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Effect of Microbial Inoculants on the Growth of Coffee in Nursery Condition

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Abstract

An experiment was conducted under shade net to evaluate *Trichoderma*, P solubilizer and N fixers for growth promoting activity of coffee seedlings. Microbial inoculants such as *Trichoderma, Bacillus coagulans* (P solubilizer) and *Azotobacter* (N fixer) were used for the studies. The growth of the plants was not significantly differing between the treatments in all the stages. The results show the potting mixture at forestry college nursery is having sufficient nutrients for the growth of coffee seedlings under nursery conditions and the addition of any chemical fertilizers or biofertilizers is not recommended for the seedlings, there by they can reduce the cost of production of the coffee seedlings under nursery condition.

Key words : *Trichoderma, Bacillus coagulans* (P solubilizer), *Azatobacter* (N fixer).

Coffee is one of the most important agricultural export products. It is second most important commodity after petroleum products in International trade. Coffee seeds are roasted ground and brined to make a stimulating and refreshing beverage. Coffee pulp is used as manure, soil conditioner and mulch for agriculture production. Caffeine is an important constituent of coffee which has stimulating effect. It is used in medicine as a diuretic and a beverage to convalescent people. Coffee in Kodagu propagated through seeds requires around 8 to 10 months from seed sowing in beds to planting in field. Realizing the importance of this crop, Bio-inoculants studies was conducted in order to know its effect on growth at nursery level so that boosting the nursery growth will have the impact on early establishment and higher growth performance of this commercially important crop. The experiment was conducted to study the effect of bio inoculants on the growth of coffee seedlings in nursery condition.

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Table 1. Effect of microbial inoculants on the height (cm) of coffee seedlings. DAT—Days after transplanting.

Treatments	On DAT				
	Initial	30	60	90	120
T_1–*Trichoderma*	9.18	11.90	12.30	18.33	22.60
T_2–P solubilizer	8.73	13.20	12.65	18.38	22.35
T_3–N fixer	8.20	12.70	13.00	18.45	23.00
T_4–*Trichoderma* + P solubilizer	8.50	12.23	13.15	18.35	22.90
T_5–*Trichoderma* + N fixer	8.13	11.65	13.68	18.45	21.40
T_6– P solubilizer + N fixer	8.75	12.43	12.28	19.80	22.70
T_7–*Trichoderma* + P solubilizer + N fixer	9.15	13.10	14.65	19.38	22.73
T_8–Chemical fertilizer	8.60	12.60	13.25	19.10	22.40
T_9–Neem cake	9.40	12.40	13.80	19.20	21.20
T_{10}–Control (only potting mixture)	8.90	11.73	13.30	18.60	22.35
SE	0.33494	0.37741	0.50839	0.35628	0.42197
F ratio	NS	NS	NS	NS	NS

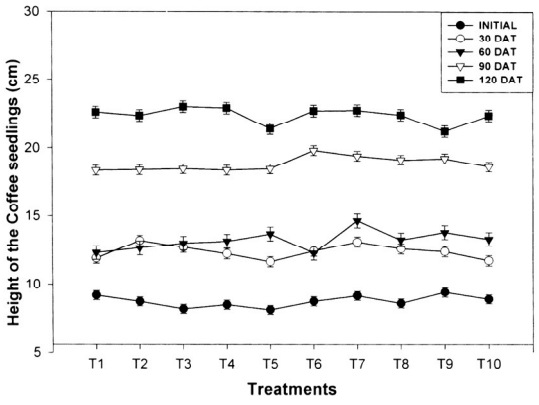

Figure 1. Effect of microbial inoculants on the height (cm) of coffee seedlings.

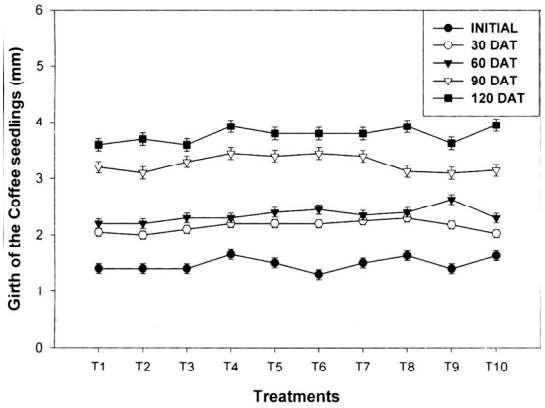

Figure 2. Effect of microbial inoculants on the girth (mm) of coffee seedlings.

support to conduct this experiment).

Methods

The experiment was conducted under shade net at college of forestry, Ponnampet to assess the potentiality of *Trichoderma*, P solubilizer and N fixers for growth promoting activity of Silver oak. Bioinoculants such as *Trichoderma, Bacillus coagulans* (P solubilizer) and *Azotobacter* (N fixer) was obtained from the Dept. of Agricultural Microbiology, UAS, GKVK, Bangalore. Three month old coffee seedlings were procured from a locally available nursery at Ponnampet. Potting mixtures was prepared by mixing sand, soil and FYM at 1:1:1 ratio and one kg of the potting mixtures was filled in for around 2,000 polythene covers. One coffee seedlings was planted in each polythene bags, totally one thousand bags were planted and maintained for one month with proper watering and weeding. The experiment was conducted in completely randomized design (CRD) with ten treatments and three replications.

Three hundred seedlings were transplanted at thirty per each treatment having three replication at 10 plants per replication. The fungal and bacterial inoculants were grown in Potato dextrose broth and Nutrient broth respectively in 250 ml conical flask for 15 days at 26 ± 2 C. The mycelial mat of *Trichoderma* was separated by muslin cloth, macerated in sterile water in a warring blender. The N fixers and P solubilizer suspension was prepared by thorough shaking of the growth and this inoculants was poured at 10 ml per plant. Chemical fertilizer like urea, rock phosphate and murate of potash was mixed at 1:1:1 ratio and

Table 2. Effect of microbial inoculants on the girth (mm) of coffee seedlings. DAT–Days after transplanting.

Treatments	Initial	On DAT 30	60	90	120
T_1–*Trichoderma*	1.40	2.05	2.20	3.20	3.60
T_2–P solubilizer	1.40	2.00	2.20	3.10	3.70
T_3–N fixer	1.40	2.10	2.30	3.30	3.60
T_4–*Trichoderma* + P solubilizer	1.65	2.20	2.30	3.45	3.93
T_5–*Trichoderma* + N fixer	1.50	2.20	2.40	3.40	3.80
T_6–P solubilizer + N fixer	1.30	2.20	2.45	3.45	3.80
T_7–*Trichoderma* + P solubilizer + N fixer	1.50	2.25	2.35	3.40	3.80
T_8–Chemical fertilizer	1.63	2.30	2.40	3.13	3.93
T_9–Neem cake	1.40	2.18	2.63	3.10	3.63
T_{10}–Control (only potting mixture)	1.63	2.03	2.30	3.15	3.95
SE	0.08684	0.07042	0.086	0.10557	0.11002
F ratio	NS	NS	NS	NS	NS

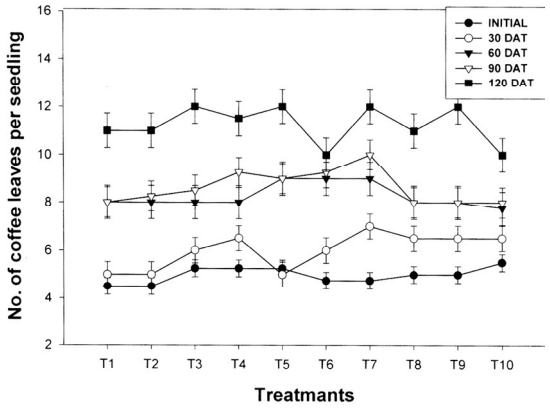

Figure 3. Effect of microbial inoculants on number of leaves of coffee seedlings.

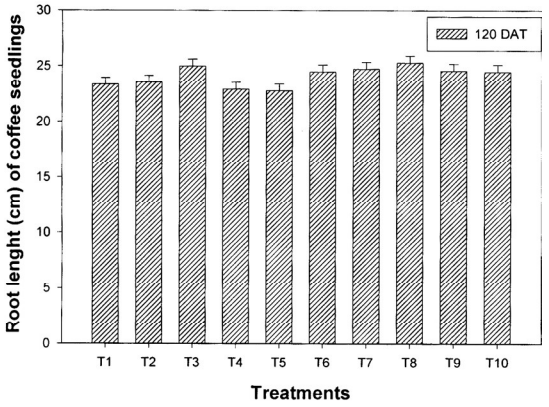

Figure 4. Effect of microbial inoculants on the root length (cm) of coffee.

applied at 5 g/plant. Neem cake was applied at 10 g/plant. This recommendation of nutrient was commonly practiced in the nursery condition at College of Forestry, Ponnampet.

Plant height of coffee was measured from the base of the shoot tip of the seedling at 30, 60, 90 and 120 days after transplanting. Stem girth of coffee was measured at the color region of the main shoot using Vernier calipers at 30, 60, 90 and 120 days after transplanting. The girth was calculated using the formula.

$$\text{Girth} = \text{Main scale reading} + \text{Vernier scale reading} \times \text{least count}$$

Total number of leaves were also counted at 30, 60, 90 and 120 days after transplanting. The root length was measured at 120 days after transplanting.

The data obtained in this experimental study were subjected to statistical analysis suitable for completely randomized experiment (1).

Results and Discussion

Biofertilizers in general provides nutrients to plants for ots growth. Some of the biofertilizers like *Trichoderma, Bacillus* and *Pseudomonas* will act as a biological control and also provides plant growth harmones to the plants (2). This microbes will alter the root physiology (3). Many strains of *Bacillus, Pseudomonas* and *Trichoderma* have been implicated in improvement of overall growth of many crop plants (4—6).

The height of the coffee seedlings in all the stages was non significant between the treatments (Table 1

Table 3. Effect of microbial inoculants on number of leaves of coffee seedlings. DAT–Days after transplanting.

Treatments	On DAT				
	Initial	30	60	90	120
T_1–*Trichoderma*	4.50	5.00	8.00	8.00	11.00
T_2–P solubilizer	4.50	5.00	8.00	8.25	11.00
T_3–N fixer	5.25	6.00	8.00	8.50	12.00
T_4–*Trichoderma* + P solubilizer	5.25	6.50	8.00	9.25	11.50
T_5–*Trichoderma* + N fixer	5.25	5.00	9.00	9.00	12.00
T_6–P solubilizer + N fixer	4.75	6.00	9.00	9.25	10.00
T_7–*Trichoderma* + P solubilizer + N fixer	4.75	7.00	9.00	10.00	12.00
T_8–Chemical fertilizer	5.00	6.50	8.00	8.00	11.00
T_9–Neem cake	5.00	6.50	8.00	8.00	12.00
T_{10}–Control (only potting mixture)	5.50	6.50	7.75	8.00	10.00
SE	0.35059	0.5164	0.6997	0.6275	0.71297
F ratio	NS	NS	NS	NS	NS

Table 4. Effect of microbial inoculants on the root length (cm) of coffee seedlings. DAT—Days after transplanting.

Treatments	120 DAT
T_1–*Trichoderma*	23.33
T_2–P solubilizer	23.53
T_3–N fixer	25.00
T_4–*Trichoderma* + P solubilizer	22.90
T_5–*Trichoderma* + N fixer	22.75
T_6–P solubilizer + N fixer	24.50
T_7–*Trichoderma* + P solubilizer + N fixer	24.75
T_8–Chemical fertilizer	25.30
T_9–Neem cake	24.60
T_{10}–Control (only potting mixture)	24.50
SE	0.61681
F ratio	NS

and Fig. 1), however there was some slight difference in the plants with different treatments and the growth of the plants were increased as the days increased. At 120 days after transplanting, the maximum height was in N fixer treated plants (23.00 cm) and it is almost on par with the results of other treatments. Minimum was observed in plants inoculated with neem cake (21.20 cm).

The same trend is observed in the girth of the Coffee seedlings (Table 2 and Fig. 2). Here the control seedlings (3.95 mm) and the seedlings treated with *Trichoderma* and P solubilizers (3.93 mm) and plants treated with chemical fertilizers (3.93 mm) is on par with each other and minimum was observed in plants treated with *Trichoderma* and N fixer (3.60 mm) at 120 days after transplanting. This is may be due to the plants require less nutrients content and the seedlings may be a slow grower in nature or the potting mixture may have enough nutrients for the growth of coffee seedlings.

The number of leaves in the coffee was increased from initial to 120 days after transplanting (Table 3 and Fig. 3), maximum was in plants treated with *Trichoderma* and N fixer, N fixer alone and plants treated with neem cake (12.00) and minimum was in plants treated with P solubilizer + N fixer (10.00) and also in control (10.00), between all the treatments at all the stages non significant differences was observed. After 60, 90 and 120 DAT, the number of leaves decreased.

The root length was recorded at 120 days after transplanting (Table 4 and Fig. 4), the results was same as we observed in the above cases the maximum length was observed in plants treated with chemical fertilizers (25.30 cm) and it is at par with the plants treated with N fixer (25.00 cm) and minimum was in plants treated with P solubilizer and N fixer (22.75 cm). To conclude the coffee nursery can be taken up with out any extra inputs to the potting mixtures and can reduce the cost for the nursery. The same observations was also noticed by Umashankar et al. (7).

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