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An Overview of the Prospects of Bio-fertilizers in Indian Farming

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ABSTRACT- Only importation and subsidies has ensured that fossil fuel-based chemical fertilisers are available and affordable at the agricultural level in India. Biofertilizers have developed as a highly potent alternate to chemical fertilisers because to their enviromentally, easy-to-apply, pro, and expense properties. They also act as a supplement to agrochemicals by allowing plants to access micronutrients that are naturally abundant in soil or the ecosystem. Furthermore, if adequate information is made available to farmers and producers via experiences and communication, they have the possibility to be commercially sustainable in the long term. The government of India is aiming to increase the usage of bio fertilisers in combination with modern agrochemical. This paper emphasises the importance of high productivity and increased and active engagement in science and technology, public awareness programmed to increase the extra possibilities of sustainable agricultural extension, and encouraging private organisations and decision makers to consider taking a passion for science in the Indian context and for its coming years in India, as well as trying to encourage private organisations and decision makers to take an interest in this topic in the Indian context including its future in India.

KEYWORDS- Bacteria, Biofertilizers, Nitrogen, Phosphorous, Rhizobium.

I. INTRODUCTION

Biofertilizers are pharmacologically important products or microbiological inoculants which include one or even more beneficial bacterial or fungal pathogens in simple, cost-effective microencapsulation that add, store, and mobilise crop fertility of the soil [1]. In other words, a biofertilizer is the product that contain living microorganism that colonise the rhizosphere or interior of the plants after being sprayed to seed, plant interfaces, or soil, boosting expansion by improving the levels of essential minerals to the growth medium [2]. Organic fertilisers are made up of organic elements that improve soil fertility explicitly or implicitly through decomposition [3]. Similarly, the words biofertilizers, green manure, manure intercrop, and organic accompanied chemical fertilizer should not be used interchangeably.

Obtaining greater agricultural food productions from decreasing per capita arable land is now one of the new millennium's new problems [4]. Biofertilizers have far-reaching and long-term environmental consequences, offsetting the negative impacts of chemicals. At the farm level, the benefits of greater technological use may be passed on to other farms and sectors in the form of less water pollution than then chemical fertilizers, and even the creation of organic manures to some degree[5]. Unlike chemical fertilizers, which offer rapid returns, the benefits of the new technique derived from the prevention of soil degradation may not be apparent for a long time [6]. Liquid bio-fertilizers are one-of-a-kind liquid preparations that comprise not only of the necessary bacteria and nutrients, but then also cell protectant or substances that promote the formations of resting capsules. The farmer must pay a large upfront price in terms of skills training, experimentation, and risks [7]. Producer companies are concerned about the product's demand or capacity to sell it, which discourages investment, especially if it is irreversible. Early entrants' successes or failures, as well as those who engage in research for a better product, communicate vital knowledge to others and, as a result, to society [8].

Biofertilizers, also known as the microbial inoculant, are intentionally multiplied principles of soils organisms that may enhance soil fertility and crop production [9]. Despite the fact that legumes' benefits in boosting soil fertility have been known since antiquity [10]. The purpose of applying latent cells of effective nitrogen-fixing, phosphate-solubilizing, or cellulolytic bacteria to seeds, soil, or compost regions is to reduce the population of these microorganisms and increase speed microbial activities that improve the accessibility of readily digested nutrients. Organic fertilizers, especially biofertilizers, are now needed to reduce our reliance on nitrogen fertilizer. Experiments on biofertilizers performed in India and elsewhere showed that legumes such as beans, soybeans, chickpeas, and pigeon peas can fix 50-500 kg atmospheric nitrogen per hectare under optimum environmental circumstances. Bio-fertilizers, on the other hand, provide a safe way to use renewable inputs to enhance soil fertility by combining biological wastes with helpful microorganisms that imparts organic nutrients to agricultural products. Biofertilizers have developed as potentially environmentally friendly input for optimal plant development. They have a lot of promise for fulfilling plant nutritional needs while reducing the usage of artificial fertilizers. These bio-inputs or bio biocontrol agents were containing products living tissue of different microbial species with the capacity to deliver physiologically essential points from non-usable form during biological stresses and so improve crop yield.

A. N-fixing Biofertilizers (NBF)

1) Rhizobium

Biofertilizers, especially Rhizobium, may serve as a link between soil nutrient removal and addition in situations when farmers can't afford expensive inputs and are working in a dangerous environment [11]. On average, 135 million metric tons of nitrogen are fixed on land each year. Rhizobium culture has been widely suggested as a pulse cultivation input in recent years. Pulses are grown on approximately 30 million hectares of land in India. They belong to the Rhizobiaceae family and are symbiotic in nature, fixing 50-100 kg of nitrogen per hectare just by growing legumes. Pulses including chickpea, red gramme, pea, lentil, black gramme, and others, and also oil-seed legumes likes soybean, groundnut, and forage legumes likes Lucerne and berseem, benefit from it. It colonises the root of some legumes, producing ammonia-producing tumor-likes growths known as root nodules. Rhizobium, in a symbiotic interaction with legumes and the non-legumes likes Parasponia, may fix atmospheric nitrogen.

2) Azotobacter

The Azotobacter that colonizes the root not only stays on the roots surface, but also infiltrates into the roots tissues and coexists with plants. It is a member of the Azotobacteriaceae family, which is aerobic, heterotrophic and free-living in nature [12]. Azotobacters may be found in both neutral and alkaline soil, with A. chroococcum being the most frequent species in arable soils. Other species include A. vinelandii, A. macrocytogenes, A. insignis, and A. beijerinckii.

3) Azospirillium

Bacillus polymixa is another name for it. It fixes atmospheric N (free living states) and makes it accessible to agricultural plants when administered to the rhizosphere. This N-fixing bacterium, which is helpful to non-leguminous plants, is heterotrophic and associatives in nature and belongs to the Spirilaceae family. They generate growth-regulating chemicals in additions to their N-fixing capabilities of approximately 20-41 kg/ha. Though there are numerous species in this genus, like A. halopraeferens, A. brasilense, and A. amazonense, the A. lipoferum and A. brasilense has been shown to have a global range and provide inoculation advantages [13]. Azospirillum was shown to have a substantial impact on the leaf area index and all yield-related factors. With the application of biofertilizers, grain production and harvest index (HI) both rise noticeably. Apart from that, Azospirillum form an associatives symbiosis through many plants, especially those through the C4- dicarboxylic photosynthesis pathway, meanwhile they develop and also fix nitrogen on organic acids salts like malic and aspartic acid. As a result, it's best for sugarcane, maize, sorghum (Sorghum bicolor L.), pearl millet, and other crops. The advantages of Azospirillium go beyond N enrichment via the synthesis of growth-promoting compounds.

4) Herbspirillum

It's an connotation symbiotic that is accountable for atmospheric nitrogen fixation on sugarcane roots [14]. Its following positive effects include increasing N availability, K phosphate absorption, boosting nitrate and the synthesis of growth and promoting hormones (kinetin, gibberellic acid and auxin).

5) Acetobacter

It thrives in the sugarcane environment as an endophyte and can withstand high sucrose concentrations. This bacteria may fix up to 15 kg of nitrogen per hectare each year as a result of the plant secreting growth hormones called IAA, which assist with germination and root development, as well as nutrient absorption. In Azotobacters, there are also variations in share by type with modest success, with PSB providing by far the greatest result. The decrease in Rhizobium implies that groundnut and pulses were not as successful as expected, and yearly capacity of unit was emptied by the quantity of units. By comparing actual distribution (rather than production) to capacity, a measure of capacity utilization is produced.

B. Blue Green Algae (BGA)

1) Cyanobacteria, Chlorococcales, and Mastigociadaceae

These photosynthesis prokaryotic microorganisms, when applied at a rate of 10 kg/ha, are now only effective in submerged paddies in the presence of optimistic sunlight, forming the bluish-green algal on excessive moisture and converting refractory P into simpler compounds, enhancing crop productivity by 10-15%[15]. BGA biomass decomposes in the soil, releasing organic chemicals and regulating plant development. For low-land rice cultivation, significant amounts of nitrogen are needed. The main bases of N for a low lands rice are soil N and BNF produced by related organisms. The 50-60% N requirement is supplied by a mixture of free alive and rice plants related bacteria mineralizing soil organic N and BNF.

BGA are photosynthetic N-fixers that live in the wild. In India, they may be found in large quantities. They, too, produce growth-promoting compounds like vitamin B12, improve aeration and water retention in the soils, and contribute to bio mass when they die. BGA creates symbiotic connections with fungi, hornworts, ferns, and angiosperms, although the most prevalent symbiotic interaction has been observed between both the similar thing and Anabaena azollae, an available water fern.

2) Phosphate Solubilizing Microorganisms and Mycorrhizae

The effectiveness of phosphate fertilizer is also permitted owing to the fixation of a significant proportion of pragmatic P into frugally soluble inorganic phosphates in most Indian soils, which range from low to medium in Pstatus [16]. Plant growth hormones are sometimes produced by PSM. Because soluble phosphorus is readily absorbed by plants, virtually all crops have a 10- to 20% boost in production. Bacillus, Pseudomonas, Rhizobium, Burkholderia, Agrobacterium, Achromobacter, Aereobacter, Flavobacterium, Erwinia and Micrococcus, are among the bacterial genera that have this ability. Because of its poor mobility and solubility, as well as its propensity to stay fixed in soil, P, which is both innate in soils and practical in the inorganic fertilizers, becomes largely inaccessible to crop. PSBs are living organisms that may aid in plant phosphate absorption in a variety of ways. More prevalent are soil bacteria fitting to the genera Pseudomonas, Bacillus, and Fungi. So, the formation of organic acids, which is followed by acidification of the medium, is the most common microbiological method for mobilizing insoluble-P compounds.

II. DISCUSSION

A. Limitations on the Use of Bio-fertilizers in the Environment

- There is a lack of superiority assurance and restricted resource cohort for the manufacture of biofertilizers.
- Farmers' lack of understanding and market limitations.
- Native microbial populations, poor inoculation methods, and mutation during fermentation are all factors to consider.
- Uncertain and seasonal need
- Soil and climatic conditions, as well as a lack of skilled personnel.
- A lack of appropriate carriers is a resource limitation.

B. Indian Market for Biofertilizers

Biofertilizers are produced commercially by about 170 entities in 24 countries. NifTAL (USA) is credited for helping to popularize Rhizobium inoculant [17]. In such situations, the cost of Biofertilizers, as well as the risks and answers associated with them, will be considered against the cost of chemical fertilizer, and the elevation of technology for environmental reasons will necessitate some level of protection to reduce inter-fertilizer price distortion. In the quality control of many commercial goods, Australia has gained the lead. The National Azolla Program (NAAP) was established in 1982 in the Philippines to develop farm-based technologies for the use of Azolla fertilizer in rice. The worldwide markets for organically grown agricultural goods is now estimated at about $31 billion, with an annual growth rates of roughly 8%. Organic farming currently covers almost 22 million hectares of land. Organic agriculture accounts for less than 2% of global conventional agricultural output and approximately 9% of overall agricultural land areas. This just emphasizes the enormous potential for biofertilizer development. There are now 60 manufacturing units, each capable of generating 10-115 tons per year. Various state governments also provide subsidies, which can equate to up to 50% of sales proceeds, however the subsidisation mechanism is sometimes haphazard. In many cases, discrimination and subsidy manipulation result in a wide range of prices within industries.

Two main barriers for suppliers and investors are insufficient demand and the erratic and periodic nature of present demand. It's important to note that the innovation was in its early stages and is evolving. The starch eastern region is still quiescent, while the wheatrice-growing north is lagging behind. The creation of productive, temperature-tolerant, and robust strains is essential for the technology's long-term success. There may be an emphasis on the technology's promise in rice and cereals in general, but its importance for crop diversification is equally important. The number of units increased by 53 percent during four years, from 62 to 95, and then to 122 in 2002. According to data from units reporting their capabilities, overall capacity increased by 12%. New private companies entered the market, increasing their numerical share, whereas the public sector stagnated following the first boom. A closer examination, on the other hand, might be more instructive.

Biofertilizer distribution and acceptance rates have not continuously increased over time, and have decelerated in the dawn 1990s. Starting from a low bases, one would anticipate a quicker and potentially faster growth rate as the inputs becomes more widely accepted. Second, despite the fact that there have been an increasing number of new entrants into the market, average capacity has decreased, indicating that the sector is characterized by a high number of tiny units. While size modification is common in the baby business, it is important to remember that the dissemination of an agricultural input also requires extensive sales schmoosing and a thorough knowledge of the fields realities. It has to be seen if smaller groups will have the required knowledge and incentives to fulfill agricultural needs, or whether synergistic partnerships with larger producers, distribution agencies, or local organizations would be the desired institution. Despite the central government's involvement, there has been almost no dissemination of the technology, and distribution across unit has moved toward increasing concentration, particularly in the Maharashtra, other western and southern states.

With varied degrees of focus, the Government of India and several state government have been encouraging the uses of biofertilizers via grants, allowance, and sales subsidies. Farmers learn about technology through time, developing their perceptions based on agronomic realities in their areas, knowledge acquired from the experiences of other farmers, comprising themselves, and informations given by various disseminating agent, and making their own acceptance choices. The Government of India has established six regional centers in Bangalore, Jabalpur, Hisar, Imphal, Bhubaneswar, and Nagpur under the National Biofertilizers Development Centre Act Ghaziabad. In the lack of published data on input usage at the farm level, this may aid in assessing the technology's development and acceptance in India.

III. CONCLUSION

New application methods, such as seed coating with methylcellulose and pellets for direct soil treatment, should be promoted. The reactions are typically influenced by a variety of external variables. The salinity, alkalinity and acidity of the soil, as well as the amounts of various phosphate, nitrates, calcium and molybdenum that aid protein synthesis in Rhyzobia, all influence the reaction. Higher doses of mineral N- as a beginning reduce nodulation, lowering Rhyzobium response, although phosphate shortage may also be a factor. The lack of organic matter, which is particularly prevalent in dryland and agriculture, it is a barrier for the non-symbiotic strain that rely on soils organic matters for energy. Only soils with high organic content and limited accessible phosphorus showed a good phosphobactrin reaction. Abiotic variables that influence N-fixation in dry land agriculture include a lack of water in the soil and high temperatures (hyperthermia). The inoculants are opposed by the native microbial community. Predatory organisms, which are often already existing in the soil, are better suited to their surroundings and outcompete the injected population.

REFERENCES

[1] D. Mishra, S. Rajvir, U. Mishra, and S. Kumar, “Role of Bio-Fertilizer in Organic Agriculture: A Review,” Res. J. Recent …, 2013.

[2] M. Iyer et al., “Environmental survival of SARS-CoV-2 – A solid waste perspective,” Environ. Res., 2021, doi: 10.1016/j.envres.2021.111015.

[3] H. M. Jais, “The status of organic fertilizer in Malaysia: For Earth’s sake,” in Organic Fertilizers: Types, Production and Environmental Impact, 2012.

[4] D. Singh, “Robust controlling of thermal mixing procedure by means of sliding type controlling,” Int. J. Eng. Adv. Technol., 2019, doi: 10.35940/ijeat.F1303.0986S319.

[5] H. Kumar, A. K. Sarma, and P. Kumar, “Experimental investigation of 2-EHN effects upon CI engine attributes fuelled with used cooking oil-based hybrid microemulsion biofuel,” Int. J. Environ. Sci. Technol., 2021, doi: 10.1007/s13762-021-03751-y.

[6] T. T. Win, G. D. Barone, F. Secundo, and P. Fu, “Algal Biofertilizers and Plant Growth Stimulants for Sustainable Agriculture,” Industrial Biotechnology. 2018, doi: 10.1089/ind.2018.0010.

[7] C. The Phan et al., “Controlling environmental pollution: dynamic role of fiscal decentralization in CO2 emission in Asian economies,” Environ. Sci. Pollut. Res., 2021, doi: 10.1007/s11356-021-15256-9.

[8] R. Sharma et al., “Analysis of Water Pollution Using Different Physicochemical Parameters: A Study of Yamuna River,” Front. Environ. Sci., 2020, doi: 10.3389/fenvs.2020.581591.

[9] P. Saranraj and P. Sivasakthivelan, “Azospirillum and its Formulations: A Review,” Int. J. Microbiol. Res., 2013, doi: 10.5829/idosi.ijmr.2013.4.3.825.

[10] Meenu, S. Andeep Kumar, V. K. Panchal, and R. Kumar, “Evolution of new integrated haze removal algorithm based on haze line,” Int. J. Eng. Adv. Technol., 2019, doi: 10.35940/ijeat.E7084.088619.

[11] B. S. Shridhar, C. Author, B. Shrimant Shridhar, B. S. Shridhar, C. Author, and B. Shrimant Shridhar, “Review : Nitrogen Fixing Microorganisms,” Int. J. Microbiol. Res., 2012, doi: 10.5829/idosi.ijmr.2012.3.1.61103.

[12] R. Hindersah, Z. Handyman, F. N. Indriani, P. Suryatmana, and N. Nurlaeny, “JOURNAL OF DEGRADED AND MINING LANDS MANAGEMENT Azotobacter population, soil nitrogen and groundnut growth in mercury-contaminated tailing inoculated with Azotobacter,” J. Degrad. Min. L. Manag., 2018, doi: 10.15243/jdmlm.

[13] S. D. Topre, S. S. Panikar, S. U. Mahajani, and S. B. Patil, “Biofertilizer: A novel approach for agriculture,” J. Pure Appl. Microbiol., 2011, doi: 10.5897/jabsd10.042.

[14] C. B. Sruthilaxmi and S. Babu, “Microbial bio-inoculants in Indian agricultureEcological perspectives for a more optimized use,” Agric. Ecosyst. Environ., 2017, doi: 10.1016/j.agee.2017.03.019.

[15] P. M. Dellamatrice, M. E. Silva-Stenico, L. A. B. de Moraes, M. F. Fiore, and R. T. R. Monteiro, “Degradation of textile dyes by cyanobacteria,” Brazilian J. Microbiol., 2017, doi: 10.1016/j.bjm.2016.09.012.

[16] A. Efthymiou, B. Jensen, and I. Jakobsen, “The roles of mycorrhiza and Penicillium inoculants in phosphorus uptake by biochar-amended wheat,” Soil Biol. Biochem., 2018, doi: 10.1016/j.soilbio.2018.09.027.

[17] P. Somasegaran and H. J. Hoben, “NifTAL Project and MIRCEN: Methods in Legume-Rhizobium Technology. Hawaii Institute of Tropical Agriculture and Hunan Resources,” Trop. Agric., 1985.