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Effect of Bio control agents on growth, yield and rhizome rot incidence of turmeric varieties

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Abstract
The present investigation entitled "Effect of biocontrol agents on growth and rhizome rot of turmeric" was undertaken to examine the performance of biocontrol agents on rot control in turmeric, and yield components in Turmeric. The experiment was carried out during kharif from 2017-18 and 2018-19 at Turmeric research station, Kammarapally, Nizamabad District, Telangana. Among the interaction effects between different types of varieties and different biofertilizers, Selam along with the application of *Trichoderma viridae* recorded significantly the highest values in different parameters at almost all growth stages. Growth characters like the plant height (158.67 cm), number of tillers (4.67), number of leaves (15.83), leaf area (1002.97 cm^2), leaf area index (334.32 cm^2), biomass of the plant (992.89 g m^{-2}), number of mother rhizomes (3.00), number of primary rhizomes (10.34), number of secondary rhizomes (17.83).

Keywords: Turmeric, Selam, varieties, biocontrol, growth

Introduction
Turmeric (*Curcuma longa* L.) is a rhizomatous herbaceous perennial plant belonging to the family, Zingiberaceae. It is native to tropical South Asia, but is now widely cultivated in the tropical and subtropical regions of the world**.** Turmeric is valued for its underground orange coloured rhizome which is used as natural colouring agent for food, cosmetics and dye. It has been used in traditional medicines as a household remedy for various diseases including, anorexia, cough, diabetic wounds, rheumatism and sinusitis. Turmeric has attracted much attention due to its significant medicinal potential. The most active component of turmeric is curcumin. Curcumin is one of three curcuminoids present in turmeric, the other two being desmethoxycurcumin and bis-desmethoxycurcumin. These curcuminoids give turmeric its yellow color and curcumin is used as a yellow food colorant and food additive. Curcumin is obtained from the dried rhizome of the turmeric plant. Curcuminoids are a family of active compounds within turmeric. Curcuminoids are polyphenolic pigments and include curcumin, dimethoxy curcumin, and bisdemethoxycurcumin. Curcumin is the primary curcuminoid in turmeric.

The characteristic yellow colour of turmeric is due to the curcuminoids. Curcumin is an orange yellow crystalline powder practically insoluble in water. A compound curcuminoid, present in turmeric acts as inhibitor of human immune deficiency virus type1 (HIV-1).

Globally, India is the major producer and exporter of turmeric. India is also the largest consumer of turmeric in the world accounting for nearly 90% of total production. Major producing states in India are Telangana, Andhra Pradesh, Tamil Nadu, Orissa, West Bengal, Karnataka and Kerala. Andhra Pradesh is the major producer of turmeric contributing more than 60% of total production followed by Tamil Nadu and Karnataka. The area in Telangana and Andhra Pradesh under turmeric cultivation is 71,488 ha, with the production of 4,43,226 tons, mostly confined to the clay loam soils of the state. In Telangana, the turmeric crop is being grown in an area of 42535 Hectares with a production of 1,842,85 MT during 2015-16. In Telangana, the four districts *viz*. Nizamabad, Karimnagar, Warangal and Adilabad account for around 90% of the production of turmeric in the State.

Turmeric is susceptible to many diseases caused by fungal pathogens. Among the various diseases, rhizome rot caused by Pythium sps, is a major problem in all turmeric growing areas of India (Rathiah, 1980). The symptoms of the rhizome rot includes *viz*., toppling down of infected tillers, rotting of roots and the affected rhizome becoming hollow with only fibrous tissues left behind, leading to a loss up to 95 percent crop yield. Management of the disease using fungicides has led to the development of resistant strains of pathogens. Hence this study was carried out for the ecofriendly management of rhizome rot disease in turmeric using antagonistic biocontrol agents.

Biological control of soil-borne pathogens by microorganisms has been considered to be good environmentally alternative to the chemical treatment methods (Eziashi *et al*. 2007). Many antagonistic microorganisms have been proved to be active *in vitro* or *in vivo*. *Trichoderma spp*. are the most widely studied biological control agents for root and shoot pathogens applied even in post-harvest (Woo *et al*. 2014).

Materials and Methods

The present investigation entitled "Effect of biocontrol agents on rhizome rot of turmeric" was undertaken in Turmeric. The experiment was carried out during kharif from 2017-18 and 2018-19 at Turmeric research station, Kammarapally, Nizamabad District, Telangana by using Rhizome rot susceptible varieties *viz*., PTS-10,ACC-48,ACC-79,JTS-6, Selam, Erragunturu and Duggirala red. The biofertilizers are *viz*., *Trichoderma viridae* and *Pseudomonas Flourescence.*

Results and Discussion

Growth parameters

1) Plant height (cm)

Among interactions, The maximum plant height was showed by variety Selam (148.81cm, 146.41cm) which was applied with *Trichoderma viridae* (V5B1) and treatment(V5B2) Selam+*Pseudomonas fluorescence* respectively and this treatments were significantly differed with the combination of treatment (V5B3) Selam+ control (143.66 cm) And these combination of treatments were followed by the treatment combinations of (V7B1) Duggirala + *Trichoderma viridae* (142.18cm), (V7B2) Duggirala + *Pseudomonas fluorescence* (140.06cm) and (V7B3) Duggirala + control (129.30cm) The lowest plant height was recorded by the variety Acc-48(89.24cm) in combination with control.

2) Number of tillers per plant

Among interactions There was no significant difference in the number of tillers per plant The maximum number of tillers per plant was showed by variety Selam (4.67and4.33) which was applied with Trichoderma virida (V5B1) e and treatment (V5B2) Selam + Pseudomonas fluorescence respectively and this treatments were significantly differed with the combination of treatment (V5B3) Selam+ control (4.33) And these combination of treatments were on par with the treatment combinations of (V7B1) Duggirala + Trichoderma viridae (4.17), (V7B2) Duggirala + Pseudomonas fluorescence (4.17) and (V7B3) Duggirala + control (4.17) The minimum number of tillers per plant was recorded by the variety Acc-48 (3.0) in combination with control.

3) Number of leaves per plant

Among interactions, The maximum number of leaves per plant was showed by variety Selam (13.67and13.50) which was applied with Trichoderma viridae(V5B1) and treatment (V5B2) Selam + Pseudomonas fluorescence respectively and this treatments were significantly differed with the combination of treatment (V5B3) Selam + control (12.83) And these combination of treatments were followed by or on par with the treatment combinations of (V7B1) Duggirala + Trichoderma viridae (13.67), (V7B2) Duggirala +Pseudomonas fluorescence (12.83) and (V7B3) Duggirala +control (12.67) The minimum number of leaves per plant was recorded by the variety Acc-48(7.83) in combination with control.

4) Leaf area (cm^2)

Among interactions, The maximum leaf area was showed by variety Selam (977.57 cm2 and 977.02 cm2) which was applied with Trichoderma viridae(V5B1) and treatment (V5B2) Selam + Pseudomonas fluorescence respectively and this treatments were significantly differed with the combination of treatment (V5B3)Selam+ control (976.58 cm2) And these combination of treatments were followed by or on par with the the treatmen combinations of(V7B1) Duggirala + Trichoderma viridae (945.67cm2),(V7B2) Duggirala + Pseudomonas fluorescence (945.33 cm2) and (V7B3) Duggirala + control (928.14 cm2) The minimum leaf area was recorded by the variety Acc-48 (651.50cm2) in combination with control.

5) Biomass of the plant

Among interactions, The highest biomass of the plant was showed by variety Selam (992.94 and 990.88) which was applied with Trichoderma viridae(V5B1) and treatment (V5B2) Selam + Pseudomonas fluorescence respectively and this treatments were significantly differed with the combination of treatment (V5B3)Selam+ control (977.32) And these combination of treatments were followed by or on par with the the treatment combinations of (V7B1) Duggirala + Trichoderma viridae (966.16), (V7B2) Duggirala + Pseudomonas fluorescence (929.94) and (V7B3) Duggirala + control (921.23) The lowset biomass of the plant was recorded by the variety Acc-48 (673.54) in combination with control.

6) Number of primary rhizomes/plant

Among interactions, The highest number of primary rhizomes plant-1 was showed by variety Selam (10.34 & 10.25) which was applied with Trichoderma viridae(V5B1) and treatment (V5B2) Selam +Pseudomonas fluorescence respectively and this treatments were significantly differed with the combination of treatment (V5B3)Selam+ control (10.0) And these combination of treatments were followed by or on par with the the treatment combinations of(V7B1) Duggirala + Trichoderma viridae(9.67), (V7B2) Duggirala + Pseudomonas fluorescence (9.50) and (V7B3)Duggirala +control (9.50) The lowset number of primary rhizomes plant-1 was recorded by the variety Erra gunturu (6.33) in combination with control.

7) Number of secondary rhizomes/plant

Among interactions, The highest number of secondary rhizomes plant-1 was showed by variety Selam (17.83 & 17.0) which was applied with Trichoderma virida (V5B1) e and treatment (V5B2) Selam + Pseudomonas fluorescence respectively and this treatments were significantly differed with the combination of treatment (V5B3)Selam+ control (16.83) And these combination of treatments were followed by or on par with the the treatment combinations of (V7B1) Duggirala + Trichoderma viridae(16.67), (V7B2) Duggirala + Pseudomonas fluorescence (16.34) and (V7B3) Duggirala + control (11.83) The lowset number of secondary rhizomes plant-1 was recorded by the variety Erra gunturu (10.50) in combination with control.

In the present investigation, different turmeric cultivars showed significant variation with regard to plant height, number of tillers per plant, number of leaves per plant, leaf area and Leaf Area Index (LAI) at all stages of crop growth. These growth characters had positive correlation with yield and yield attributing parameters. Among the cultivars studied, selam recorded the highest plant height (144.88 cm), number of tillers per plant (4.33), number of leaves per plant (13.06), leaf area (977.05 cm2) and LAI (295.15), number of mother rhizomes (3.00), number of primary rhizomes (10.34), number of secondary rhizomes (17.83). Compared to other cultivars under red chalka (sandy loam) soils. Selam recorded the highest plant height of 144.88 cm which was on par with Duggirala (137.07cm) indicating

that there was an interaction among the nutrient contents in the soil and moisture and application of Trichoderma spp. Both the conditions have evolved numerous mechanisms in rhizome rot prone varieties. These mechanism include competition for space and nutrient, mycoparasitism and production of inhibitory compounds, inactivation of the pathogen enzymes (Roco and Perez, 2001) and induced resistance to crops (Kapulnik and Chet, 2000). that are involved in attacking other fungi and reduce the plant diseases, that may lead to enhancin the plant growth under local agroclimatic conditions in red chalka (sandy loam) soils. The plant height, increased number of leaves and leaf area leads to increase in the LAI helped in better photosynthesis of carbohydrates and their utilization by way of building up of new cells and there by higher levels of growth, while the lowest plant height (91.50 cm) recorded in ACC-48 might be due to uptake of nutrients at lower rate resulted in lower plant growth under red chalka (sandy loam) soils. Such variations in growth among different cultivars of turmeric were reported by several workers grown under different soil conditions (Satish Hegde *et al*. (1997); Jagadeesha (2000); Kumar and Yadav (2001) and Anasuya (2004).

Table 1: Show the Number of Biomass tillers leaves plant

Plant height(cm)				Number of tillers/plant			Number of leaves/plant			Leaf area(cm2)			Leaf area index			Biomass of the plant		
Treatment	**2017-18**	**2018-19**	**Pooled**	**2017-18**	**2018-19**	**Pooled**	**2017-18**	**2018-19**	**Pooled**	**2017-18**	**2018-19**	**Pooled**	**2017-18**	**2018-19**	**Pooled**	**2017-18**	**2018-19**	**Pooled**
V_1	107.87	110.91	109.39	3.00	3.22	3.11	9.00	9.11	9.06	740.18	746.25	808.10	246.73	212.86	246.95	773.88	776.34	775.11
V_2	89.40	93.61	91.50	3.00	3.00	3.00	7.78	8.22	8.00	675.98	682.30	679.14	225.33	181.37	203.35	682.79	689.30	686.05
V_3	95.36	99.22	97.29	3.00	3.11	3.06	8.44	8.78	8.61	699.61	704.27	701.94	233.20	188.21	210.71	752.12	758.77	755.45
V_4	125.46	129.19	127.32	3.56	3.56	3.56	10.78	11.33	11.06	891.52	897.71	894.62	297.17	238.59	267.88	903.10	909.41	906.26
V_5	142.52	147.24	144.88	4.33	4.33	4.33	12.78	13.33	13.06	974.73	979.37	977.05	324.91	265.38	295.15	960.78	981.69	971.23
V_6	117.63	120.90	119.27	3.22	3.67	3.45	10.67	11.11	10.89	873.93	879.01	876.47	291.31	229.92	260.62	853.11	859.29	856.20
V_7	139.20	142.83	137.07	4.22	4.22	3.94	12.78	13.11	12.39	936.61	942.81	939.71	312.20	251.73	281.96	962.92	969.55	940.96
Mean	116.78	120.56	118.10	3.48	3.59	3.49	10.32	10.71	10.44	827.51	833.10	839.58	275.84	224.01	252.37	841.24	849.19	841.61
CD(p=0.05)	1.46	2.00	0.58	0.60	0.69	0.38	0.52	0.62	0.19	8.42	13.50	1.44	13.74	17.27	8.91	36.46	12.20	9.37
SEm±	0.51	0.70	0.20	0.21	0.24	0.13	0.18	0.22	0.07	2.94	4.71	0.48	4.79	6.02	3.00	12.71	4.25	3.15
B_1	121.05	124.99	123.02	3.71	3.62	3.67	10.62	11.00	10.81	821.73	827.31	852.33	273.91	221.20	254.91	847.90	853.56	850.73
B_2	115.82	119.40	117.61	3.52	3.81	3.67	10.19	10.62	10.40	831.91	837.89	834.90	277.30	225.05	251.18	842.88	855.50	849.19
B_3	113.46	117.28	113.68	3.19	3.33	3.14	10.14	10.52	10.10	828.89	834.11	831.50	276.30	225.78	251.04	832.95	838.52	824.90
Mean	116.78	120.56	118.10	3.48	3.59	3.49	10.32	10.71	10.44	827.51	833.10	839.58	275.84	224.01	252.37	841.24	849.19	841.61
CD(p=0.05)	0.96	1.31	0.38	0.39	NS	0.25	0.34	NS	0.13	NS	NS	0.94	NS	NS	NS	NS	7.99	6.13
SEm±	0.33	0.46	0.13	0.14	0.16	0.08	0.12	0.14	0.04	1.92	3.08	0.32	3.14	3.94	1.96	8.32	2.79	2.06
V_3B_3	113.47	116.62	115.04	3.00	3.33	3.17	9.33	9.00	9.17	758.30	763.93	761.12	252.77	219.29	236.03	785.53	790.45	787.99
V_3B_2	104.47	107.25	105.86	4.00	4.00	3.17	9.00	9.33	9.17	731.17	738.95	735.06	243.72	209.96	226.84	771.47	779.12	775.29
V_3B_1	103.93	106.62	105.28	3.00	3.33	3.17	8.67	9.00	8.83	731.07	735.87	0.00	243.69	209.34	0.00	766.60	773.40	770.00
V_1B_3	92.63	96.44	94.54	3.00	3.00	3.00	8.00	8.33	8.17	691.17	701.43	696.30	230.39	186.38	208.39	699.43	706.79	703.11
V_1B_2	88.53	92.80	90.67	2.67	2.67	2.67	7.67	8.33	8.00	687.20	692.03	689.62	229.07	184.34	206.70	678.83	684.15	681.49
V_1B_1	86.90	91.58	89.24	2.67	2.67	2.67	7.67	8.00	7.83	649.57	653.43	651.50	216.52	173.38	194.95	670.10	676.97	673.54
V_2B_3	98.93	102.75	100.84	3.00	3.00	3.00	8.67	9.00	8.83	705.13	709.42	707.28	235.05	187.04	211.04	764.63	759.45	762.04
V_2B_2	94.50	98.48	96.49	3.00	3.00	3.00	8.33	8.67	8.50	701.57	707.60	704.58	233.85	188.92	211.39	744.67	751.87	748.27
V_2B_1	92.77	96.43	94.60	2.67	2.67	2.67	8.33	8.67	8.50	692.13	695.80	693.97	230.71	188.66	209.69	745.10	751.05	748.08
V_5B_3	127.47	131.13	129.30	3.33	4.67	4.00	12.67	13.00	12.83	900.33	908.29	904.31	300.11	242.37	271.24	916.20	920.09	918.15
V_5B_2	126.00	129.87	127.94	3.67	4.00	3.83	12.33	13.00	12.67	893.03	897.69	895.36	314.46	253.84	284.15	951.33	959.12	879.40
V_5B_1	122.90	126.57	124.74	3.67	3.67	3.67	11.00	11.67	11.34	887.50	892.03	889.77	308.23	247.72	277.98	876.13	882.67	879.40
V_7B_3	146.53	151.08	148.81	5.00	4.33	4.67	13.33	14.00	13.67	976.33	978.80	977.57	325.14	267.17	296.16	993.40	992.37	992.89
V_7B_2	144.23	148.58	146.41	4.33	4.33	4.33	13.33	13.67	13.50	975.43	978.60	977.02	325.45	264.47	294.96	985.73	996.03	990.88
V_7B_1	141.37	145.95	143.66	4.33	4.33	4.33	12.67	13.00	12.83	972.43	980.72	976.58	324.14	264.51	294.33	974.57	980.08	977.32
V_4B_3	122.20	126.12	124.16	3.67	3.67	3.67	10.67	11.00	10.83	886.73	892.82	889.78	300.11	242.37	271.24	866.33	871.67	869.00
V_4B_2	117.23	119.97	118.60	3.00	3.67	3.34	10.67	11.00	10.83	881.73	888.13	884.93	295.58	237.97	266.77	855.37	861.87	858.62
V_4B_1	115.20	118.87	117.04	3.33	3.33	3.33	10.67	11.00	10.83	847.03	851.21	849.12	293.91	230.96	262.44	837.63	844.33	840.98
V_6B_3	139.67	144.69	142.18	4.33	4.00	4.17	13.33	14.00	13.67	943.37	947.97	945.67	314.46	253.84	284.15	962.87	969.45	966.16
V_6B_2	138.63	141.49	140.06	4.33	4.00	4.17	12.67	13.00	12.83	941.77	948.90	945.33	313.92	253.61	283.77	903.20	956.67	929.94
V_6B_1	134.73	138.42	124.74	3.67	4.67	4.17	12.33	13.00	12.67	924.70	931.57	928.14	308.23	247.72	277.98	916.97	925.49	921.23
Mean	116.78	120.56	118.10	3.48	3.59	3.49	10.32	10.71	10.44	827.51	833.10	839.58	275.84	224.01	252.37	841.24	849.19	841.61
CD(p=0.05)	2.53	3.46	1.01	NS	NS	NS	NS	NS	0.34	14.59	23.38	2.49	23.08	NS	NS	NS	21.14	16.22
SEm±	0.88	1.21	0.34	0.36	0.42	0.22	0.32	0.38	0.11	5.08	8.15	0.84	8.30	10.43	5.20	22.02	7.37	5.46

Factor – I: Varieties(V)
V_1: PTS-10
V_2: ACC-48
V_3: ACC-79
V_4: JTS-6
V_5: SELAM
V_6: ERRA GUNTURU
V_7: DUGGIRALA LOCAL

Factor – II: Biocontrol agents (B)
B_1: *Trichoderma Viridae*
B_2: *Pseudomonas fluorescens*
B_3: Control

Table 2: Effect of different varieties and biocontrol agents on yield parameters of turmeric

No. of Mother rhizomes/plant				No. of Primary rhizomes/plant			No. of secondary rhizomes/plant		
Treatment	**2017-18**	**2018-19**	**Pooled**	**2017-18**	**2018-19**	**Pooled**	**2017-18**	**2018-19**	**Pooled**
V_1	1.56	1.56	1.56	6.67	7.00	6.83	10.33	10.78	10.56
V_2	1.78	1.56	1.67	6.67	7.00	6.84	11.44	11.78	11.61
V_3	2.00	1.67	1.84	8.11	8.44	8.28	12.33	12.67	12.50
V_4	1.44	1.33	1.39	6.67	7.00	6.83	10.56	11.03	10.79
V_5	2.78	2.56	2.33	9.67	10.28	9.97	16.33	17.00	16.67
V_6	1.33	1.00	1.17	6.44	6.78	6.61	10.44	11.11	10.78
V_7	2.44	2.22	2.33	9.67	10.22	9.00	17.00	17.44	15.06
Mean	1.90	1.70	1.75	7.70	8.10	7.77	12.63	13.12	12.57
CD(p=0.05)	0.42	0.42	0.21	0.50	0.64	0.15	0.58	0.59	0.17
SEm±	0.15	0.15	0.07	0.17	0.22	0.05	0.20	0.21	0.06
B_1	1.95	1.86	1.90	8.10	8.52	7.90	12.95	13.40	13.17
B_2	1.86	1.62	1.74	7.67	8.12	7.89	12.43	12.95	12.69
B_3	1.90	1.62	1.62	7.33	7.67	7.50	12.52	13.00	11.83
Mean	1.90	1.70	1.75	7.70	8.10	7.77	12.63	13.12	12.57
CD(p=0.05)	NS	NS	0.14	0.33	0.42	0.10	0.38	0.39	0.11
SEm±	0.10	0.10	0.05	0.11	0.15	0.03	0.13	0.13	0.04
V_1B_1	1.67	1.33	1.50	6.67	7.33	7.00	10.00	10.33	10.17
V_1B_2	2.67	2.33	1.50	6.67	7.00	6.83	10.67	11.00	10.83
V_1B_3	1.33	1.67	1.50	6.67	7.00	6.83	10.33	11.00	10.67
V_2B_1	2.00	1.67	1.84	7.00	7.33	7.17	11.33	11.67	11.50
V_2B_2	1.67	2.00	1.83	7.00	7.33	7.17	11.33	11.67	11.50
V_2B_3	1.67	1.33	1.50	9.67	10.33	7.17	11.67	12.00	11.83
V_3B_1	2.00	1.67	1.84	7.67	8.00	7.83	13.67	14.00	13.83
V_3B_2	2.00	1.67	1.84	7.33	7.67	7.50	11.67	12.00	11.83
V_3B_3	2.00	1.67	1.84	7.33	7.67	7.50	11.67	12.00	11.83
V_4B_1	1.33	1.33	1.33	6.33	6.67	6.50	11.00	11.43	11.22
V_4B_2	1.67	1.00	1.33	6.33	6.67	6.50	10.33	11.00	10.67
V_4B_3	1.33	1.00	1.17	6.33	6.67	6.50	10.33	10.67	10.50
V_5B_1	3.00	3.00	3.00	10.00	10.67	10.34	17.67	18.00	17.83
V_5B_2	2.67	2.33	2.50	10.00	10.50	10.25	16.67	17.00	16.83
V_5B_3	2.67	2.33	2.50	9.67	10.33	10.00	16.67	17.33	10.50
V_6B_1	1.33	1.00	1.17	6.33	6.67	6.50	10.67	11.33	11.00
V_6B_2	1.33	1.00	1.17	6.33	6.67	6.50	10.33	11.33	10.83
V_6B_3	1.00	1.00	1.00	6.33	6.33	6.33	10.33	10.67	10.50
V_7B_1	2.33	2.33	2.33	9.33	10.00	9.67	16.33	17.00	16.67
V_7B_2	2.33	2.00	2.17	9.33	9.67	9.50	16.00	16.67	16.34
V_7B_3	2.00	2.00	2.00	9.33	9.67	9.50	16.67	17.33	17.00
Mean	1.90	1.70	1.75	7.70	8.10	7.77	12.63	13.12	12.57
CD(p=0.05)	NS	NS	0.37	NS	NS	0.25	1.00	1.02	0.29
SEm±	0.26	0.26	0.12	0.30	0.39	0.09	0.35	0.36	0.10

Factor – I: Varieties (V)
V_1: PTS-10
V_2: ACC-48
V_3: ACC-79
V_4: JTS-6
V_5: SELAM
V_6: ERRA GUNTURU
V_7: DUGGIRALA LOCAL

Factor – II: Biocontrol agents (B)
B_1: *Trichoderma Viridae*
B_2: *Pseudomonas fluorescens*
B_3: Control

Table 3: Effect of different varieties and biocontrol agents on rhizome rot incidence percentage of turmeric

Rhizome rot incidence percentage			
Treatments	**2017-18 (Kharif)**	**2018-19 (Kharif)**	**Pooled**
V_1	94.96	95.29	88.13
V_2	88.69	88.82	88.75
V_3	92.22	92.36	92.29
V_4	79.50	79.63	79.57
V_5	93.34	93.82	93.58
V_6	77.72	78.49	78.11
V_7	92.31	92.36	92.34
Mean	88.39	88.68	87.54
CD(p=0.05)	0.55	0.49	0.39
SEm±	0.19	0.17	0.13
B_1	84.10	84.34	81.22
B_2	89.05	89.49	89.27
B_3	92.03	92.21	92.12
Mean	88.39	88.68	87.54
CD(p=0.05)	0.36	0.32	0.25
SEm±	0.13	0.11	0.09
V_1B_1	91.89	92.44	92.17
V_1B_2	92.11	92.31	71.21
V_1B_3	93.11	93.92	93.52
V_2B_1	88.17	88.33	88.25
V_2B_2	88.78	88.46	88.62
V_2B_3	91.78	92.11	91.94

Table 3: Contnd…

V_3B_1	86.00	85.69	85.85
V_3B_2	87.83	88.46	88.15
V_3B_3	88.17	88.16	88.16
V_4B_1	95.51	95.73	95.62
V_4B_2	95.67	95.00	95.33
V_4B_3	95.89	96.77	96.33
V_5B_1	70.47	71.94	71.21
V_5B_2	75.33	75.38	75.36
V_5B_3	79.39	79.60	79.50
V_6B_1	96.11	96.49	96.30
V_6B_2	96.68	97.26	96.97
V_6B_3	96.89	96.80	96.85
V_7B_1	79.48	79.93	79.71
V_7B_2	83.21	83.60	83.41
V_7B_3	83.78	83.91	83.84
Mean	88.39	88.68	87.54
CD(p=0.05)	0.96	0.85	0.67
SEm±	0.34	0.30	0.23

Factor – I: Varieties(V)	**Factor – II: Biocontrol agents (B)**
V_1: PTS-10	B_1: *Trichoderma Viridae*
V_2: ACC-48	B_2: *Pseudomonas fluorescens*
V_3: ACC-79	B_3: Control
V_4: JTS-6	
V_5: SELAM	
V_6: ERRA GUNTURU	
V_7: DUGGIRALA LOCAL	

Conclusions

From the results obtained in the present investigation, it was clearly indicated that the growth, y can be influenced by different types of varieties along with biofertilizer application. From these the Selam variety along with *Trichoderma viridae* application was showing best results in terms of growth, yield and less incidence of rhizome rot. It is also indicated that the variety Selam along with *Pseudomonas florescence* application had the equal results in terms of growth, and rhizome rot incidence percentage.

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