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Effect Of Native Trichoderma On The Growth And Yield Of Some Vegetable Crops In Manipur

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Abstract: Trichoderma is an ecofriendly, soil-borne fungus found ubiquitously in soil and known to be a potential biocontrol and growth-promoting agent. Bio prospection of native Trichoderma spp. is a promising research area that encourages organic farming culture and the withdrawal of dependency on chemical pesticides. The adoption of organic crop production reduces health hazards in various sustainable ways. In the present investigation, the in vivo effect of native Trichoderma spp. was studied on the growth and yield of some vegetable crops, i.e., cabbage, cauliflower, pea. During the crop season of 2017-18, 3 native isolates of Trichoderma, namely Trichoderma asperellum-7 (KU933475), Trichoderma asperellum-25 (KT601340), Trichoderma harzianum-69(KU933468), along with a commercial formulation of Trichoderma viridi, were evaluated for its effect. The native Trichoderma and a commercial Trichoderma formulation were treated individually. A consortium treatment of the native Trichoderma was assessed for their performance in terms of plant growth & yield against control (only compost and FYM). The different treatments of Trichoderma spp. were influenced growth parameters and yield attributes on the vegetables studied. It was found out that the performance in terms of yield was highest in the consortium treatment of the native Trichoderma in all of the crops studied. Hence, the application of native Trichoderma improves the quality of the products and thereby increases crop yield.

Keywords: Trichoderma, cabbage, cauliflower, pea

1. INTRODUCTION

India shares 13.38% of vegetable production, important vegetables cabbage, cauliflower, peas, etc. (Anonymous, 2013). Cabbage (*Brassica oleracea var. capitata*) and Cauliflower (*Brassica oleracea var. botrytis*) are the few vital vegetables to the world food supply cole crops. Its high nutritional value contains vitamin B, vitamin C, beta-carotene, antioxidant, calcium, potassium, etc. Its nutritive value leads to increase high demand (Haque, 2006). Based on Anonymous 2011, India ranks next to China in the world's cabbage production, with an area of 18000 ha, its productivity of 20 metric tons/ha, and production of 36000 metric tons. Cauliflower contains vitamins, minerals, ant-cancer compounds, viz,

glucosinolates, sulforaphane, etc. (Kirsh et al., 2007). *Brassica oleracea* has the potential that can tolerate lower temperatures which enhance post-harvest storage in a cooler temperature (Plich, 1997; Steindal, 2013). Pea (*Pisumsativum*) is a leguminous vegetable grown globally. In India, pea is cultivated in UP, Orissa, Punjab, Haryana, Bihar, etc. Pea is produced in an area of 0.77 million ha, production of 0.71 million tones, and productivity with 1032kg per ha (Anon, 2009).

The genus *Trichoderma* plays an essential role in the management of soil-borne pathogens. They are free-living, beneficial microorganisms widely used as biocontrol, plant symbiotic, plant growth-promoting fungi (Harman & Bjorman1998), and biocontrol agents used to overcome the adverse effect on the environment. Different species of *Trichoderma* with similar biotypes vary from each other when used as a biocontrol. It has been reported that some strains of *Trichoderma* can interact directly or indirectly on roots, increasing plant growth potential, plant resistance against disease, and tolerance to environmental stresses (Howell, 2003; Hermosa et al., 2012). Soil-borne disease caused by *Fusarium sp.* on pea and broad bean is distributed worldwide, and 25-50% yield losses due to disease. (Phal and Choudhary, 1983; Munjal et al.,1963; Sharma et al.,1989; Maheshwari and Gandhi, 1998; Warkentin et al.,1996; Lin, 199; Kraft,1994). The damping-off of cabbage seedlings is caused by *Rhizoctonia solani,* a soil-borne pathogen that influences heavy losses (Seema and Devaki, 2010).

Trichoderma's influence on plant growth enhancement is due not only to the *Trichoderma* isolate and plant species but also to the complex interaction of different elements such as environmental conditions, soil microorganisms, and soil-plant interaction (Harman et al., 2004), and Fe, Mn, and Mg are micronutrients and minerals that play an essential role in plant growth, exogenous enzyme release, and siderophores (Jalal et al., 1987) and vitamins (Inbar et al., 1994; Kleifield et al., 1992), as well as indirectly with the control of major and minor microorganisms or pathogens that infect roots (Harman et al., 2004).

Trichoderma spp. has a direct as well as indirect impact on crop growth, yield parameters, and quality in the field. The current study marked to find out the effect of native *Trichoderma* spp. against the production of cabbage, cauliflower, and pea plant growth and yield.

2. MATERIALS AND METHODS

The experiment was conducted in the research field of College of Agriculture, Central Agricultural University (CAU), Imphal, situated in the Indian State of Manipur during their cropping season of 2017-2018 to study the effect of native *Trichoderma* spp. on the growth and yield of some vegetable crops in Manipur by using cultivars *viz*., cabbage (Green Hero), cauliflower (local variety) and pea (local variety). The soil was prepared using FYM/Compost @ 0.3g mixed with different treatments of *Trichoderma,* and it was applied before transplanting. The land preparation was done in 2x3m^2experimental plot size in three replication and six treatment in a randomized block design (RBD). The seedlings of cauliflower and cabbage with 60cm×45cm spacing and pea seeds with 30cm×20cm were planted in each plot respectively by following the recommended agronomical practices of the crop. The same treatment was applied for cabbage and cauliflower with root dip treatment and seed treatment in pea.

The treatment details for cabbage and cauliflower wereT1- Root dip treatment @10g/l of water for 10 min and soil treatment @5kg/ha with *Trichoderma asperellum*-25, T2- Root dip treatment @10g/l of water for 10 min, and soil treatment @5kg/ha *Trichoderma harzianum*-69, T3- Root dip treatment @10g/l of water for 10 min and soil treatment @5kg/ha with *Trichoderma asperellum*-7, T4- Root dip treatment @10g/l of water for 10 min and soil treatment @5kg/ha with *Trichoderma asperellum*-25 + *Trichoderma harzianum*-69 + *Trichoderma asperellum*-7, T5-Root dip treatment @10g/l of water for 10 min and soil treatment @5kg/ha with *Trichoderma viridi* (Commercial based) and T6- Control (FYM/Compost treatment).

The treatment details for pea were T1-Seed treatment @6kg/kg of seed and soil treatment @5kg/ ha with *Trichoderma asperellum*-25, T2- Seed treatment @6kg/kg of seed and soil treatment @5kg/ ha with *Trichoderma harzianum*-69, T3- Seed treatment @6kg/kg of seed and soil treatment @5kg/ ha with *Trichoderma asperellum*-7, T4- Seed treatment @6kg/kg of seed and soil treatment @5kg/ ha with *Trichoderma asperellum*-25 + *Trichoderma harzianum*-69 + *Trichoderma asperellum*-7, T5- Seed treatment @6kg/kg of seed and soil @5kg/ ha treatment with *Trichoderma viridi* (Commercial based) and T6-Control (FYM/Compost treatment).

Data were recorded for growth and yield parameters under the field conditions as well as at the time of harvesting of Cabbage (plant height, number of leaves/plant, leaf length with petiole in cm, breadth of leaves in cm, weight of head, and yield), Cauliflower (plant height, number of leaves/plant, leaf length with petiole in cm, weight of the curd and yield) and Pea (plant height, number of podding nodes, total number of pods/plant and 100 fresh seed weight in gram).

3. RESULTS AND DISCUSSIONS

Effect of different treatments on growth and yield of cabbage

All treatments significantly increased the height of seedlings as compared to control. Among the different treatments, T5 recorded the highest plant height with 19.50 cm as compared to control with 14.70. T4 recorded the maximum number of leaf/plant and leaf length with petiole with the mean value of 19.20 and 19.70cm and the minimum in T6 with 18.00 and 15.80cm. Regarding breath of the leaf, T1 was found highest with 18.90cm compared to the other treatments. On the other hand, T4 (combination of root dip treatment and soil treatment with *Trichoderma asperellum*-25 + *Trichoderma harzianum*-69 + *Trichoderma asperellum*-7) recorded the highest weight and yield of cabbage with the mean value of 1.75kg and 70.00 tonnes followed by T5 (commercial based) with 1.66 kg and 66.40 tonnes, respectively.

Effect of different treatments on growth and yield of cauliflower

Among the different treatments, T5 recorded the highest plant height with 37.30 cm as compared to control with 30.90. T4 (combination of root dip treatment and soil treatment with *Trichoderma asperellum*-25 + *Trichoderma harzianum*-69 + *Trichoderma asperellum*-7) recorded the highest number of leaf/plant (17.00), leaf length with the petiole (31.47 cm), the weight of curd (1.89 kg/plant) and yield (56.70 ton/ha), respectively as compared with other treatments. The results are presented in (Table 3, Fig.2 A & B).

Application of *Trichoderma* spp. increased cabbage and cauliflower growth, yield, and other characters through the increases were statistically significant. The present investigation shows the application of T4-consortium treatment of native *Trichoderma asperellum* and *T harzianum* and T5- *Trichoderma viride* (Commercial based) to cabbage and cauliflower treated just before planting mixed with FYM/compost enhances the plant growth and yield. In cabbage and cauliflower, the application of beneficial soil microbes like *Trichoderma* species promotes vegetative growth, healthier and greener leaves, healthy root systems, and increases yield. Similar findings have been supported by Samawat *et al*., 2001; Bharadwaj *et al*., 2000; Choudhary *et al*.; 2003; Chang *et al*., 1986. Application of T4-consortium treatment of native *Trichoderma asperellum* and *T harzianum,* which not only increase in plant growth but also increase in yield of cabbage up to 70 ton/ha and in cauliflower 56.70 ton/ha.

Effect of different treatments on growth and yield of pea

Among the different treatments, T2 recorded the highest plant height with 37.70 cm, followed by T4 with 56.90 cm as compared to control with 41.30 cm. In the case of the number of podding/node, a total number of pods/plant and 100 fresh seed weight, T4 (combination of root dip treatment and soil treatment with *Trichoderma asperellum*-25 + *Trichoderma harzianum*-69 + *Trichoderma asperellum*-7) recorded the highest with the value of 2.60/plant, 41.00/plant, and 52.60 g, respectively. Furthermore, the second highest was found in T5-(Commercial based) with 2.40/plant (number of podding/node), 24.70/plant (total number of pods/plant), and 46.40g (100 seed fresh weight) as compared to control.

Similar results were inferred from Nkechi Betsy Izuogu and T.O. Abiri (2015) that *Trichoderma harzianum* promotes plant growth and increases the plant's yield, increasing the plant's growth rate to resist biotic factors. The finding was similar to Alaerson Maia Geraldine et al. 2013. The number of pods per plant was increased by 89.4%, 81.3%, and 82.5% in *Trichoderma asperellum* treated common bean.

4. CONCLUSION

Overall, the paper demonstrates, and the discussion here shows that application of *Trichoderma spp*. increases growth characters of crops compared to the control treatment where no *Trichoderma* has been applied and can be utilized successfully to improve the sustainability of agricultural systems. Each combination in the current study is simply reproducible, biodegradable, cost-effective with no environmental hazards to human health. These are ecologically safe and culturally more acceptable, especially amongst the farmers. Further research is recommended to assess the potential of *Trichoderma spp* fully for various crops in subsistence and intensive agricultural systems.

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Figure A & B: Cabbage: Before and After Harvest.

Figure C & D: Growth of Cauliflower in the experimental field.

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Figure E & F: Pea field.

Figure G: Overall research field of cabbage, cauliflower, and pea at Central Agricultural University (CAU), Imphal.

TABLE 1: Effect of different treatments of *Trichoderma* on growth and yield of cabbage.

Treatment	**Plant height (cm)**	**No. of leaf/Plant**	**Leaf length with the petiole (cm)**	**Breadth of leaf (cm)**	**Weight of cabbage(kg)/Plant**	**Yield (tons/per ha)****
T1	15.50*	18.30	18.30	18.90	1.25	50.00
T2	17.00	18.10	17.90	19.00	1.37	54.80
T3	16.40	18.50	17.30	18.90	1.44	57.60
T4	16.70	19.20	19.70	19.80	1.75	70.00

T5	19.50	18.90	19.00	19.10	1.66	66.40
T6	14.70	18.00	15.80	18.50	0.89	35.60
S.Ed(±)	1.00	0.75	1.44	1.28	4.15	
CD	2.19	1.63	3.14	2.80	9.05	

*Average of four replication

**Calculated as 40,000 plant population/ha.

***Calculated as 30,000 plant population/ha.

TABLE 2: Effect of different treatments of *Trichoderma* on growth and yield of Cauliflower.

Treatment	**Plant height (cm)**	**No. of leaf/Plant**	**Leaf length with petiole**	**Weight of curd (kg)/Plant**	**Yield (tons/per ha)*** **
T1	34.40*	16.70	30.73	1.67	43.50
T2	33.10	16.70	30.40	1.41	42.30
T3	32.50	17.10	29.20	1.45	48.30
T4	32.10	17.00	31.47	1.89	56.70
T5	37.30	16.70	31.47	1.61	50.10
T6	30.90	13.40	28.00	1.06	31.80
S.Ed(±)	3.51	1.63	1.74	0.20	
CD	7.66	3.56	3.81	0.45	

*Average of four replication,

**Calculated as 40,000 plant population/ha,

***Calculated as 30,000 plant population/ha.

TABLE 3. Effect of different *Trichoderma* treatment on growth and yield of a pea.

Treatment	**Plant height (cm)**	**No. of podding node**	**Total no. of pod/ plant**	**100 fresh seed weight(gm)**
T1	42.80	1.80	18.00	39.90
T2	**57.70**	1.70	21.70	46.40
T3	46.00	1.40	17.30	44.70
T4	56.90	**2.60**	**41.00**	**52.60**
T5	53.90	2.40	24.70	46.40
T6	41.30	1.40	13.00	38.40
S.Ed(±)	7.35	0.31	7.15	6.22
CD	16.03	0.68	15.60	13.57