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Studies of different Microbial Inoculants on Growth of Cardamom in Nursery Condition

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Abstract

Nursery experiment was conducted to evaluate *Trichoderma,* P solubilizer and N fixers for growth promoting activity of cardamom under shade net. Microbial inoculants such as *Trichoderma, Bacillus coagulans* (P solubilizer) and *Azotobacter* (N fixer) were used for the studies. The growth of the plants showed significant difference between the treatments in almost all the growth parameters except in some stages it is not showing significant difference. The results of the treated plants compared to control did not show much difference. The potting mixture at forestry college nursery has to be provided biofertilizer viz. *Trichoderma*, P solubilizer and if necessary the N fixers for the cardamom seedlings.
Key words : *Trichoderma, Bacillus coagulants* (P solubilizer), *Azotobacter* (N fixer), Cardamom, Growth, Nursery.

Cardamom popularly known as "Queen of Spices". Indian cardamom occupies a unique position in the world market, for its high quality. It is used as flavoring agent in food, confectionary beverages, cosmetics and medicinal values of cardamom are due to the volatile oil present in seed and husk.The aroma and medicinal values of cardamon are due to the volatile oil present in seed and husk. The cardamom oil is of high economic value since it is used in flavoring beverages, cosmetics. Therefore, realizing the importance of this crop, bio-inoculants were used 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 cardamom seedlings in nursery condition.

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Methods

Nursery experiment was conducted under shade net at college of Forestry, Ponnampet to evaluate *Trichoderma,* P solubilizer and N fixers for growth promoting activity of cardamom. Bioinoculants such as *Trichoderma, Bacillus coagulans* (P solubilizer) and *Azotobacter* (N fixer) were obtained from the Department of Agricultural Microbiology, USA, GKVK, Bangalore. Cardamom seeds obtained from Spice Research Center at Madikeri. Potting mixtures was prepared by mixing sand, soil and FYM at 1:1:1 ratio and one kg the potting mixtures was filled in for around 2000 polythene covers. One cardamom seed was sown in each polythene bags, totally one thousand bags were sown 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 microbial inoculants were grown in potato dextrose broth and nutrient broth respectively in 250 ml conical flask for 15 days at 26 ± 2C. The mycelial mat of *Trichoderma* was separated by muslin cloth, macerated in sterile water in a blender. The N fixers and P solubilizer suspension were prepared by thorough shaking of the growth and this inoculants was poured at 10 ml per plant. Chemical fertilizers like urea, rock phosphate and murate of potash was mixed at 1:1:1 ratio and applied at 5 g plant. Neem cake was applied at 10 g/plant. This rec-

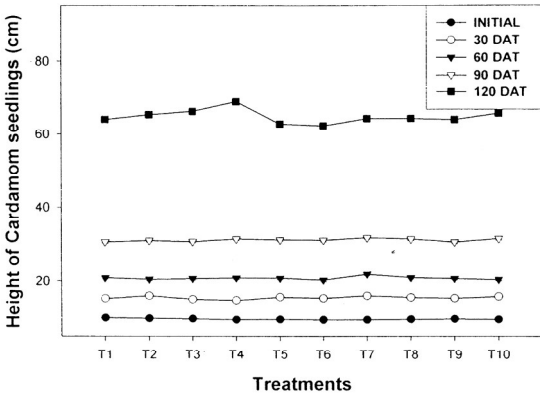

Figure 1. Effect of microbial inoculants on the height (cm) of cardamon seedlings.

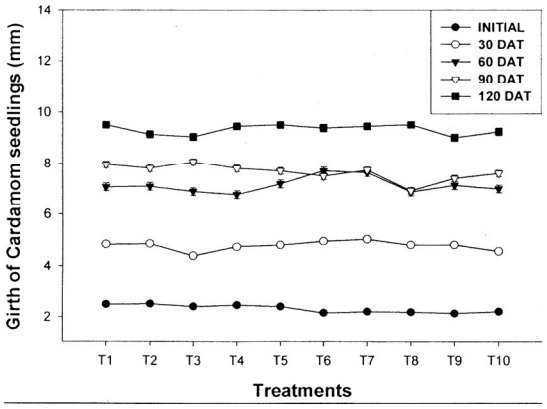

Figure 2. Effect of microbial inoculants on the girth (mm) of cardamom seedlings.

ommendation of nutrient was commonly practiced in the nursery condition at College of Forestry, Ponnampet.

Plant height of cardamom was measured from the base of the shoot tip of the seedling at 30, 60, 90 and 120 days after transplanting. Stem girth of cardamom 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 was also counted at 30, 60, 90 and 120 days after transplanting. The root length was recorded at 120 DAT. The data obtained in this experimental study were statistically analyzed using standard methods (1).

Results and Discussion

Microbial inoculants have been advocated to provide benefits to growing plants in terms of direct promotion of vegetative growth through atmospheric N fination, P solubilization and release of growth promoting substances in the rhizosphere which altered root physiology (2). The study was aimed to assess the effects of *Bacillus, Pseudomonas* and *Trichoderma* isolates on plant growth of silver oak in the nursery condition.

The data pertaining to the height of cardamom showed an increase at all the stages and there was

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

Treatments	Initial	On DAT 30	60	90	120
T_1—*Trichoderma*	9.95	15.20	20.88	30.55	64.10
T_2—P solubilizer	9.78	15.93	20.45	30.90	65.40
T_3—N fixer	9.70	15.00	20.63	30.63	66.30
T_4—*Trichoderma* + P solubilizer	9.43	14.68	20.83	31.33	68.95
T_5—*Trichoderma* + N fixer	9.50	15.58	20.75	31.08	62.83
T_6—P solubilizer + N fixer	9.40	15.28	20.25	31.00	62.30
T_7—*Trichoderma* + P solubilizer + N fixer	9.40	15.93	21.88	31.68	64.30
T_8—Chemical fertilizer	9.55	15.50	20.93	31.33	64.30
T_9—Neem cake	9.65	15.28	20.68	30.55	64.03
T_{10}—Control (only potting mixture)	9.50	15.75	20.40	31.45	65.73
SE	0.144482	0.282179	0.380296	0.384572	0.828213
F-Ratio	NS	NS	NS	NS	-

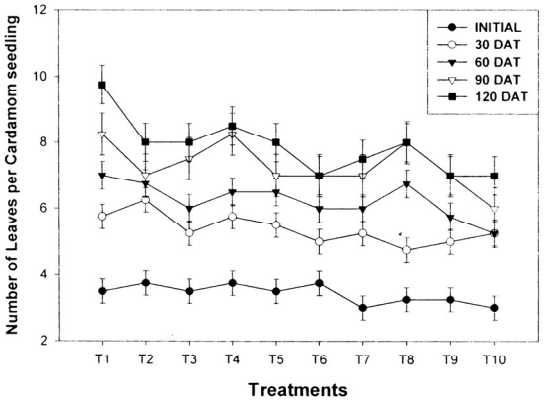

Figure 3. Effect of microbial inoculants on number of leaves of cardamom seedlings.

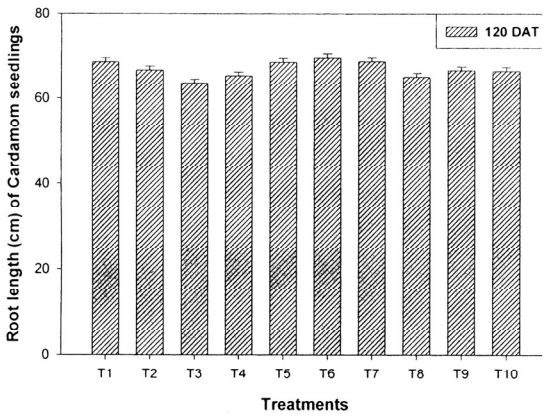

Figure 4. Effect of microbial inoculants on the root length (cm) of cardamom seedlings.

significant difference between the treatments at 120 days after transplanting. Maximum height was observed in *Trichoderma* and P solubilizers inoculated plant (68.95 cm) (Table 1 and Fig. 1) and minimum was in P solubilizer and N fixer inoculated plants (62.35 cm) and in control plants it was 65.73 cm. Initially. At 30, 60, 90 DAT the same trend was not observed and the results were not significantly differ from each other.

Many strains of *Bacillus, Pseudomonas* and *Trichoderma* have been implicated in improvement of overall growth of many crop plants (3). Here the treatment inoculated with *Trichoderma* and P solubilizers showed a maximum growth, this shows that the plant needs phosphorus and other plant hormones for its growth and the potting mixture is not providing sufficient amount of nutrients for the maximum growth of the plants. The plants with the chemical fertilizers and neem cake were almost at par with each other.

The collor diameter significantly differed from each other at 30, 60, 90 DAT but in the later stages at 120 DAT the results did not significantly differ (Table 2 and Fig. 2) ; maximum was in plants inoculated with *Trichoderma* (2.95 mm) and minimum in *Trichoderma* and N fixer inoculated plants and the plants inoculated with *Trichoderma* alone (9.50 mm) and it was at par with the plants inoculated with chemical fertilizers. At 30, 60 and 90 DAT the trend was entirely different compared to 120 DAT the maximum was in combined microbial inoculated plants (5.03 mm) at 30 DAT. Plants inoculated with P solubilizer and N fixer (7.70 mm) at 60 DAT it is the plants inoculated with N Fixer

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

Treatments	Initial	On DAT 30	60	90	120
T_1—*Trichoderma*	2.48	4.83	7.08	7.95	9.50
T_2—P solubilizer	2.50	4.85	7.10	7.80	9.13
T_3—N Fixer	2.40	4.38	6.90	8.05	9.03
T_4—*Trichoderma* + P solubilizer	2.45	4.73	6.78	7.80	9.45
T_5—Trichoderma + N fixer	2.40	4.80	7.20	7.70	9.50
T_6—P solubilizer + N fixer	2.15	4.95	7.70	7.50	9.38
T_7—*Trichoderma* + P solubilizer + N fixer	2.20	5.03	7.63	7.73	9.45
T_8—Chemical fertilizer	2.18	4.80	6.88	6.93	9.50
T_9—Neem cake	2.13	4.80	7.13	7.40	9.00
T_{10}—Control (only potting mixture)	2.20	4.55	7.00	7.60	9.23
SE	0.10498	0.08756	0.152138	0.128938	0.150831
F—Ratio	NS	*	*	*	NS

Table 3. Effect of microbial inoculants on number of leaves of cardamom seedlings. DAT—Days after transplanting.

Treatments	On DAT				
	Initial	30	60	90	120
T_1 —*Trichoderma*	3.50	5.75	7.00	8.25	9.75
T_2—P solubilizer	3.75	6.25	6.75	7.00	8.00
T_3—N fixer	3.50	5.25	6.00	7.50	8.00
T_4—*Trichoderma* + P solubilizer	3.75	5.75	6.50	8.25	8.50
T_5—*Trichoderma* + N fixer	3.50	5.50	6.50	7.00	8.00
T_6—P Solubilizer + N fixer	3.75	5.00	6.00	7.00	7.00
T_7—*Trichoderma* + P solubilizer + N fixer	3.00	5.25	6.00	7.00	7.50
T_8—Chemical fertilizer	3.25	4.75	6.75	8.00	8.00
T_9—Neem cake	3.25	5.00	5.75	7.00	7.00
T_{10}—Control (only potting mixture)	3.00	5.25	5.25	6.00	7.00
SE	0.373609	0.36799	0.41833	0.635741	0.582738
F-Ratio	NS	NS	NS	NS	-

alone (8.05 mm).

In the leaves in all the stages there was no significant difference between the treatments except at 120 DAT (Table 3 and Fig. 3). Initially all the plants in different treatments was at par with each other, later on at 30 DAT the maximum was observed in plants treated with P solubilizers (6.25) and it was almost at par with the other microbial treated plants. The lowest number was observed in plants treated with chemical fertilizers (4.75). The maximum number of leaves was in *Trichoderma* treated plants both at 30 DAT (7.00) and at 90 DAT (8.25) and it more when compared to the control plants, at 60 DAT (5.25) and at 90 DAT it is 6.00.

The root length was significantly differ from all the treatments (Table 4 and Fig. 4). The maximum was observed in the plants treated with P solubilizers and N fixers (69.50 cm). Plants treated with *Trichoderma* inoculants (68.5 cm) also gave the promising results when compared to control (66.38 cm) and it is on par with the plants treated with *Trichoderma* and N fixer (68.45 cm) and the plants inoculated with all the three microbial inoculants (68.65 cm). The lowest was recorded in the plants with chemical fertilizers (65.05 cm).

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

Treatments	120 DAT
T_1—*Trichoderma*	68.50
T_2—P solubilizer	66.63
T_3—N fixer	63.60
T_4—*Trichoderma* + P solubilizer	65.30
T_5—*Trichoderma* + N fixer	68.45
T_6—P solubilizer + N fixer	68.50
T_7—*Trichoderma* + P solubilizer + N fixer	68.65
T_8—Chemical fertilizer	65.05
T_9—Neem cake	66.55
T_{10}—Control (only potting mixture)	66.38
SE	0.900255
F-Ratio	-

The overall results showed there is significant increase in the plant growth with the application of bioinoculants, so the nursery plants of cardamom at Forestry College has to be treated with bioinoculants for overall increase in growth. The type and method of bioinoculant applications and the nutrient status of the soil sample has to be worked out before inoculation. The increase in length and girth of the cardamom at different growth stages could be attributed to thew release of growth promoting substances and increase nutrient availability by *Bacillus, Pseudomonas* and *Trichoderma* (4). The growth promoting substances are known to cause enhanced cell division and root development (5). The results obtained during the current investigation uphold the results observed by Daiho and Upadhyay (6) and Bochow (7), where in pot experiment, sand maize culture of *Trichoderma* resulted in an increase in the height and better root development of soybean plants.

To conclude the potting mixture at Forestry college nursery has to be provided with biofertilizer viz., *Trichoderma,* P solubilizer and if necessary the N fixers based on the nutrient status and the plant requirement. By the use of biofertilizers we can reduce

the cost incurred for growing cardamom in nursery condition.

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