Evaluation of Bio-inoculants Enriched Marginal Soils as Potting Mixture in Coffee Nursery

Shiva Prasad P, Hareesh SB, Maria Violet D’Souza*, Manjunath AN and Jayarama

Central Coffee Research Institute, Chikmagalur, Karnataka, India

*Corresponding author: Violet D’Souza M, Central Coffee Research Institute, Karnataka, India, Tel: +91-80-22266991-994; E-mail: m.violet@gmail.com

Received date: August 14, 2014; Accepted date: August 15, 2014; Published date: August 22, 2014

Copyright: © 2014, Violet D’Souza M et al. This is an open-access editorial distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Fertile jungle soil is a primary ingredient of potting mixture used in coffee nursery to raise healthy, vigorous seedlings and in recent times its availability has diminished due to the receding forest lands in traditional coffee cultivating areas. Hence a nursery trial was conducted with the objective of exploring the possibility of utilizing marginal or less fertile soils enriched with bio-inoculants in the potting mixture. Two soils, (soil-1 and soil-2), which are less fertile and marginal in characteristics compared to the jungle soil enriched with bio-inoculants consortia of Azospirillum, Pseudomonas flurosence, Phosphate Solubilising Bacteria (PSB) and Vesicular Arbuscular Mycorrhiza (VAM) were employed in the secondary nursery to raise coffee seedlings and monitored for growth parameters, nutrient uptake, soil nutrient status and colony forming units for about 200 days after sowing. The results of the study indicated that the recommended Standard Package of Practice (SPP) with jungle soil, Farm Yard Manure (FYM) and sand in the 6:2:1 proportion is a best suited potting mixture to raise the coffee nursery. But in absence of the fertile jungle soil, the marginal soils also can be utilized as an ingredient of potting mixture with due care to incorporate adequate quantity of farm yard manure and the microbial consortia is not a substitute for FYM in the potting mixture.

Keywords: Jungle soil; Soil-1; Soil-2; Bio-inoculants

Introduction

Raising vigorous and healthy coffee seedlings in the nursery is a must for establishing superior coffee plantation in a long run. The recommended Standard Package of Practice (SPP) for coffee nursery includes a primary sowing bed prepared using the fertile jungle soil and mixture of jungle soil, Farm Yard Manure (FYM) and sand in the ratio of 6:2:1 [1] for the poly bag/secondary nursery. Nowadays due to dwindling of forest lands in the traditional coffee growing areas and various other associated problems, procuring of fertile jungle soil in large quantity to raise the nursery is not an easy task. Under such a situation the farmers are compelled to use the easily available marginal/ less fertile soils for raising nursery which in turn will result into weak and unhealthy seedlings. The advantageous uses of bio-inoculants for boosting growth in the nursery are known in many crops and also in coffee. The individual and consortia of Azospirillum, *Pseudomonas flurosence*, Phosphate Solubilising Bacteria (PSB) and Vesicular Arbuscular Mycorrhiza (VAM) procured from University of Agricultural Sciences, Dharwad were used to prepare bio-inoculants consortia. Adequate numbers of seeds were sown in three different primary beds prepared using jungle soil, soil-1 and soil-2 and seedlings in ‘topi’ stage were raised. These seedlings were transplanted during April from primary bed to the secondary nursery with the following treatments.

- **T1** – Soil 1 or Soil 2 only
- **T2** – Standard package of practice (SPP) [Jungle soil, farm yard manure (FYM) and sand in the ratio of 6:2:1]
- **T3** – T2 + Consortia (100 g)
- **T4** – Soil 1 / Soil 2: FYM: Sand - (4: 2: 3)
- **T5** – Soil 1 / Soil 2 (4): Consortia (50 g): Sand (3)
- **T6** – Soil 1 / Soil 2 (4): Consortia (100 g): Sand (3)
- **T7** – Soil 1 / Soil 2 (4): Consortia (150 g): Sand (3)

Nursery was maintained under shade net and as per the existing package of practice all the necessary plant pest and disease care practices were followed strictly. At intervals of 100, 150 and 200 days after transplanting (DAT) observations on shoot and root length, stem girth, leaf area, dry weight of seedlings, soil chemical parameters like pH, EC, available major and secondary nutrients, organic carbon content and DTPA extractable micronutrients were determined by employing the standard methods. The soil biological properties, namely, microbial population [5], microbial respiration, Dehydrogenase activity (Incubation method) [6] and Biomass Carbon (K) from growth media were recorded at the end of the trial (200 DAT).

Materials and Methods

A nursery trial on Chandragiri (arabica) seedlings was conducted during the year 2010-11 at Central Coffee Research Institute, Chikmagalur District to explore the possible utility of marginal soils enriched with bio-inoculants in nursery mixture. A Randomized Block Design (RBD) with seven treatments (T1-T7), three replications per treatment and about 100 seedlings per treatment was adopted in the trial where in two types of soils namely, soil-1 and soil-2 were employed. Microbial inoculants viz., *Azospirillum, Pseudomonas flurosence*, Phosphate Solubilizing Bacteria (PSB) and Vesicular Arbuscular Mycorrhiza (VAM) procured from University of Agricultural Sciences, Dharwad were used to prepare bio-inoculants consortia. Adequate numbers of seeds were sown in three different primary beds prepared using jungle soil, soil-1 and soil-2 and seedlings in ‘topi’ stage were raised. These seedlings were transplanted during April from primary bed to the secondary nursery with the following treatments.
Results and Discussion

Soil characteristics

The soil physical, chemical and microbial parameters of the soils employed in the study are presented in Tables 1-3 respectively. Perusal of the data indicates that the two soils (Soil 1 and Soil 2) do not differ much from the jungle soil with respect to the sand, silt and clay contents.

| Soil Type | Sand (%) | Silt (%) | Clay (%) | Classification |
|-----------|----------|----------|----------|----------------|
| Jungle soil | 46.5 | 17.6 | 35.3 | Clay loam |
| Soil-1 | 49.9 | 19.3 | 31.0 | Clay loam |
| Soil-2 | 49.3 | 17.0 | 33.2 | Clay loam |

Table 1: Soil physical properties (Initial)

| Soil type | pH | OC (%) | Available nutrients | DTPA extractable micronutrients |
|-----------|----|--------|---------------------|--------------------------------|
|           |    |        | P (kg/ha) | K (kg/ha) | Ca (ppm) | Mg (ppm) | Cu (ppm) | Zn (ppm) | Mn (ppm) | Fe (ppm) |
| Jungle Soil | 5.9 | 3.0 | 23 | 159 | 1200 | 90 | 0.7 | 4.5 | 33.3 | 27.1 |
| Soil-1 | 4.8 | 1.0 | 2 | 76 | 800 | 30 | 0.5 | 1.6 | 21.6 | 25.2 |
| Soil-2 | 5.7 | 0.56 | 8 | 109 | 900 | 60 | 0.3 | 2.5 | 12.5 | 3.1 |

Table 2: Soil chemical properties (Initial)

| Soil type | P. Fluorescence ($10^3$) | PSB ($10^3$) | Azospirillum ($10^3$) | VAM (%) | Microbial Respiration (CO$_2$ mg kg$^{-1}$ soil hr$^{-1}$) | Dehydrogenase activity (µg of PNP g$^{-1}$ of soil hr$^{-1}$) | Biomass Carbon (mg kg$^{-1}$ CO$_2$ soil hr$^{-1}$) |
|-----------|-------------------------|-------------|---------------------|--------|---------------------------------|---------------------------------|-------------------------|
| Jungle Soil | 18 | 14 | 13 | 45 | 10.5 | 20.3 | 1575 |
| Soil-1 | 10 | 8 | 3 | 20 | 3.1 | 2.5 | 357 |
| Soil-2 | 7 | 7 | 5 | 30 | 1.1 | 3.8 | 295 |

Table 3: Microbial properties (Initial)

The jungle soil was far more superior to Soil 1 or Soil 2 (Table 2) in fertility status even though all the 3 soils registered acidic soil reaction. Soil 1 and Soil 2 had low organic carbon content and were deficient with respect to available P, K, Ca and Mg contents while the micro-nutrient status was not below respective critical limits. Hence Soil 1 and Soil 2 were referred to as marginal compared to the very fertile jungle soil. It can also be noted that Soil 1 and Soil 2 recorded lower microbial population as well as other biological properties compared to the jungle soil.

Growth parameters

The growth parameters of the seedlings in both the marginal soils recorded after 100 and 200 days of transplanting are presented in Tables 4 and 5 respectively. In general, the growth parameters increased in all the treatments over the period of observation. At 100 and 200 DAT, in both the marginal soils under study, the growth parameters, namely, plant height, root length, stem girth, number of leaves and leaf area were higher in seedlings receiving treatment T$_3$ (T$_2$ + 100 g consortia) compared to control T$_1$ (Soil 1/ Soil 2 only) at 100 DAT. The treatments T$_3$ (Standard package of practice- SPP) and T$_4$ (Soil 1/ Soil 2: FYM: Sand: 4: 2: 3), also recorded growth parameters on par with T$_3$. The growth of the seedlings receiving treatments T$_5$, T$_6$ and T$_7$ was poor compared to the seedlings under T$_2$, T$_3$ T$_4$. These observations are in lines of the results reported by Glory Swarupa, [4] who found significant increase in growth of coffee seedlings when treated with Azospirillum, Phosphobacteria and VAM. The potting mixtures under various treatments were subjected to analysis of nutrient status and biological properties to understand the variation in growth parameters observed under different treatments. Nutrient uptake of the seedlings was also studied.

Nutrient status of potting mixtures

At 200 DAT the potting mixtures were analyzed for the chemical properties (pH, OC) and nutrient status. The results are presented in Table 6 and 7 for Soil 1 and Soil 2 respectively. The soil reaction was near neutral in the treatments containing both the marginal soils with bio-inoculants. Per cent organic carbon and available P were significantly high in T$_3$ compared to T$_1$ (Soil 1 and Soil 2 only). However, available K was high in T$_7$ and on par with T$_5$, T$_6$ and T$_2$ compared to T$_1$. Thus the soil analytical data clearly indicated the fact that the nutrient availability in T$_2$ (SPP) is higher compared to the T$_1$ and the added microbial inoculants have the advantage of supplying nutrients in balanced and adequate quantities from the medium as seen in T$_3$. 

Citation: Prasad, Hareesh, D’souza, Manjunath, Jayarama (2014) Evaluation of Bio-inoculants Enriched Marginal Soils as Potting Mixture in Coffee Nursery. J Biofertil Biopestici 5: 148. doi:10.4172/2155-6202.1000148
### Table 4: Growth parameters of seedlings - 100 DAT

| Treatment | Soil-1 | Soil-2 |
|-----------|--------|--------|
|           | Plant height (cm) | Root length (cm) | Stem Girth (mm) | No. of leaves | Leaf area | Plant ht. (cm) | Root length (cm) | Stem Girth (mm) | No. of leaves | Leaf area (sq.cm) |
| T1        | 6.6    | 9.4    | 2.35 | 3.9 | 14.17 | 7.0    | 8.5    | 1.42 | 2.7 | 13.66 |
| T2        | 8.3    | 12.7   | 1.45 | 4.8 | 21.74 | 8.0    | 11.9   | 1.52 | 4.5 | 18.30 |
| T3        | 9.3    | 11.8   | 1.50 | 4.8 | 20.75 | 8.8    | 11.9   | 1.78 | 5.3 | 20.33 |
| T4        | 7.7    | 11.8   | 1.34 | 5.5 | 20.47 | 8.1    | 10.8   | 1.47 | 5.1 | 14.42 |
| T5        | 5.8    | 9.7    | 1.34 | 2.2 | 10.95 | 7.2    | 9.5    | 1.44 | 2.6 | 13.31 |
| T6        | 5.5    | 10.8   | 1.33 | 2.0 | 11.81 | 6.1    | 9.9    | 1.46 | 2.1 | 10.89 |
| T7        | 5.2    | 8.9    | 1.30 | 2.2 | 11.70 | 6.9    | 9.1    | 1.40 | 3.5 | 10.13 |
| Sem+/-    | 0.44   | 1.38   | 0.13 | 0.29 | 1.49 | 0.58   | 1.26   | 0.06 | 0.44 | 1.42 |
| CD at 5%  | 0.92   | 2.88   | 0.26 | 0.60 | 3.10 | 1.22   | 2.63   | 0.12 | 0.92 | 2.96 |

### Table 5: Growth parameters of seedlings (200 DAT)

| Treatment | Soil-1 | Soil-2 |
|-----------|--------|--------|
|           | Plant ht. (cm) | Root length (cm) | Stem Girth (mm) | No. of leaves | Leaf area | Plant ht. (cm) | Root length (cm) | Stem Girth (mm) | No. of leaves | Leaf area (sq.cm) |
| T1        | 7.1    | 14.7   | 2.0  | 7.0 | 9.5 | 9.7 | 16.1 | 2.5 | 8.3 | 15.2 |
| T2        | 16.3   | 17.3   | 3.6  | 11.5 | 46.3 | 16.2 | 16.7 | 3.8 | 11.1 | 39.6 |
| T3        | 16.8   | 19.1   | 3.9  | 12.3 | 51.6 | 19.2 | 19.4 | 4.0 | 12.8 | 56.1 |
| T4        | 16.2   | 15.1   | 3.4  | 10.7 | 38.5 | 15.4 | 15.2 | 3.4 | 10.9 | 34.1 |
| T5        | 7.9    | 16.1   | 2.4  | 9.6 | 11.2 | 9.6 | 16.2 | 2.6 | 9.9 | 14.4 |
| T6        | 10.4   | 15.9   | 2.6  | 10.6 | 21.8 | 9.0 | 15.2 | 2.6 | 10.4 | 14.1 |
| T7        | 9.5    | 14.7   | 2.4  | 9.9 | 19.5 | 9.7 | 16.0 | 2.9 | 9.5 | 15.3 |
| Sem+/-    | 0.42   | 1.21   | 0.15 | 0.57 | 1.34 | 0.53 | 0.67 | 0.15 | 0.44 | 2.08 |
| CD at 5%  | 0.87   | 2.47   | 0.31 | 1.17 | 2.75 | 1.08 | 1.78 | 0.31 | 0.90 | 4.28 |

### Available nutrients

| Treat. | pH | OC (%) | P (kg/ha) | K (kg/ha) | Ca (ppm) | Mg (ppm) | Cu (ppm) | Zn (ppm) | Mn (ppm) | Fe (ppm) |
|--------|----|--------|-----------|-----------|----------|----------|----------|----------|----------|----------|
| T1     | 4.6 | 0.9    | 13.7      | 199.7     | 700      | 30       | 0.5      | 4.5      | 28.5     | 25.9     |
| T2     | 5.7 | 4.2    | 104.0     | 388.7     | 800      | 130      | 0.6      | 7.5      | 107.0    | 27.5     |
| T3     | 6.3 | 4.2    | 96.0      | 434.7     | 1000     | 140      | 0.5      | 6.3      | 52.8     | 25.4     |
| T4     | 6.2 | 3.7    | 25.7      | 297.3     | 900      | 90       | 0.3      | 5.8      | 52.4     | 25.4     |
| T5     | 7.2 | 3.0    | 40.0      | 449.7     | 1600     | 240      | 0.3      | 5.6      | 41.7     | 20.7     |
| T6     | 7.9 | 3.8    | 26.7      | 413.3     | 1400     | 70       | 0.2      | 3.4      | 22.1     | 6.7      |
Table 6: Soil chemical properties of soil-1 at 200 DAT

| Treat. | pH  | OC (%) | Available nutrients | DTPA extractable micronutrients |
|--------|-----|--------|---------------------|---------------------------------|
|        |     |        | P (kg/ha) | K (kg/ha) | Ca (ppm) | Mg (ppm) | Cu (ppm) | Zn (ppm) | Mn (ppm) | Fe (ppm) |
| T_1    | 5.9 | 0.8    | 6.0       | 210.7     | 1400     | 70       | 0.1      | 2.8      | 15.1     | 3.5      |
| T_2    | 6.3 | 3.3    | 125.3     | 355.3     | 900      | 130      | 0.7      | 7.4      | 82.9     | 27.0     |
| T_3    | 6.6 | 4.2    | 77.3      | 355.3     | 1400     | 50       | 0.4      | 3.4      | 50.7     | 12.7     |
| T_4    | 6.6 | 3.2    | 45.0      | 232.0     | 1400     | 90       | 0.4      | 6.3      | 29.4     | 11.6     |
| T_5    | 7.8 | 3.0    | 36.7      | 377.0     | 1500     | 60       | 0.1      | 4.4      | 11.9     | 3.7      |
| T_6    | 8.0 | 3.4    | 15.0      | 438.7     | 1500     | 60       | 0.1      | 3.4      | 12.7     | 2.8      |
| T_7    | 8.2 | 2.6    | 21.7      | 493.7     | 1500     | 100      | 0.2      | 3.5      | 23.0     | 3.6      |
| Sem+/- | 0.2 | 0.42   | 26.20     | 70.44     | 178.6    | 43.1     | 0.04     | 0.80     | 6.7      | 5.6      |
| CD at 5%| 0.42| 0.88   | 55.02     | 147.91    | NS       | NS       | NS       | 1.74     | 14.5     | 12.2     |

Table 7: Soil chemical properties of soil-2 at 200 DAT

Biological properties of potting mixtures

The potting mixtures under various treatments in which the seedlings were grown for 200 days were enumerated for microbial Colony Forming Units (cfus) and biological parameters like Microbial respiration, Dehydrogenase activity and Biomass carbon. The data is presented in Tables 8 and 9.

### Table 8: Colony forming units of Soil-1 at 200 DAT

| Treatments | P.Fluroscence \(10^3\) | PSB \(10^3\) | Azosprillum \(10^3\) | VAM (%) | Microbial Respiration \((\text{CO}_2 \text{ mg kg}^{-1} \text{ soil hr}^{-1})\) | Dehydrogenase activity \((\mu g \text{ of PNP g}^{-1} \text{ of soil hr}^{-1})\) | Biomass Carbon \((\text{CO}_2 \text{ mg kg}^{-1} \text{ soil hr}^{-1})\) |
|------------|-----------------|-------------|-----------------|--------|-----------------------------|-------------------------------|--------------------|
| T_1        | 15              | 10          | 5               | 40     | 7.8                         | 12.2                          | 1207               |
| T_2        | 35              | 18          | 12              | 70     | 18.1                        | 29.8                          | 2809               |
| T_3        | 40              | 20          | 14              | 70     | 16.8                        | 37.4                          | 2824               |
| T_4        | 29              | 17          | 11              | 70     | 16.1                        | 25.5                          | 1783               |
| T_5        | 18              | 13          | 6               | 50     | 12.7                        | 13.9                          | 785                |
| T_6        | 24              | 14          | 8               | 60     | 14.3                        | 12.7                          | 1277               |
| T_7        | 25              | 15          | 8               | 60     | 17.7                        | 15.1                          | 977                |
| Sem+/-     | 3.01            | 2.0         | 1.38            | 4.1    | 2.4                         | 4.1                           | 390.7              |
| CD at 5%   | 6.03            | 4.0         | 2.76            | 8.2    | NS                          | NS                            | 781.5              |
(18.1, 2809 CO₂ mg kg⁻¹ soil hr⁻¹ and 29.8 µg of PNP g⁻¹ of soil hr⁻¹ respectively) and T₄ (16.1, 1783 CO₂ mg kg⁻¹ soil hr⁻¹ and 25.5 µg of PNP g⁻¹ of soil hr⁻¹ respectively) compared to T₁ (7.8, 1207 CO₂ mg kg⁻¹ soil hr⁻¹ and 12.2 µg of PNP g⁻¹ of soil hr⁻¹ respectively). Similar results have been recorded for Soil-2 also.

### Table 9: Colony forming units Soil-2 at 200 DAT

| Treatments | P. Fluroscence (10³) | PSB (10³) | Azosprillum (10³) | VAM (%) | Microbial Respiration (CO₂ mg kg⁻¹ soil hr⁻¹) | Dehydrogenase activity (µg of PNP g⁻¹ of soil hr⁻¹) | Biomass Carbon (CO₂ mg kg⁻¹ soil hr⁻¹) |
|------------|---------------------|-----------|------------------|---------|---------------------------------------------|-----------------------------------------------|--------------------------------|---|
| T₁         | 43                  | 27        | 20               | 50      | 12.3                                        | 4.9                                           | 7.8                                           |
| T₂         | 38                  | 15        | 9                | 60      | 13.7                                        | 5.8                                           | 8.6                                           |
| T₃         | 31                  | 15        | 9                | 60      | 15.1                                        | 13.7                                          | 8.9                                           |
| T₄         | 38                  | 15        | 11               | 60      | 15.1                                        | 8.8                                           | 9.7                                           |
| T₅         | 30.2                | 3.5       | 15.3             | 9.2     | 1.3                                         | 3.6                                           | 7.0                                           |
| T₆         | 31.6                | 3.6       | 16.0             | 9.8     | 1.5                                         | 5.6                                           | 8.8                                           |
| T₇         | 26.3                | 3.0       | 13.0             | 8.1     | 1.3                                         | 5.3                                           | 10.8                                          |
| Sem+/−     | 3.01                | 2.0       | 1.38             | 4.1     | 2.3                                         | 4.1                                           | 390.7                                         |
| CD at 5%   | 6.03                | 4.0       | 2.76             | 8.2     | NS                                          | 8.2                                           | 781.5                                         |

### Table 10: Nutrient uptake of seedlings at 200 DAT in Soil-1

| Treatments | Leaf | Stem | Root |
|------------|------|------|------|
|             | N (mg/g) | P (mg/g) | K (mg/g) | N (mg/g) | P (mg/g) | K (mg/g) | N (mg/g) | P (mg/g) | K (mg/g) |
| T₁         | 2.0  | 0.2  | 1.1  | 1.5  | 0.1  | 0.6  | 2.1  | 0.1  | 1.0  |
| T₂         | 30.2 | 3.5  | 15.3 | 9.2  | 1.3  | 5.6  | 11.3 | 1.3  | 6.4  |
| T₃         | 31.6 | 3.6  | 16.0 | 9.8  | 1.5  | 7.0  | 14.6 | 1.7  | 8.3  |
| T₄         | 26.3 | 3.0  | 13.0 | 8.1  | 1.3  | 5.3  | 10.8 | 1.1  | 5.1  |
| T₅         | 3.8  | 0.6  | 2.0  | 1.9  | 0.2  | 0.7  | 3.8  | 0.3  | 1.8  |
| T₆         | 11.9 | 1.2  | 4.0  | 2.6  | 0.4  | 1.1  | 5.0  | 0.5  | 2.4  |
| T₇         | 10.3 | 1.1  | 4.6  | 2.1  | 0.4  | 1.3  | 4.0  | 0.4  | 2.1  |
| Sem+/−     | 1.82 | 0.28 | 1.21 | 1.25 | 0.2  | 0.71 | 1.4  | 0.13 | 0.68 |
| CD at 5%   | NS   | 0.57 | 2.43 | 2.51 | 0.39 | 1.42 | 2.7  | 0.26 | 1.36 |

#### Nutrient uptake by seedlings

The seedlings were uprooted at 200 DAT and plant parts were analyzed for the nutrient contents and the uptake was computed. The nutrient uptake of the seedlings grown in both the marginal soils is presented in Tables 10 and 11.

Uptake of N, P and K by leaf, stem and root of seedlings grown in Soil 1 and Soil 2, were significantly high in T₃ and on par with T₂ and T₄ compared to T₁. Thus the higher growth parameters observed under T₃ can be attributed to availability and uptake of balanced and higher quantum of nutrients to seedlings through FYM as well as bio-inoculants consortia compared to ‘control’. The poor growth of seedlings observed in the treatments T₅, T₆ and T₇ compared to the seedlings under T₂, T₃, and T₄ may be due to the lack of adequate organic matter which is essential for establishment of externally supplied microbes in the form of bio-inoculants. Better growth of seedlings in T₄ confirms the fact that FYM is an inevitable ingredient of potting mixture for raising coffee seedlings as it is capable of providing the organic matter even when the soil used in the potting mixture is deficient in organic matter.
Table 1: Nutrient uptake of seedlings at 200 DAT in Soil-2

| Treatments | Leaf | | | Stem | | | | Root | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N (mg/g) | P (mg/g) | K (mg/g) | N (mg/g) | P (mg/g) | K (mg/g) | N (mg/g) | P (mg/g) | K (mg/g) |
| T1 | 2.3 | 0.3 | 1.1 | 1.3 | 0.1 | 0.6 | 1.5 | 0.1 | 0.9 |
| T2 | 28.0 | 3.5 | 12.1 | 8.3 | 1.2 | 4.9 | 10.3 | 1.2 | 6.3 |
| T3 | 29.3 | 3.8 | 14.5 | 9.3 | 1.3 | 6.7 | 14.6 | 1.5 | 8.1 |
| T4 | 26.3 | 2.9 | 11.3 | 8.1 | 1.2 | 4.8 | 9.9 | 1.1 | 6.1 |
| T5 | 6.3 | 0.5 | 2.4 | 1.6 | 0.2 | 0.8 | 3.1 | 0.4 | 1.7 |
| T6 | 9.7 | 0.9 | 4.8 | 2.4 | 0.4 | 1.2 | 4.8 | 0.5 | 2.3 |
| T7 | 8.8 | 0.9 | 4.3 | 2.2 | 0.3 | 1.4 | 4.0 | 0.4 | 2.1 |
| Sem+/− | 1.73 | 0.28 | 1.21 | 1.25 | 0.2 | 0.71 | 1.4 | 0.13 | 0.68 |
| CD at 5% | NS | 0.57 | 2.43 | 2.51 | 0.39 | 1.42 | 2.7 | 0.26 | 1.36 |

Table 11: Nutrient uptake of seedlings at 200 DAT in Soil-2

Conclusion

The growth parameters, nutrient status and biological parameters of the potting mixtures, and data on nutrient uptake by the seedlings under different treatments recorded in the nursery trial conducted with the objective of exploring the possibility of utilizing marginal or less fertile soils enriched with bio-inoculants in the potting mixture lead to a conclusion that the SPP (mixture of jungle soil, FYM and sand in the ratio 6:2:1) is the best suited potting mixture to raise the coffee nursery. But in absence of the fertile jungle soil, the marginal soil can be utilized as an ingredient of potting mixture with due care to incorporate adequate quantity of farm yard manure and the microbial consortia is not a substitute for FYM in the potting mixture. This is because of the fact that adequate organic matter is essential for establishment of externally supplied microbes in the form of bio-inoculants and FYM is capable of providing the organic matter even when the soil used in the potting mixture is deficient in organic matter.

References

1. Anonymous (1996) Coffee Guide. Coffee Board, Research Department. India. 180 pp.

2. Azizuddin M, Krishnamurthy RW (1984) Field and nursery experiment with Azotobacter. pp. 289-295. In: Proceedings of 6th Symposium on plantation crops, Rubber Institute of India, Kottayam, 16-20 Dec 1984. Vance ED, Brookes PC, Jenkinson DS (1987) An extraction method for measuring microbial biomass carbon. Soil Biol Biochem 19: 783-707.

3. Biradar IB, Raghuramulu Y, Muralidhara HR, Sudhakar SR (2006) Effect of Bio-fertilizers and PGPRS on growth and development of coffee seedlings. J Coffee Research 34: 57-63.

4. Glory Swarupa (1997) Effect of bio fertilizers on nutrient uptake by coffee seedlings. 3rd IFOAM-ASIA Scientific Conference. Bangalore. 54.

5. Buchanan RE, Gibbons NE (1974) Bergy's Manual of Determinative Bacteriology, 8th ed., William and Wilkins, Baltimore. p.1268.

6. Eivazi F, Tabatabai MA (1977) Phosphatases in soils. Soil Biol Biochem 9: 167-172.

7. Anderson JPE (1982) Soil respiration in Methods of soil Analysis. Part-2, Chemical and Microbiological properties, 2nd ed., (page, Al, et al., Eds), Soil Science Society of America Inc., USA. pp 831.