BioThink, Vol -2, Issue -2
ISSN: 3048-7943

Enhancing Soil Microbe Partnerships to Reduce Fertilizer Use

Aparna Jyoti

Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur,Uttar Pradesh

The worldwide agriculture is grappling with rising issues such as soil health, sustainability, and excessive fertiliser use. Since, 1950-1960 the era of green revolution has no doubt increased the production of cereals tremendously but on the other hand made us dependent on use of chemical fertilizer. The use of chemical fertilizer has increased day by day without realising its adverse effect on overall environmental effect especially on soil health. It has affected the soil condition at extreme extent that the organic carbon content has reduced from 0.8% (Minimum) to 0.52% at most of the places. For years, farmers have used both organic sources (manures and composts) and inorganic sources (NPK fertilisers) to supplement their nutrient needs. Even at a high rate of 5.0-10.0 Mg ha-1 year, organics can increase SOC concentrations by 10-15% compared to no organics (only NPK). The incorporation of crop wastes reduces SOC depletion. The presence of organics increased the rate of crop residue C conversion to SOC by 1.6 times (4.2 vs. 6.9%), indicating that organics may have assisted this process. Extensive rather than intensive, or more equitable, application of organic amendments in fields may be preferable for enhancing carbon sequestration in soils. This process may be expedited in the presence of legumes compared to non-legume crops (Wani et al., 2003; Mandal et al., 2007). Beneficial soil microbes also plays important role in enriching soil nutrients. Unlocking Nature's Potential Plants rely on symbiotic relationships with soil microorganisms to absorb nutrients such as nitrogen and phosphorus. Researchers found a plant-derived signal that improves collaboration, allowing bacteria to mobilise nutrients more efficiently. Farmers who exploit this natural process may be able to significantly cut their nitrate and phosphate fertiliser use, lowering costs and alleviating environmental problems.

BioThink, Vol -2, Issue -2
ISSN: 3048-7943

Role of different microorganism in enhancing soil fertility and health

The microorganisms found in solution offer a variety of benefits to plants. They can fix atmospheric nitrogen and convert it into a form that plants can use, minimising the need for nitrogen-based fertilisers. These microbes also solubilise phosphorus, making it more accessible to plants, which is especially useful in soils with low phosphorus levels. They also create growth-promoting compounds such as phytohormones, vitamins, and enzymes, which promote plant growth, root development, and stress tolerance. Azospirillum, a type of free-living, nitrogen-fixing bacteria, has sparked significant interest in agriculture as a liquid biofertilizer. It belongs to the Rhodospirillaceae family because of its ability to create symbiotic relationships with plant roots, which improve nutrient uptake and promote plant growth.

Phosphate solubilising bacteria (PSB) are helpful microorganisms that may dissolve organic molecules by turning inorganic phosphorus compounds into phosphatases such as phytase. Bacillus and Pseudomonas are the most abundant phosphate-solubilizing species, accounting for 1 to 50% of all soil-dwelling microorganisms (Kalayu, 2019). Pseudomonas-based liquid biofertilizers provide a sustainable and environmentally benign way to improve plant growth and agricultural production. Their nitrogen-fixing ability, phosphate solubilisation, synthesis of growth-promoting compounds, biocontrol qualities, and stress tolerance make them essential instruments in modern agriculture, helping to reduce chemical inputs and promote sustainable agricultural techniques.

Potassium (K) is one of the major macronutrients which play an important role in plant growth and development. The major macronutrients which play an important role in plant growth and development. There are certain microorganisms which use a number of biological processes to make potassium available from unavailable forms. These potassium-solubilizing bacteria (KSB) can be used as a promising approach to increase K availability in soils, thus playing an important role for crop establishment under K-limited soils (**Ahmed *et al* 2016).**

BioThink, Vol -2, Issue -2
ISSN: 3048-7943

Benefits for Sustainable Agriculture

- Soil bacteria improve nutrient uptake, which reduces the demand for chemical fertilisers and saves farmers money.
- Improved Soil Health: Excess fertiliser use can degrade soil quality over time. Increased microbial activity increases long-term soil fertility.
- Environmental Protection: Synthetic fertiliser runoff pollutes water and emits greenhouse gases. A microbe-based method mitigates the unwanted impacts.
- Increased Crop Resilience: Improving microbial interactions can help plants resist drought, pests, and soil-borne illnesses, resulting in more consistent harvests.
- Enhanced Biodiversity: A diversified soil environment encourages natural regeneration and equilibrium.

Application in Modern Farming

The usage of microbial-based solutions is expanding, with agricultural researchers developing biofertilizers, seed coatings, and microbial inoculants to improve soil health naturally. Farmers can increase soil health by:

- Increasing microbial variety through cover cropping and crop rotation.
- Reducing tillage to protect microbial communities and organic matter.
- Add compost and organic amendments to help healthy microorganisms thrive.

Future Prospects

This discovery opens the door to new biofertilizer products and microbial inoculants that can be employed in modern farming operations. As research advances, the agricultural industry may move towards more biologically driven, sustainable food production systems.Governments and governments can support these initiatives by incentivising microbial-based farming systems and funding research into soil microbiome applications. For farmers, agronomists, and politicians, harnessing the power of soil bacteria is a critical step towards a more resilient and environmentally responsible agricultural future.

References:

Ahmad, M., Nadeem, S.M., Naveed, M. and Zahir, Z.A., 2016. Potassium-solubilizing bacteria and their application in agriculture. *Potassium solubilizing microorganisms for sustainable agriculture*, pp.293-313.

Kalayu, G., 2019. Phosphate solubilizing microorganisms: promising approach as biofertilizers. *International Journal of Agronomy*, *2019*(1), p.4917256.

Mandal, B., Majumder, B., Bandyopadhyay, P.K., Hazra, G.C., Gangopadhyay, A., Samantaray, R.N., Mishra, A.K., Chaudhury, J., Saha, M.N. and Kundu, S., 2007. The potential of cropping systems and soil amendments for carbon sequestration in soils under long-term experiments in subtropical India. *Global change biology*, *13*(2), pp.357-369.

Wani, S.P., Pathak, P., Jangawad, L.S., Eswaran, H. and Singh, P., 2003. Improved management of Vertisols in the semiarid tropics for increased productivity and soil carbon sequestration. *Soil use and management*, *19*(3), pp.217-222.