.

There are many farming strategies that are used that help make agriculture more sustainable. Some of the most common techniques include growing plants that can create their own nutrients to reduce the use of fertilizers and rotating crops in fields, which minimizes pesticide use because the crops are changing frequently. Another common technique is mixing crops, which reduces the risk of a disease destroying a whole crop and decreases the need for pesticides and herbicides. Sustainable farmers also utilize water management systems, such as drip irrigation, that waste less water.

Soils are habitats for major forms of life such as microorganisms (e.g., bacteria, archaea, fungi) as well as insects, annelids, algae, and plants. Microorganisms have potential roles to play in sustainable agricultural production due to their ability to promote plant growth and enhance biotic and abiotic stress resistance, remediate contaminated soils, recycle nutrients, manage soil fertility, and weather and mineralize rocks and other abilities that result in the reduced use of fertilizers or pesticides in agriculture. Recently introduced biotechnological approaches help to modify microbes that can be used to enhance bioremediation and phyto-remediation of contaminated soil that can be used for agricultural production. Sustainable agriculture is essential today to meet our long-term agricultural needs by using natural resources without degrading the environment. Here, we discuss the structure and diversity of soil microorganisms and their potential role in nutrient recycling, remediation of heavy metal from contaminated environments, plant growth promotion, stress tolerance, phytohormone production, etc. for sustainable agriculture to feed future generations.

Microbial Biotechnology and its Applications in Agriculture

1. Natural fermentation

Micro-organisms found in the soil to improve agricultural productivity. Men use naturally occurring organisms to develop bio-fertilizers and bio-pesticides to assist plant growth and control weeds, pests, and diseases. Micro-organisms that live in the soil actually help plants to absorb more nutrients. Plants and these friendly microbes are involved in "nutrient recycling". The microbes help the plant to "take up" essential energy sources. In return, plants donate their waste by-products for the microbes to use for food. Scientists use these friendly micro-organisms to develop biofertilizers.

2. Biofertilizers

Phosphate and nitrogen are important for the growth of plants. These compounds exist naturally in the environment but plants have a limited ability to extract them. Phosphate plays an important role in crop stress tolerance, maturity, quality and directly or indirectly, in nitrogen fixation. A fungus, *Penicillium bilaii* helps to unlock phosphate from the soil. It makes an organic acid, which dissolves the phosphate in the soil so that the roots can use it. Biofertilizer made from this organism is applied by either coating seeds with the fungus as inoculation, or putting it directly into the ground. *Rhizobium* is a bacteria used to make biofertilizers. This bacterium lives on the plant's roots in cell collections called nodules. The nodules are biological factories that can take nitrogen out of the air and convert it into an organic form that the plant can use.

This fertilization method has been designed by nature. With a large population of the friendly bacteria on its roots, the legume can use naturally-occurring nitrogen instead of the expensive traditional nitrogen fertilizer. Biofertilizers help plants use all of the food available in the soil and air, thus allowing farmers to reduce the amount of chemical fertilizers they use. This helps preserve the environment for the generations to come.

3. Bio-pesticides

Microorganisms found in the soil are all not so friendly to plants. These pathogens can cause disease or damage the plant. As scientists developed biological "tools," which use these disease-causing microbes to control weeds and pests naturally.

4. Bio-herbicides

Weeds are the problem for farmers. They not only compete with crops for water, nutrients, sunlight, and space but also harbor insect and disease pests; clog irrigation and drainage systems; undermine crop quality; and deposit weed seeds into crop harvests. Bio-herbicides are another way of controlling weeds without environmental hazards posed by synthetic herbicides. The microbes possess invasive genes that can attack the defence genes of the weeds, thereby killing it. The benefit of using bioherbicides is that it can survive in the environment long enough for the next growing season where there will be more weeds to infect. It is cheaper than synthetic pesticides thus could essentially reduce farming expenses if managed properly. Further, it is not harmful to the environment compared to conventional herbicides and will not affect non-target organisms.

5. Bioinsecticides

Biotechnology can also help in developing alternative controls to synthetic insecticides to fight against insect pests. Micro-organisms in the soil that will attack fungi, viruses or bacteria, which cause root diseases. Formulas for coatings on the seed (inoculants) which carry these beneficial organisms can be developed to protect the plant during the critical seedling stage. Bioinsecticides do not persist long in the environment and have shorter shelf lives; they are effective in small quantities, safer to humans and animals compared to synthetic insecticides; they are very specific, often affecting only a single species of insect and have a very specific mode of action; slow in action and the timing of their application is relatively critical.

6. Fungal- bioinsecticides

Fungi cause diseases in some 200 different insects and this disease producing traits of fungi is being used as bioinsecticides. Fermentation technology is used to mass production of fungi.

Spores are harvested and packaged so these are applied to insect-ridden fields. When the spores are applied, they use enzymes to break through the outer surface of the insects' bodies. Once inside, they begin to grow and eventually cause death. Fungal agents are recommended by some researchers as having the best potential for long-term insect control. This is because these bioinsecticides attack in a variety of ways at once, making it very difficult for insects to develop resistance.

7. Virus-Based Bioinsecticides

Baculoviruses affect insect pests like corn borers, potato beetles, flea beetles and aphids. One particular strain is being used as a control agent for bertha army worms, which attack canola, flax, and vegetable crops. Traditional insecticides do not affect the worm until after it has reached this stage and by then much of the damage has been done.