

Effect of bioagents on quality and soil analysis in Ridge gourd

ABSTRACT

The present investigation entitled effect of bioagents on quality and soil analysis in ridge gourd was carried out during *Kharif*, 2021 and Summer, 2022 at P.G block, College of Horticulture, Rajendranagar, SKLTSHU, Hyderabad. The experiment was carried out with 11 treatments in Randomized Block Design with three replications. The results reported that the T₁ (RDF + *Trichoderma viride*) recorded highest in fruit quality, soil parameters and benefit-cost ratio compared to other treatments.

Keywords: Ridge gourd, Arka prasan, *Trichoderma*, *Pseudomonas*, *Bacillus*

1. INTRODUCTION

Ridge gourd (*Luffa acutangula*) is one of the most important warm season vegetable which is commercially propagated by seeds. It contains high content of water and nutrients, protein, fat, carbohydrates, minerals and vitamins. In India, gourds are cultivated in an area of 4.52 lakh hectares with a production of 36.16 lakh MT (Anonymous 2019a) and in Telangana the crop is grown in an area of 14,087 hectares with a production of 2.82 lakhs MT and productivity of 20 MT (Anonymous 2019b).

Biological agents are the living organisms, which can significantly lower the density of plant pathogens and have become very popular as an alternative to chemical pesticides for management of pests and diseases (O'Brien, 2017).

Biocontrol fungi of the genus *Trichoderma* fungi can utilize a variety of nutrient sources are able to effectively degrade some of them (Harmamet, 2004) biofertilizers function as key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity current soil management strategies are mainly dependent on inorganic chemical-based fertilizers, which caused a serious threat to human health and environment. The exploitation of beneficial microbes as biofertilizers has become paramount importance in agriculture sector for their potential role in food safety and sustainable crop production.

2. Materials and methods

The present investigation was carried out during *Kharif*, 2021 and Summer, 2022 at P.G block, College of Horticulture, SKLTSHU, Rajendranagar, Hyderabad. The experimental site is situated at a latitude of 17°32' North, longitude of 78°40' East and altitude of 542.3 m above mean sea level. The experiment was laid out in randomized block design with eleven treatments replicated three times. The entire experiment was executed on a creeping mesh. The pit size of 60 cm² were dug with a spacing of 1.5 × 1.0 m and were kept open for solarization for about 15 days. Good agricultural practices were followed during the entire crop period. The data recorded on quality, soil analysis were statistically analysed

3. Results and discussion

3.1 Quality parameters

The data pertaining to the quality parameters were recorded *viz.*, TSS, ascorbic acid content, reducing sugars, non-reducing sugars, total sugars, chlorophyll content and crude fibre as influenced by different bioagents are presented in the Tables 1 to 3.

3.1.1 TSS (°Brix)

The data enunciated on the TSS (°Brix) as influenced by the effect of bioagents on quality in ridge gourd is presented in Table 1.

From the data it is clear that there was significant differences observed among the treatments with respect to TSS during *Kharif* season. Significantly maximum TSS (4.02) was recorded in T₁ (RDF + *Trichoderma viride*) followed by T₂ (RDF + *Pseudomonas fluorescens*) (3.78), while the minimum TSS (2.89) was recorded with T₁₁ (Absolute control).

During Summer season among all the treatments, T₁ (RDF + *Trichoderma viride*) recorded maximum TSS (4.25) followed by T₂ (RDF + *Pseudomonas fluorescens*) (4.01), while the minimum TSS (3.04) was recorded with T₁₁ (Absolute control).

The highest TSS content of the fruit was recorded in T₁ (RDF + *Trichoderma viride*) was due to the application of NPK significantly increased the TSS in fruit. TSS content significantly increased with the nitrogen application which helped in vigorous vegetative growth and imparted deep green colour to the foliage and favoured photosynthetic activity of the plants. The greater accumulation of food material *i.e.* carbohydrates in the fruit leading to increase in TSS content. Similar results have been reported by Tripathy *et al.* (2013) in onion, Diriba-Shiferaw *et al.* (2014) in garlic and Sharma (2014) in onion.

3.1.2 Ascorbic acid content (mg/100g)

The data presented in Table 1 revealed that during *Kharif* season, significantly maximum ascorbic acid content (13.33) was observed with T₁ (RDF + *Trichoderma viride*) followed by T₂ (RDF + *Pseudomonas fluorescens*) recording the ascorbic acid content of 12.25. The minimum ascorbic acid content (8.27) was recorded with T₁₁ (Absolute control).

During Summer season, significantly maximum ascorbic acid content (13.65) was observed with T₁ (RDF + *Trichoderma viride*) and was at par with T₂ (RDF + *Pseudomonas fluorescens*) recording the ascorbic acid content of 13.39. The minimum ascorbic acid content (8.48) was recorded with T₁₁ (Absolute control).

The highest ascorbic acid content was recorded in T₁ (RDF + *Trichoderma viride*) which was due to the availability of sufficient quantities of various nutrient sources resulting in production of more photosynthates, consequently synthesizing more vitamin 'C' content. Similar findings are comparable with Thriveni *et al.* (2015) in bitter gourd and Rathod *et al.* (2018) in ridge gourd.

Table 1. Effect of bioagents on TSS (°Brix), ascorbic acid content (mg/100g) of ridge gourd during *Kharif*, 2021 and Summer, 2022

Treatments	TSS (°Brix)		Ascorbic acid content (mg/100g)	
	Kharif	Summer	Kharif	Summer
	2021	2022	2021	2022

T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	4.02	4.25	13.33	13.65
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	3.78	4.01	12.25	13.39
T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	3.66	3.89	12.61	12.97
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	3.70	3.85	10.18	10.55
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	3.68	3.72	9.26	10.32
T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	3.64	3.77	9.12	9.49
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	3.60	3.65	8.65	8.85
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	3.44	3.58	8.39	8.53
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	3.57	3.65	8.55	9.98
T ₁₀ : RDF (100:100:50 NPK kg/ha)	3.52	4.00	10.34	10.81
T ₁₁ : Absolute control	2.89	3.04	8.27	8.48
SEm±	0.06	0.06	0.16	0.16
CD (P=0.05)	0.16	0.17	0.46	0.48

3.1.3 Reducing sugars (%)

The data enunciated on the reducing sugars as influenced by the effect of bioagents on quality in ridge gourd is presented in Table 2.

From the data it is clear that there was significant differences observed among the treatments with respect to reducing sugars during *Kharif* season. Significantly maximum reducing sugars (4.54 %) was recorded in T₁ (RDF + *Trichoderma viride*) and was at par with T₂ (RDF + *Pseudomonas fluorescens*) (4.41 %), while the minimum reducing sugars (2.98 %) was recorded with T₁₁ (Absolute control).

During Summer season among all the treatments, T₁ (RDF + *Trichoderma viride*) recorded

maximum reducing sugars (4.62%) and was at par with T₂ (RDF + *Pseudomonas fluorescens*) (4.57 %), while the minimum reducing sugars (3.07 %) were recorded with T₁₁ (Absolute control).

3.1.4 Non reducing sugars (%)

The data presented in Table 2 revealed that during *Kharif* and Summer season, significantly minimum non reducing sugars (1.69 and 1.74 %) was observed with T₁ (RDF + *Trichoderma viride*), while the maximum non reducing sugars (2.10 and 2.15 %) was recorded with T₁₁ (Absolute control).

3.1.5 Total sugars (%)

The data enunciated on the total sugars as influenced by the effect of bioagents on quality in ridge gourd is presented in Table 2.

From the data it is clear that there was significant differences observed among the treatments with respect to total sugars during *Kharif* season. Significantly maximum total sugars (6.23%) was recorded in T₁ (RDF + *Trichoderma viride*) and was at par with T₂ (RDF + *Pseudomonas fluorescens*) (6.17%), while the minimum total sugars (5.08 %) was recorded with T₁₁ (Absolute control).

During Summer season among all the treatments, T₁ (RDF + *Trichoderma viride*) recorded maximum total sugars (6.36 %) and was at par with T₂ (RDF + *Pseudomonas fluorescens*) (6.32 %), while the minimum total sugars (5.22 %) was recorded with T₁₁ (Absolute control).

The sugar content was highest in T₁ (RDF + *Trichoderma viride*) due to application of nutrient content which enhanced the carbon nitrogen ratio in the soil which might have increased the sugar content. Similar findings were also observed by Nayak *et al.* (2016) in pointed gourd.

Table 2. Effect of bioagents on reducing sugars (%), non-reducing sugars (%), total sugars (%) of ridge gourd during *Kharif*, 2021 and Summer, 2022

Treatments	Reducing sugars (%)		Non-reducing sugars (%)		Total sugars (%)	
	Khari f	Sum mer	Khari f	Sum mer	Kha rif	Sum mer
	2021	2022	2021	2022	2021	2022
T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	4.54	4.62	1.69	1.74	6.23	6.36
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	4.41	4.57	1.83	1.81	6.17	6.32
T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	3.67	3.58	1.88	1.90	5.55	5.48
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	3.89	3.56	1.76	1.75	5.72	5.37
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	3.24	3.43	1.94	1.91	5.18	5.34

T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	3.25	3.65	1.94	1.84	5.19	5.49
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	3.72	4.04	1.85	1.98	5.57	6.02
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	3.30	3.87	1.87	1.86	5.17	5.73
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	3.38	3.44	1.96	1.97	5.34	5.41
T ₁₀ : RDF (100:100:50 NPK kg/ha)	3.42	3.58	1.84	1.88	5.26	5.46
T ₁₁ : Absolute control	2.98	3.07	2.10	2.15	5.08	5.22
SEm±	0.06	0.06	0.03	0.03	0.08	0.09
CD (P=0.05)	0.17	0.18	0.08	0.08	0.25	0.26

3.1.6 Chlorophyll content (DA meter reading)

The data presented in Table 3 revealed that during *Kharif* season significantly maximum chlorophyll content (1.49) were observed with T₁ (RDF + *Trichoderma viride*) followed by T₂ (RDF + *Pseudomonas fluorescens*) recording the chlorophyll content of 1.38. The minimum chlorophyll content (0.55) was recorded with T₁₁ (Absolute control).

During Summer season, significantly maximum chlorophyll content (1.57) was observed with T₁ (RDF + *Trichoderma viride*) followed by T₂ (RDF + *Pseudomonas fluorescens*) recording the chlorophyll content of 1.40. The minimum chlorophyll content (0.62) was recorded with T₁₁ (Absolute control).

Application of NPK significantly increased with the fertilizer application which helped in vigorous vegetative growth and imparted deep green colour to the foliage favouring photosynthetic activity of the plants. There was greater accumulation of food material due to increased photosynthetic activity. Similar results have also been reported by Tripathy *et al.* (2013) in onion.

3.1.7 Crude fibre content (%)

The data presented in Table 3 revealed that during *Kharif* season, significantly minimum crude fibre (2.15) was observed with T₁ (RDF + *Trichoderma viride*) and was at par with T₂ (RDF + *Pseudomonas fluorescens*) recording the chlorophyll content of 2.24. The maximum crude fibre (2.86) was recorded with T₁₁ (Absolute control).

During Summer season, significantly minimum crude fibre (2.10) was observed with T₁ (RDF + *Trichoderma viride*) and was at par with T₂ (RDF + *Pseudomonas fluorescens*) recording the crude fibre of 2.21. The maximum crude fibre (2.79) was recorded with T₁₁ (Absolute control).

The crude fiber content increased with the advancement of crop growth. The decrease in crude fibre content was due to the increase in succulence by the increased application of nitrogen,

potassium, potassium in strengthening the thickness of the cell wall. Similar results were obtained by Prabu *et al.* (2003) in okra. Mani and Ramanathan (1981), Abusaleha (1992) and Naidu *et al.* (2000) in okra. Similar decrease in crude fibre content with increased of nitrogen was obtained by Irene (1990).

Table 3. Effect of bioagents on chlorophyll content, crude fibre content of ridge gourd during Kharif, 2021 and Summer, 2022

Treatments	Chlorophyll content		Crude fibre content	
	Kharif 2021	Summer 2022	Kharif 2021	Summer 2022
T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	1.49	1.57	2.15	2.10
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	1.38	1.40	2.24	2.21
T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	1.23	1.28	2.47	2.43
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	1.20	1.25	2.59	2.55
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	1.17	1.14	2.56	2.50
T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	1.18	1.20	2.60	2.51
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	1.13	1.19	2.62	2.56
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	0.93	1.06	2.69	2.57
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	1.15	1.17	2.74	2.70
T ₁₀ : RDF (100:100:50 NPK kg/ha)	1.29	1.24	2.53	2.46
T ₁₁ : Absolute control	0.55	0.62	2.86	2.79
SEm±	0.02	0.02	0.04	0.04
CD (P=0.05)	0.05	0.06	0.11	0.11

3.2 PEST AND DISEASE INCIDENCE

3.2.1 Pest incidence

The data presented in Table 4 revealed that there was no significant difference observed by using the bioagents on the fruitfly and leaf miner incidence during *Kharif* and Summer season respectively.

3.2.2 Disease incidence

3.2.2.1 Downy mildew

The results presented in Table 5 revealed that the effect of bioagents of ridge gourd during experimentation revealed that T₁: RDF+ *Trichoderma viride* was shown less (24.18) percent of disease incidence and the highest incidence treatment was T₁₁ Absolute control (55.10) during *Kharif* season.

Roco and Perez (2001) reported that *Trichoderma* spp. have evolved numerous mechanisms which includes competition for space and nutrient, mycoparasitism and production of inhibitory compounds, inactivation of the pathogen enzymes and induced resistance to crops that are involved in attacking other fungi and reduce the plant diseases. Similar results were reported by Yadav *et al.* (2013) in onion, Shilpa *et al.* (2022) in cabbage and Yogita *et al.* (2022) in ridge gourd.

Table 4. Effect of bioagents on pest incidence of ridge gourd during *Kharif*, 2021 and Summer, 2022

Treatments	Mean Per cent fruit damage by fruit fly		Mean number of leaf mines per plant	
	Kharif 2021	Summer 2022	Kharif 2021	Summer 2022
T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	38.60	24.90	4.26	4.15
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	38.23	24.25	4.35	4.28
T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	39.36	25.58	4.44	4.49
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	38.58	25.18	4.46	4.24
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	39.90	27.59	4.65	4.58
T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	41.60	29.25	4.55	4.45
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	41.54	27.32	4.67	4.35
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	40.78	28.64	4.59	4.62
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	43.85	29.58	4.54	4.59
T ₁₀ : RDF -100% NPK	40.52	25.24	4.75	4.37
T ₁₁ : Absolute control	43.90	30.07	4.98	4.79
SEm±	0.57	0.39	0.07	0.07

CD (P=0.05)	NS	NS	NS	NS
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Table 5. Effect of bioagents on disease incidence of ridge gourd during *Kharif*, 2021

	Mean of downy mildew Per cent Incidence
	Kharif 2021
T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	24.18
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	25.27
T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	26.46
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	25.10
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	26.78
T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	27.36
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	26.26
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	30.69
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	31.61
T ₁₀ : RDF -100% NPK	48.25
T ₁₁ : Absolute control	55.10
SEm±	0.40
CD (P=0.05)	1.17

3.3 Soil analysis

3.3.1 pH

It is clear from Table 6 that pH did not vary significantly with different treatments during *Kharif* and Summer season respectively.

3.3.2 EC (dS/m)

The data presented in Table 6 there was no significant difference observed between the treatments during *Kharif* and Summer season respectively.

3.3.3 Organic carbon (%)

It is clear from Table 6 that organic carbon did not vary significantly with different treatments during

Kharif and Summer season respectively.

Table 6. Effect of bioagents on P^H, electrical conductivity (dS/m) and organic carbon (%) of ridge gourd during Kharif, 2021 and Summer, 2022

Treatments	P ^H		Electrical conductivity (dS/m)		Organic carbon (%)	
	Kharif 2021	Summer 2022	Khari f 2021	Sum mer 2022	Kha rif 2021	Sum mer 2022
T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	7.11	7.13	0.297	0.299	0.58	0.59
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	7.17	7.19	0.295	0.297	0.57	0.58
T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	7.14	7.17	0.294	0.294	0.55	0.56
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	7.23	7.25	0.289	0.290	0.52	0.54
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	7.25	7.25	0.288	0.285	0.50	0.52
T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	7.26	7.31	0.287	0.288	0.51	0.53
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	7.17	7.22	0.285	0.282	0.49	0.49
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	7.28	7.29	0.281	0.280	0.47	0.48
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	7.31	7.34	0.284	0.286	0.45	0.47
T ₁₀ : RDF (100:100:50 NPK kg/ha)	7.23	7.27	0.292	0.294	0.52	0.55
T ₁₁ : Absolute control	7.36	7.35	0.270	0.272	0.44	0.46
SEm±	0.11	0.11	0.004	0.004	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS

3.3.4 Available nitrogen (kg/ha)

The data pertaining to available nitrogen in the soil after harvest as influenced by the effect of bioagents are presented in Table 7.

The data indicated that among the treatments evaluated, significantly maximum available nitrogen content in the soil (269.53 and 268.64) was observed with T₁ (RDF + *Trichoderma viride*) which was on par with T₂ (RDF + *Pseudomonas fluorescens*) (268.32 and 265.44) and T₃ (RDF + *Bacillus subtilis*) (266.78 and 263.05), while the minimum nitrogen content in the soil was recorded with T₁₁ (Absolute control) (211.66 and 215.04) during *Kharif* and Summer season respectively.

3.3.5 Available phosphorus (kg/ha)

The data on available phosphorus in the soil after harvest as influenced by the effect of bioagents are presented in Table 7.

The data indicated that among the treatments evaluated, significantly maximum available phosphorus content in the soil (33.35 and 35.05) was observed with T₁ (RDF + *Trichoderma viride*) followed by T₂ (RDF + *Pseudomonas fluorescens*) (31.77 and 33.47), while the minimum phosphorus content in the soil was recorded with T₁₁ (Absolute control) (23.31 and 23.52) during *Kharif* and Summer seasons respectively.

3.3.6 Available potassium (kg/ha)

The data on available potassium in the soil after harvest as influenced by the effect of bioagents are presented in Table 7.

The data indicated that among the treatments evaluated, significantly maximum available potassium content in the soil (203.64 and 206.45) was observed with T₁ (RDF + *Trichoderma viride*) and was on par with T₂ (RDF + *Pseudomonas fluorescens*) (196.31 and 198.87) and T₃ (RDF + *Bacillus subtilis*) (195.24 and 198.59), while the minimum potassium content in the soil was recorded with T₁₁ (Absolute control) (149.17 and 154.90) during *Kharif* and Summer season respectively.

Owing to ready release of nutrients in available forms, N, P and K was higher with RDF treatment compared to other treatments. It may be due to added supply of nutrients and proliferous root system developed under balanced nutrient application resulting in better absorption of water and nutrients along with improved physical environment. Similar findings were reported by Sundar Raman *et al* (2000) in gherkin.

Table 7. Effect of bioagents on N, P and K of ridge gourd during *Kharif*, 2021 and Summer, 2022

Treatments	Nitrogen (kg/ha)		Phosphorous (kg/ha)		Potassium (kg/ha)	
	Kharif	Summer	Kharif	Summer	Kharif	Summer
	2021	2022	2021	2022	2021	2022
T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	269.53	268.64	33.35	35.05	203.64	206.45
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	268.32	265.44	31.77	33.47	196.31	198.87

T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	266.78	263.05	31.23	32.51	195.24	198.59
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	259.02	257.01	30.42	31.82	193.18	197.04
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	256.86	257.03	30.01	31.48	190.11	190.39
T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	255.19	255.54	29.89	30.26	183.74	189.71
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	248.91	249.70	26.50	26.66	177.51	180.79
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	246.58	242.46	25.11	25.32	168.53	170.83
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	245.44	244.95	24.74	26.35	163.46	169.58
T ₁₀ : RDF (100:100:50 NPK kg/ha)	260.73	260.12	30.52	31.63	194.96	193.62
T ₁₁ : Absolute control	231.66	235.04	23.31	23.52	149.17	154.90
SEm±	3.40	3.47	0.44	0.45	2.74	2.78
CD (P=0.05)	10.23	10.04	1.33	1.29	8.21	8.08

3.4 Benefit cost ratio

The economics as influenced by the effect of bioagents has been calculated and presented in Table 8.

Among the treatments during *Kharif* season, significantly T₁ (RDF + *Trichoderma viride*) recorded the highest gross returns (Rs. 3,615,00), net returns (Rs. 2,625,49.60) with benefit cost ratio of 2.65:1, Whereas the T₂₀ (Absolute control) recorded the lowest gross returns per hectare (Rs. 1,071,00), net returns per hectare (Rs. 16,845) with benefit cost ratio of 0.19:1.

During Summer season, T₁ (RDF + *Trichoderma viride*) recorded the highest gross returns (Rs. 3,706,50), net returns (Rs. 2,711,49.60) with benefit cost ratio of 2.73:1, Whereas the T₂₀ (Absolute control) recorded the lowest gross returns per hectare (Rs. 1,254,00), net returns per hectare (Rs. 34,595) with benefit cost ratio of 0.38:1.

Similar results were also reported by Kavita *et al.* (2020) in ridge gourd.

Table 8. Effect of bioagents on benefit: cost ratio of ridge gourd during *Kharif*, 2021 and Summer, 2022

Treatments	Cost of cultivation (Rs/ha)		Gross income (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
	Khari f	Sum mer	Kha rif	Sum mer	Kharif	Summ er	Kha rif	Sum mer
	2021	2022	2021	2022	2021	2022	2021	2022
T ₁ : RDF + <i>Trichoderma viride</i> (5 kg/ha)	98950.40	99500.40	361500	370650	262549.60	271149.60	2.65	2.73
T ₂ : RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	98950.40	99500.40	320250	324750	221299.60	225249.60	2.24	2.26
T ₃ : RDF + <i>Bacillus subtilis</i> (5 kg/ha)	98970.40	99520.40	295050	300450	196079.60	200929.60	1.98	2.02
T ₄ : 75% RDF + <i>Trichoderma viride</i> (5 kg/ha)	96801.60	97351.60	346200	351750	249398.40	254398.40	2.58	2.61
T ₅ : 75% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	96801.60	97351.60	281400	288900	184598.40	191548.40	1.91	1.97
T ₆ : 75% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	96821.60	97371.60	268800	280500	171978.40	183128.40	1.78	1.88
T ₇ : 50% RDF + <i>Trichoderma viride</i> (5 kg/ha)	94652.70	95202.70	313950	315900	219297.30	220697.30	2.32	2.32
T ₈ : 50% RDF + <i>Pseudomonas fluorescens</i> (2.5 kg/ha)	94652.70	95202.70	253200	258750	158547.30	163547.30	1.68	1.72
T ₉ : 50% RDF + <i>Bacillus subtilis</i> (5 kg/ha)	94672.70	95222.70	233850	237750	139177.30	142527.30	1.47	1.50
T ₁₀ : RDF (100:100:50 NPK kg/ha)	98850.40	99400.40	287400	293550	188549.60	194149.60	1.91	1.95
T ₁₁ : Absolute control	90255.00	90805.00	107100	125400	16845.00	34595.00	0.19	0.38

4. Conclusion

From the study it could be concluded that T₁ (RDF + *Trichoderma viride*) had shown the positive effect on fruit quality, soil parameters and benefit-cost ratio in ridge gourd compared to other treatments, hence it was proved to be the best treatment in ridge gourd.

6. References

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