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Role of biofertilizers in increasing tea productivity

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ABSTRACT

Objective: To increase the tea productivity using biofertilizers like VAM fungi, phosphobacteria, Azosprillium. **Methods:** Nitrogen fixing Azospirillum, phosphate solubilising bacteria and VAM fungi were isolated from tea soils of southern India and region specific potential strains were selected based on laboratory, greenhouse, as well as field experiments. A technology for their mass multiplication has been developed. **Results:** Biofertilizers were showed higher yield at the rate of 5g/seedling and VAM fungi with 15 g of formulation/bush. **Conclusions:** Multifunctional biofertilizers were used to reduce the chemical fertilizers, diseases and to increase soil fertility in tea.

1. Introduction

The excessive use of chemical fertilizers in agriculture has resulted in several environmental problems like ozone layer depletion, poor soil health, due to the decline in natural microflora and acidification of water. To overcome these problems application of biofertilizers has been found effective. Generally the biofertilizers are beneficial microorganisms involve in breakdown of organic matter, Nitrogen fixation, and secretion of growth promoting substances. They also supply nutrients to the plants, control soil borne diseases and maintain the soil structure in cultivable fields. Intensive research has been done to find out the usefulness of this aspect in the tea plantations.

2. Bio inoculants

Certain group of bacteria and fungi are considered as biofertilizers in tea and they are freely available in top soil and usually associate with plants having symbiotic relationship. These organisms receive nutrients from the plant tissue and in turn supply the required nitrogen and phosphorus to plants. The following group of bacteria and fungi are major biofertilizers available in tea soil.

2.1. Mycorrhizae

Mycorrhizae are soil fungi having symbiotic association with plant roots and play a key role in nutrient cycling in the ecosystem and they are non-pathogenic. They colonize the cortical tissues of roots during periods of active plant growth.

2.1.1. Beneficial effects of mycorrhizae

Mycorrhizal symbiosis is an important factor in the establishment of tea seedlings. The beneficial effects of this symbiotic relationship in plants are

(i) Improvement in rooting
(ii) Improved nutrient uptake
(iii) Enhanced plant tolerance to stress
(iv) Improved state of soil structure
(v) Water uptake
(v) Disease control

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The mycorrhiza associated with tea is Vesicular arbuscular Mycorrhizae (VAM).

2.1.2. Vesicular arbuscular mycorrhiza (VAM)

Vesicular arbuscular mycorrhizal (VAM) belongs to the lower group of fungi called zycomycetes and the beneficial effects are highly pronounced in acidic soils. In the tropics, many crops are grown in infertile acidic soils, where low levels of available phosphorus frequently limit their establishment. In such soils, an efficient mycorrhizal association can increase phosphorus uptake and crop yield.

In addition to enhanced P (phosphorus) uptake, VAM fungi often enhance acquisition of relatively immobile micronutrient cations, particularly Zn (zinc) and Cu (copper). Vesicular-arbuscular mycorrhizae are also important for N (nitrogen) uptake to stimulate the growth and are of great ecological importance with regards to N-nutrition of plants, especially in non nitrogen-fixing species[1].

Vesicular-Arbuscular Mycorrhizae plays an important role in the direct transfer of carbon from one plant to another. Nutrient transfer can occur between plants of the same species or between different species. The plant roots are interconnected by mycorrhizal hyphae through which the nutrients move from one plant to another. Vesicular-Arbuscular Mycorrhiza can mediate interplant transfer of P and N. In tea, significantly higher yields were recorded in the plots treated with 15 g of formulation / bush.

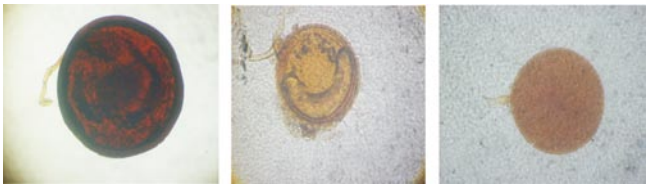

Figure 1. Vesicular arbuscular mycorrhizal (VAM)

2.2. Nitrogen fixing bacteria (N_2)

Although N2 is abundant (around 80%) the atmospheric N2 is not readily available for plant uptake and some bacteria are capable of N2 fixation from the atmospheric N2 pool. Many free living N2 fixing bacteria occur in soil. Some have adapted to form symbiotic association with plants. The amount of N2 fixed by these organisms is considerable because of the close proximity they have with their host plant. Efficient plant use of field N2 minimizes volatilization, leaching and denitrification. The major types of nitrogen fixing bacteria are Rhizobium, Azospirillum and Frankia. For tea productivity Azosprillum is the most efficient for increasing the nutrient enhancement in the seedlings. The genus Azospirillum is an effective root colonizer and its use is not limited by host specificity[2].

Azospirillum is free living in soils so that it can be cultured and produced in artificial medium. The commercially available Azospirillum also can be used at the rate of 5g/ seedling, however it depends on the required population of infective propagules and strains which have positive response to the host. Azospirillum stimulates the density and length of root hairs, increases the growth through hormonal production, increases biomass, increases survival rate and fixes nitrogen.

2.3. Phosphate solubilizing Bacteria (PSB) for tea

PSB plays a major role in the solubilization and uptake of native and applied soil P[3]. Phosphate is essential for early establishment and better growth of plants. Most of the Indian soils are deficient in P and its requirement is met by the addition of phosphate fertilizers in the form of aluminium or iron phosphate. But these fertilizers are becoming expensive and may have adverse effect on tea. Hence, the phosphate solubilizing bacteria have to be used as they play an important role in the utilization of unavailable native phosphate by bringing about changes in soil producing chelating agents and organic acids. Generally Bacillus, Pseudomonas, Flavobacterium and Streptomyces are involved in P solubilization[4]. This bacteria have to be isolated from the soil and cultured under laboratory conditions with a suitable medium (Fig.2). However, the commercially available PSB also can be used at the rate of 5g/seedling.

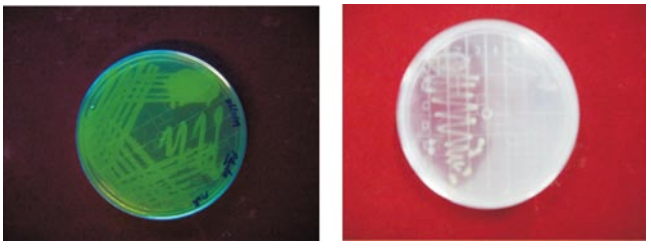

Figure 2. Phosphate solubilizing Bacteria (PSB) – *Pseudomonas*

3. Multiple inoculation for tea

Inoculation of more than one biofertilizer to the tea plant will give maximum benefit in growth enhancement. Co-inoculation of VAM, Azospirillum and Phosphobacteria increases the growth significantly. Growth is generally much greater in plants associated with these individual organisms in a tripartite relationship (N fixers – P mobilizers – AM fungi) than the uninoculated ones.

The bio inoculants will definitely increase the efficiency

of shoot and root system providing essential N and P for growth. For quality seedling production of tea plant, due consideration should be given to the biofertilizers such as VAM, Azospirillum and PSB rather than chemical inputs. This technology could be adopted in tea growing areas to improve the rate of growth and enhance productivity in the field and also helps reducing chemical fertilizers use and subsequently reduces the cost of seedling production.

4. Conclusions

The bio inoculants will definitely increase the efficiency of shoot and root system providing essential N and P for growth. For quality seedling production of tea plant, due consideration should be given to the biofertilizers such as VAM, Azospirillum and PSB rather than chemical inputs. This technology could be adopted in tea growing areas to improve the rate of growth and enhance productivity in the field and also helps reducing chemical fertilizers use and subsequently reduces the cost of seedling production.

Conflict of interest statement

We declare that we have no conflict of interest.

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