Effect of bioagents on fruit quality and soil analysis in Ridge gourd

ABSTRACT

The present investigation entitled effect of bioagents on fruit 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 T_1 (RDF + *Trichoderma viride*recorded highest in fruit quality, soil parameters and benefit-cost ratio in ridge gourd.

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 grown commercially in *Kharif* and Summer season propagated by seeds. It has 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 (www.aps.dac.gov.in.)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 (www.telanganahorticulture.nic.in.)

" Biocontrol 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).

"Genus *Trichoderma* can utilize a variety of nutrient sources and are able to effectively degrade some of them" (Harmametal, 2004). Biofertilizer functions as a key player in sustainable agriculture by improving soil fertility, plant tolerance and crop productivity. Current soil management strategies are mainly dependent on inorganic chemical fertilizers, which caused a serious threat to human health and environment. Utilization of beneficial microbes as biofertilizers is of paramount importance in agricultural sector due to their potential in food safety and sustainable crop production.

2.Materials and methods

The present investigation was carried out during Kharif season(2021) and summer season(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 treatmentsreplicated three times. The entire experiment was executed on a creeping mesh. The pit size of 60 cm^2 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 fruit quality*i.e*. total soluble solids (^{o}Brix), ascorbic acid content (mg/g), reducing sugars (%), non-reducing sugars (%), total sugars(%), crude fibre content (%), pest percent of fruit damage=(Number of affected fruits/total number of fruits)×100, leaf miner by counting per plant and downy mildew per cent incidence= (Number of plants infected/ Number of plants under observation) × 100 and in soil analysis pH using digital ELICO pH, EC using digital EC meter, organic carbon (Jackson 1973), Available nitrogen (Subbaiah and Asija, 1956), available phosphorus (Watanabe and Olsen, 1965), available potassium (Jackson, 1973) were statistically analysed using Fisher's method of "Analysis of variance" (ANOVA) as outlined by Gomez and Gomez (1984).

3. Results and discussion

3.1 Quality parameters

The data pertaining to the fruit quality parameters *viz.*, TSS, ascorbic acid content, reducing sugars, non-reducing sugars, total sugars, chlorophyll content and crude fibre influenced by different bioagents was recorded (Tables 1 to 3).

3.1.1 TSS (^{o}Brix)

The data on the TSS (^{o}Brix) affected by the 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 T_1followed by T_2(3.78), while the minimum TSS (2.89) was recorded with T_{11} (control).

During the summer season, T_1recorded maximum TSS (4.25) followed by T_2(4.01), while the minimum TSS (3.04) was recorded with T_{11} (control).

The highest TSS content of the fruit was recorded in T_1due to the application of NPK. TSS content 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 shows that during the *Kharif* season, maximum ascorbic acid content (13.33) was observed with T_1followed by T_2recording the ascorbic acid content of 12..25. The minimum ascorbic acid content (8.27) was recorded with T_{11} (control).

During the summer season, maximum ascorbic acid content (13.65) was observed with $T_1$and was at par with T_2recording the ascorbic acid content of 13.39. The minimum ascorbic acid content (8.48) was recorded with T_{11} (control).

The highest ascorbic acid content was recorded in T_1 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 (^{o} Brix) and ascorbic acid content (mg/100g) of Ridge gourd during *Kharif*, 2021 and Summer, 2022

Treatments	TSS (^{o} Brix)		Ascorbic acid content (mg/100g)	
	Kharif 2021	Summer 2022	Kharif 2021	Summer 2022
T_1 : RDF + *Trichoderma viride* (5 kg/ha)	4.02	4.25	13.33	13.65

T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	3.78	4.01	12.25	13.39
T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	3.66	3.89	12.61	12.97
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	3.70	3.85	10.18	10.55
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	3.68	3.72	9.26	10.32
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	3.64	3.77	9.12	9.49
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	3.60	3.65	8.65	8.85
T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	3.44	3.58	8.39	8.53
T_9 : 50% RDF + *Bacillus subtilis* (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} : 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 on the reducing sugars affected by the bioagents on quality in ridge gourd is presented in Table 2.

There was significant differences observed among the treatments with respect to reducing sugars during *Kharif* season.Maximum reducing sugars (4.54 %) were recorded in $T_1$and was at par with T_2(4.41 %), while minimum reducing sugars (2.98 %) were recorded inT_{11} (control).

During the summer season, T_1recorded maximum reducing sugars (4.62%) and was at par with T_2(4.57 %), while the minimum reducing sugars (3.07 %) were recorded with T_{11} (control).

3.1.4 Non reducing sugars (%)

During *Kharif* and summerseasons, minimum non reducing sugars (1.69 and 1.74 %) were observed with T_1, while maximum (2.10 and 2.15 %) were recorded with T_{11} (control).

3.1.5 Total sugars (%)

The data on the total sugars affected by the bioagents on quality in ridge gourd is presented in Table 2.

There was significant differences observed among the treatments with respect to total sugars during *Kharif* season.Maximum total sugars (6.23%) were recorded in $T_1$and was at par with T_2(6.17%), while the minimum total sugars (5.08 %) was recorded with T_{11} (control).

During the summer season, T_1recorded maximum total sugars (6.36 %) and was at par with T_2(6.32 %), while the minimum total sugars (5.22 %) was recorded with T_{11} (control).

The sugar content was highest in T_1due to application of nutrient 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 the*Kharif*, 2021 and Summer, 2022

Treatments	Reducing sugars (%)		Non-reducing sugars (%)		Total sugars (%)	
	Kharif 2021	Summer 2022	Kharif 2021	Summer 2022	Kharif 2021	Summer 2022
T_1 : RDF + *Trichoderma viride* (5 kg/ha)	4.54	4.62	1.69	1.74	6.23	6.36
T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	4.41	4.57	1.83	1.81	6.17	6.32
T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	3.67	3.58	1.88	1.90	5.55	5.48
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	3.89	3.56	1.76	1.75	5.72	5.37
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	3.24	3.43	1.94	1.91	5.18	5.34
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	3.25	3.65	1.94	1.84	5.19	5.49
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	3.72	4.04	1.85	1.98	5.57	6.02
T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	3.30	3.87	1.87	1.86	5.17	5.73

T_9 : 50% RDF + *Bacillus subtilis* (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} : 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 the *Kharif* season maximum chlorophyll content (1.49) was observed with T_1 followed by T_2recording the chlorophyll content of 1.38. The minimum chlorophyll content (0.55) was recorded with T_{11} (control).

During the summer season, maximum chlorophyll content (1.57) was observed with T_1followed by T_2recording the chlorophyll content of 1.40. The minimum chlorophyll content (0.62) was recorded with T_{11} (control).

Application of NPK significantly increased the 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 the *Kharif* season, minimum crude fibre (2.15) was observed with $T_1$and was at par with T_2recording the chlorophyll content of 2.24. The maximum crude fibre (2.86) was recorded with T_{11} (control).

During the summer season, minimum crude fibre (2.10) was observed with $T_1$and was at par with T_2recording the crude fibre of 2.21. The maximum crude fibre (2.79) was recorded with T_{11} (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 application of nitrogen,phosphorus, potassium increasing 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 observed by Irene (1990).

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

Treatments	**Chlorophyll**		**Crude fibre content**	
	Kharif 2021	**Summer 2022**	**Kharif 2021**	**Summer 2022**

T_1 : RDF + *Trichoderma viride* (5 kg/ha)	1.49	1.57	2.15	2.10
T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	1.38	1.40	2.24	2.21
T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	1.23	1.28	2.47	2.43
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	1.20	1.25	2.59	2.55
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	1.17	1.14	2.56	2.50
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	1.18	1.20	2.60	2.51
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	1.13	1.19	2.62	2.56
T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	0.93	1.06	2.69	2.57
T_9 : 50% RDF + *Bacillus subtilis* (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} : 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

There was no significant difference in incidence of fruitfly and leaf miner 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 shows less (24.18) percent of disease incidence and the highest incidence was observed in T_{11} control (55.10) during the *Kharif* season.

Roco and Perez (2001) reported that *Trichoderma* spp. have evolved numerous mechanisms such as competition for space and nutrient, mycoparasitism and production of inhibitory compounds, inactivation of the pathogen enzymes and induced resistance to crops by 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 the*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 + *Trichoderma viride* (5 kg/ha)	38.60	24.90	4.26	4.15
T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	38.23	24.25	4.35	4.28
T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	39.36	25.58	4.44	4.49
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	38.58	25.18	4.46	4.24
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	39.90	27.59	4.65	4.58
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	41.60	29.25	4.55	4.45
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	41.54	27.32	4.67	4.35
T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	40.78	28.64	4.59	4.62
T_9 : 50% RDF + *Bacillus subtilis* (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} : 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**

Table 5. Effect of bioagents on disease incidence of ridge gourd during the *Kharif*, 2021

	Mean of Downy Mildew % Incidence
	Kharif 2021
T_1 : RDF + *Trichoderma viride* (5 kg/ha)	24.18
T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	25.27

T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	26.46
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	25.10
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	26.78
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	27.36
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	26.26
T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	30.69
T_9 : 50% RDF + *Bacillus subtilis* (5 kg/ha)	31.61
T_{10} : RDF -100% NPK	48.25
T_{11} : 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 6there 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 in soil of ridge gourd plots during *Kharif*, 2021 and Summer, 2022

Treatments	**P^{H}**		**Electrical conductivity (dS/m)**		**Organic carbon (%)**	
	Kharif 2021	**Summer 2022**	**Kharif 2021**	**Summer 2022**	**Kharif 2021**	**Summer 2022**

T_1 : RDF + *Trichoderma viride* (5 kg/ha)	7.11	7.13	0.297	0.299	0.58	0.59
T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	7.17	7.19	0.295	0.297	0.57	0.58
T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	7.14	7.17	0.294	0.294	0.55	0.56
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	7.23	7.25	0.289	0.290	0.52	0.54
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	7.25	7.25	0.288	0.285	0.50	0.52
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	7.26	7.31	0.287	0.288	0.51	0.53
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	7.17	7.22	0.285	0.282	0.49	0.49
T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	7.28	7.29	0.281	0.280	0.47	0.48
T_9 : 50% RDF + *Bacillus subtilis* (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} : 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 of 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, maximum available nitrogen content in the soil (269.53 and 268.64) was observed with T_1which was on par with T_2(268.32 and 265.44) and T_3(266.78 and 263.05), while the minimum nitrogen content in the soil was recorded with T_{11} (control) (211.66 and 215.04) during the *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 maximum available phosphorus content in the soil (33.35 and 35.05) was observed with T_1followed by T_2(31.77 and 33.47), while the minimum phosphorus content in the soil was recorded with T_{11} (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 maximum available potassium content in the soil (203.64 and 206.45) was observed with $T_1$and was on par with T_2(196.31 and 198.87) and T_3(195.24 and 198.59), while the minimum potassium content in the soil was recorded with T_{11} (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 washigherwithRDFtreatmentcomparedtoothertreatments. 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 soil of ridge gourd plots during *Kharif*, 2021 and Summer, 2022

Treatments	Nitrogen (kg/ha)		Phosphorous (kg/ha)		Potassium (kg/ha)	
	Kharif 2021	Summer 2022	Kharif 2021	Summer 2022	Kharif 2021	Summer 2022
T_1 : RDF + *Trichoderma viride* (5 kg/ha)	269.53	268.64	33.35	35.05	203.64	206.45
T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	268.32	265.44	31.77	33.47	196.31	198.87
T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	266.78	263.05	31.23	32.51	195.24	198.59
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	259.02	257.01	30.42	31.82	193.18	197.04
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	256.86	257.03	30.01	31.48	190.11	190.39
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	255.19	255.54	29.89	30.26	183.74	189.71
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	248.91	249.70	26.50	26.66	177.51	180.79

T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	246.58	242.46	25.11	25.32	168.53	170.83
T_9 : 50% RDF + *Bacillus subtilis* (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} : 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.

During *Kharif* season,T_1recorded 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 T_{20} (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 the summer season, T_1 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 T_{20} (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**	
	Kharif 2021	**Summer 2022**	**Kharif 2021**	**Summer 2022**	**Kharif 2021**	**Summer 2022**	**Kharif 2021**	**Summer 2022**
T_1 : RDF + *Trichoderma viride* (5 kg/ha)	98950.40	99500.40	361500	370650	262549.60	271149.60	2.65	2.73

T_2 : RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	98950.40	99500.40	320250	324750	221299.60	225249.60	2.24	2.26
T_3 : RDF + *Bacillus subtilis* (5 kg/ha)	98970.40	99520.40	295050	300450	196079.60	200929.60	1.98	2.02
T_4 : 75% RDF + *Trichoderma viride* (5 kg/ha)	96801.60	97351.60	346200	351750	249398.40	254398.40	2.58	2.61
T_5 : 75% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	96801.60	97351.60	281400	288900	184598.40	191548.40	1.91	1.97
T_6 : 75% RDF + *Bacillus subtilis* (5 kg/ha)	96821.60	97371.60	268800	280500	171978.40	183128.40	1.78	1.88
T_7 : 50% RDF +*Trichoderma viride* (5 kg/ha)	94652.70	95202.70	313950	315900	219297.30	220697.30	2.32	2.32
T_8 : 50% RDF + *Pseudomonas fluorescens* (2.5 kg/ha)	94652.70	95202.70	253200	258750	158547.30	163547.30	1.68	1.72
T_9 : 50% RDF + *Bacillus subtilis* (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} : control	90255.00	90805.00	107100	125400	16845.00	34595.00	0.19	0.38

4. **Conclusion**

From the study it may be concluded that RDF along with *Trichoderma viride* (5 kg/ha)was found to be most effective treatment combination for getting higher fruit quality, soil parameters and maximum net returns in ridge gourd.

5. Acknowledgement

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Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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Details of the AI usage are given below:

1.

2.

3.

6. References

Abusaleha, Efficiency of organic vs inorganic form of nitrogen on fruit quality and yield of okra hybrids. Crop Research. 1992;37 (1/3): 101-106.

Anonymous. "Area and production published by Ministry of Agriculture and Cooperation," www.aps.dac.gov.in, 2019a.

Anonymous. "Crop wise area and production of horticultural crops in Telangana state," www.telanganahorticulture.nic.in, 2019b.

Diriba-Shiferaw G, Nigussie-Dechassa R, Kebede W, Getachew T, Sharma JJ. Bulb quality of garlic (Allium sativum L.) as influenced by the application of inorganic fertilizers. African Journal of Agricultural Research. 2014. 9 (8): 778- 790.

Gomez KH, Gomez, AA. 1984. Statistical Procedures for Agriculture Research. John Willy and Sons, Inc., New York.

Haraman GE, Howell CR. Viterbo I."Trichoderma species Opportunistic, avirulent plant symbionts", Nature Reviews Microbiology. 2004. 2: 43-56.

Irene VP, Balakrishnan R. Studies on the influence of the herbicide, nitrogen and mulching on the nutrient uptake of okra (Abelmoschus esculentus (L). Moench.) cv. MDU.1. Indian Journal of Horticulture. 1990. 47 (2): 233-238.

Jackson ML. Soil chemical analysis. Prentice Hall India Pvt. Ltd., New Delhi. 1973. 209- 213.

Kavita C, Paliwal R, Mahariya JS, Hoshiyar S, Gupta NK. Plant growth improvement in ridge gourd through integrated nutrient management practices. International Journal of Current Microbiology and Applied Sciences. 2020. 9(3): 1228-1234.

Mani S, Ramnathan KM. Effect of nitrogen and potassium on the crude fibre content of bhendi fruit on successive stage of picking. South Indian Horticulture. 1981. 29 (2): 100-104.

Naidu AK, Kushwah SS, Dwivedi YC. Performance of organic manures, bio and chemical fertilizers and their combinations on microbial population of soil and growth and yield of okra. JNKVV Research Journal. 2000. 33 (½): 34-38.

Nayak DA, Pradhan S, Mohanty, A, Parida K, Mahapatra P. 2016. Effect of integrated nutrient management on productivity and profitability of pointed gourd. Journal of Crop and Weed. 2016. 12 (1): 25-31.

O'Brien, PA. Biological control of plant diseases. Australas Plant Pathology. 2017. 46: 293–304.

Prabu T, Narwadkar PR, Sajindranath AK, Rafi M. Effect of Integrated nutrient managementon growth and yield of okra (*Abelmoschus esculentus* L.) Cv. Parbhani kranti. Orissa Journal of Horticulture. 2003. 31(1): 17-21.

Rathod P, Salvi VG, Jadhav S. Growth, yield and quality of ridge gourd as influenced by integrated nutrient management in coastal region of Maharashtra. International Journal of Chemical Studies. 2018. 6 (5): 2357- 2360.

Sharma S. 2014. Effect of integrated nutrient management on growth, yield and quality of Kharif onion (*Allium cepa* L.). M.Sc. (Ag.) Thesis, SKRAU, Bikaner.

Shilpa V, Neha S, Meenakshi S, Mohanta TP, Prashant K. Application of *Trichoderma viride* and *Pseudomonas fluorescens* to cabbage (*Brassica oleracea* L.) improves both its seedling quality and field performance. Sustainability. 2012. 14:1-12.

Subbaiah BV, Asija GL. Alkaline permanganate method. Current Science. 1956. 25: 258-260.

Sundar Raman S, Dakshina MKM, Ramesh G, Palaniappan SP, Chelliah, S. Effect of fertigation on growth and yield of gherkin. Vegetable Science. 2000. 27 (1): 64-66.

Thriveni V, Mishra HN, Pattanayak SK, Sahoo GS, Thomson T. Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd (*Momordica charantia* L.). International Journal of Farm Sciences. 2015. 5(1): 24-29.

Tripathy P, Sahoo BB, Priyadarshini A, Das SK. and Dash DK. Effect of sources and levels of sulphur on growth, yield and bulb quality in onion (*Allium cepa* L.). International Journal of Bio-resource and Stress Management. 2013. 4(4): 641-644.

Watanabe FC, Olsen SR. Test of ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extract from soil. Procedure for Soil Amendments. 1965. 29(b): 677-678.

Yadav PM, Rakholiya KB, Pawar DM. Evaluation of bioagents for management of the onion purple blotch and bulb yield loss assessment under field conditions. The Bioscan. 2013. 8 (4): 1295-1298.

Yogita P, Prasad VM, Vijay B, Gaddam T. Effect of inorganic fertilizers, organic manures and Trichoderma on growth, quality and yield of ridge gourd (*Luffa acutangula*) cv. Kashi Shivani. The Pharma Innovation Journal. 2022. 11(6): 1793-1797.