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SP Khedkar
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

PC Mali
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

RG Khandekar
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

VG Salvi
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

BR Salvi
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

KV Malshe
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Corresponding Author:
SP Khedkar
Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

Influence of bio-fertilizers and organic manures on growth and yield of turmeric

SP Khedkar, PC Mali, RG Khandekar, VG Salvi, BR Salvi and KV Malshe

Abstract
The present investigation entitled Influence of bio-fertilizers and organic manures on growth and yield of turmeric was undertaken at College of Horticulture, DBSKKV, Dapoli during the year 2021 and 2022 by considering the importance of turmeric under Konkan agro-climatic conditions. The experiment was carried out using factorial randomize block design consisting four bio fertilizers and two organic manures with three replications. The treatment combination O_2B_4 (7.5 t ha^{-1} Vermicompost; 5 kg ha^{-1} PSB) recorded the maximum number of leaves (14.78), plant height (86.40 cm) and number of tillers per plant (2.87). In post harvest parameter treatment combination O_2B_4 (Vermicompost 7.5 t ha^{-1}; PSB 4 kg ha^{-1}) showed the maximum number of primary fingers (16.25), number of secondary fingers (18.80), fresh turmeric per plot (11.38 kg) and yield per hectare in tones (37.91 t). The economic analysis of the yield data revealed that O_2B_4 *i.e.,* Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1} given the highest gross return (Rs. 863400) and B:C ratio (1.89).

Keywords: Organic, bio-fertilizers, turmeric, vermicompost

Introduction
Turmeric (*Curcuma longa* L.) is one of India's most significant and historic spices. India uses it in every food preparation to give it its distinctive color and flavour. Additionally, it is utilized as a dye in the textile industry as well as in medicine and cosmetics. Dry turmeric has roughly 69.49 percent carbohydrates, 6.30 percent protein, 5.10 percent oil, and 3.5 percent minerals and other crucial components (Misra, 2012) [4].

India produces 78 percent of the world's turmeric, with most of its production going to domestic use. Although, turmeric has a significant export potential, for one reason or another, production has not kept up with rising domestic and global demand for one reason or another. Turmeric is a popular spice and the most significant crop for medical purposes. The seedlings developed on pro-trays made from finger rhizome buds should be employed to provide the maximum yield and economic returns possible from turmeric under agroclamtic condition in the Konkan region. Similar to how it will assist increase the area planted with turmeric in the Konkan region of Maharashtra, where there is a severe water constraint in the months of April and May when the crop is planted and grown from mother rhizomes (Mali *et al*, 2016) [3].

Pests including the stem fly, girdle beetle and other sucking and chewing pests were also more common because of the increase in plant population. Nitrogen is one of the key elements in determining the yield potential of high producing cultivars. Several workers noted the significance of bio-fertilizer and organic manures in the turmeric high quality and production of the crop. Long-term usage of chemical fertilizers in monoculture has been demonstrated to have significant negative effects on the ecological balance. Adopting a plan for the wise use of bio-fertilizers and organic manures is therefore necessary. The use of bio-fertilizers, which are eco-friendly, economical, and improve the soil fertility condition, also plays a supporting nutritional function in production (Padmapriya and Chezhiyan, 2009) [5].

Methodology
The study "Influence of bio-fertilizers and organic manures on growth and yield of turmeric" was conducted at College of Horticulture, Dapoli; Dist. Ratnagiri (MS) from 2021 to 2022. The plots were chosen based on how well the soil and topography would cultivate turmeric. The field was set up according to design and treatment details, the beds for the two trials were built in accordance with the plans and layouts. The pro tray raised uniformly growing seedlings was planted at 45 cm × 30 cm spacing for experiment.

The dirt was thoroughly covered after the seedlings were transplanted 10 cm deep. For experiment doses of organic manure and bio-fertilizers applied to each combination by spot application at the time transplanting.

Gap filling was done at 10 days after transplanting planting to maintain uniform plant population. Seven months after transplantation, the crop was harvested when it was physiologically matured. The rhizomes were carefully removed. Mother rhizomes and fingers were separated and carefully cleaned. The experiment was done using FRBD with three replications. Five plants were randomly used for observation from every replication.

Plate 1: General view of experimental plot 2

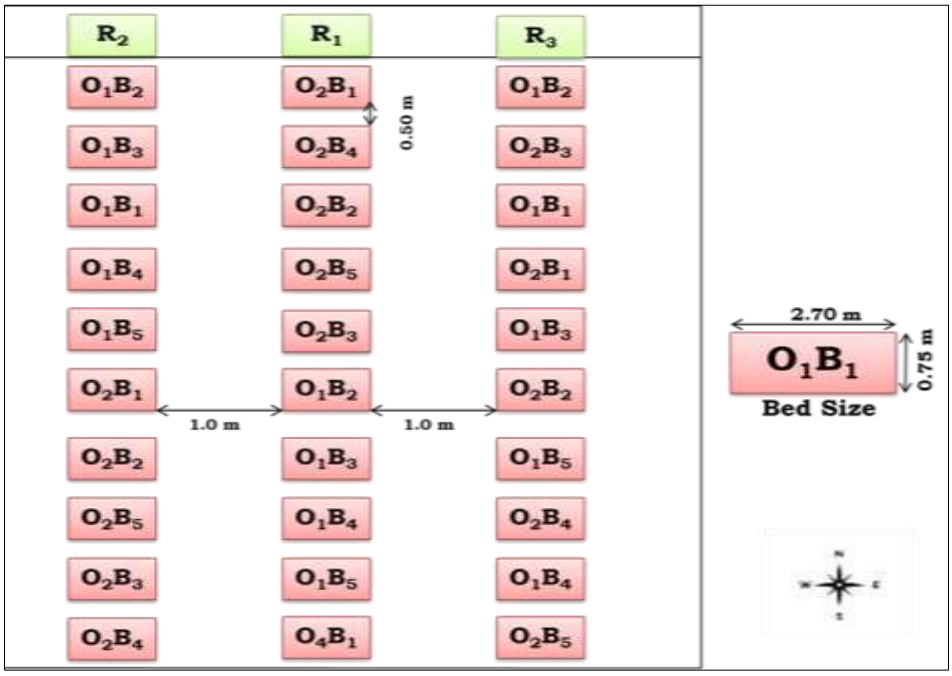

Plate 2: Layout of experimental plot

Results and Discussion

With regards to interaction influence of bio fertilizer and organic manures on leaves of turmeric, it was varied significantly. At 150 DAT, the highest number of leaves per plant (19.47, 10.10, 14.78) was recorded in O_2B_4 (Vermicompost 7 t ha^{-1} and PSB 5 kg ha^{-1}) and the lowest number of leaves per plant (12.33, 8.20 and 10.27) was noticed in O_1B_1 (FYM 25 t ha^{-1} and No Biofertilizer) during 2021, 2022 including pooled analysis (Table 1). This may be because there are more nutrients available from bio-fertilizers and organic manures, which has raised the photosynthetic activity, chlorophyll production, nitrogen metabolism and auxin contents in the plants, which ultimately increase the plant height. Singh (2013) [8] reported that maximum number of leaves in Poultry manures + PSB combination. Amala *et al*. (2022) [1] recorded highest number of leaves in T_6, 75% NPK (RDF) + FYM (25 t ha^{-1}) + VC (5 t ha^{-1}) + Neem cake (500 kg ha^{-1}) + Azoto (2 kg ha^{-1}) + PSB (2 kg ha^{-1}). It was observed that there was increasing trend in plant height along with irrespective of treatments.

The highest plant height was recorded in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}) (93.50 cm, 79.30 cm and 86.40 cm) and the lowest plant height (78.43 cm, 56.12 cm and 67.28 cm) recorded in O_1B_1 (FYM 25 t ha^{-1} and No Biofertilizer) during 2021, 2022 and in pooled analysis (Table 2). The increase in photosynthetic activity, chlorophyll production, nitrogen metabolism and auxin quantity in the plants as a result of nutrients availability from bio-fertilizers and organic manure may be responsible for this outcome, which ultimately increased plant height. Poinkar (2006) [6] observed that the application of NPK 120:60:60 kg ha^{-1} followed by Farmyard manure (10 t ha^{-1}) + Azotobactor + PSB (250 g for 10 kg of seed) increased plant height. Amala *et al*. (2022) [1] recorded that maximum plant height in 75% NPK (RDF) + FYM (25 t ha^{-1}) + VC (5 t ha^{-1}) + Neem cake (500 kg ha^{-1}) + Azotobacter (2 kg ha^{-1}) + PSB (2 kg ha^{-1}) recorded.

Table 1: Influence of bio-fertilizers and organic manures on number of leaves

Number of leaves per plant									
Treatments	**2021**			**2022**			**Pooled**		
	O_1	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**
B_1	12.33	14.33	13.33	8.20	8.87	8.53	10.27	11.60	10.93
B_2	13.47	15.37	14.42	8.60	9.30	8.95	11.03	12.33	11.68
B_3	15.40	17.40	16.40	8.83	9.27	9.05	12.12	13.33	12.73
B_4	17.43	19.47	18.45	9.03	10.10	9.57	13.23	14.78	14.01
B_5	15.93	16.40	16.17	8.30	8.63	8.47	12.12	12.52	12.32
Mean	14.91	16.59	15.75	8.59	9.23	8.91	11.75	12.91	12.33
	S.Em ±	CD at 5%	F- test	S.Em ±	CD at 5%	F- test	S.Em ±	CD at 5%	F- test
O	0.07	0.19	S	0.05	0.15	S	0.05	0.14	S
B	0.10	0.30	S	0.08	0.23	S	0.08	0.22	S
O x B	0.15	0.43	S	0.11	0.32	S	0.11	0.31	S
O_1 - FYM (25 t ha^{-1})	O_2 -Vermicompost (7.5 t ha^{-1})								
B_1 -No Bio-fertilizers	B_2 -VAM (3 kg ha^{-1})	B_3 -Azotobactor (2.5 kg ha^{-1})		B_4 -PSB (5 kg ha^{-1})			B_5 – Azospirillum (5 kg ha^{-1})		

Table 2: Influence of bio-fertilizers and organic manures on plant height (cm)

Plant height (cm)									
Treatments	**2021**			**2022**			**Pooled**		
	O_1	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**
B_1	78.43	81.27	79.85	56.12	59.89	58.01	67.28	70.58	68.93
B_2	79.57	83.60	81.58	58.49	64.08	61.29	69.03	73.84	71.44
B_3	85.23	88.00	86.62	59.99	69.94	64.96	72.61	78.97	75.79
B_4	90.70	93.50	92.10	64.36	79.30	71.83	77.53	86.40	81.97
B_5	83.33	84.97	84.15	54.61	59.88	57.25	68.97	72.43	70.70
Mean	83.45	86.27	84.86	58.71	66.62	62.67	71.08	76.44	73.76
	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test
O	0.10	0.30	S	0.68	1.96	S	0.33	0.96	S
B	0.17	0.48	S	1.08	3.10	S	0.53	1.52	S
O x B	0.23	0.68	S	1.52	4.39	S	0.74	2.15	S
O_1 - FYM (25 t ha^{-1})	O_2 -Vermicompost (7.5 t ha^{-1})								
B_1 -No Bio-fertilizers	B_2 -VAM (3 kg ha^{-1})	B_3 -Azotobactor (2.5 kg ha^{-1})		B_4 -PSB (5 kg ha^{-1})			B_5 - Azospirillum (5 kg ha^{-1})		

With regards to interaction influence of bio fertilizer and organic manures on number of tillers, it was varied significantly. The highest number of tillers per plant was observed in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}) (4.10, 1.63 and 2.87) and the lowest number of tillers per plant (1.80, 0.70 and 1.25) was recorded in O_1B_1 (FYM 25 t ha^{-1} and No Biofertilizer) during 2021, 2022 and in pooled analysis (Table 3). This might be because increasing photosynthetic activity, chlorophyll production, nitrogen metabolism and auxin contents in the plants with the use of bio-fertilizers and organic manures resulted in better clump length per plant. Velmurugan *et al.* (2009) [9] reported that the greatest numbers of tillers (4.32) were obtained with FYM + *Azospirillum* + PSB (*Bacillus megaterium*) + VAM (vermiculite - based inoculum *Glomus fasciculatum, G. mosseae*and *Gigaspora*sp.). Amala *et al.* (2022) [1] recorded the maximum tillers in 75% NPK (RDF) + FYM (25 t ha^{-1}) + VC (5 t ha^{-1}) + Neem cake (500 kg ha^{-1}) + Azotobacter (2 kg ha^{-1}) + PSB (2 kg ha^{-1}).

In both the years of trail and the pooled data, the influence of interaction of bio-fertilizer on the number of primary fingers exhibited a significant trend (Table 4).

During 2021, the maximum number of primary fingers (16.67) was recorded in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}), which was superior over all treatment combination, while the lowest number of primary fingers (8.53) recorded in O_1B_1 (FYM 25 t ha^{-1} and No Bio-fertilizers). In 2022, highest number of primary fingers (15.83) was recorded in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}) while the lowest number of primary fingers (7.67) was observed in O_2B_1 (Vermicompost 7.5 t ha^{-1} and No Bio-fertilizers) (Table 4).

With regards to pooled data, the maximum number of primary fingers (16.25) was noted in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}), while the lowest number of primary fingers (8.35) was noted in O_1B_1 (FYM 25 t ha^{-1} and No Bio-fertilizers). Organic manure increase soil physical texture, structure and reduce soil bulk density, retained more moisture and bio fertilizer provide microbial activity with provide fixed or immobile nutrient of soil to plant which create way for maximum number of primary rhizomes per plant. It had been presumed that organic manure played a crucial role within the formation of primary fingers during reproductive stage. Similarly, Chanchan *et al.* (2018) [2] reported number of primary fingers (10.72) in combination of Compost + NP 75% + *Azospirillum* + AMF. Sahoo *et al.* (2020) [7] recorded that maximumt number of primary finger per plant (5.60).

In 2021, the highest number of secondary fingers (19.07) was recorded in O_2B_4 (VC 7.5 t ha^{-1} and PSB 5 kg ha^{-1}) which is at par with O_2B_3 (VC 7.5 t ha^{-1} and Azotobactor2.5 kg ha^{-1}) (18.23). In second year, the treatment O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}) recorded the highest secondary fingers (18.53). In pooled data, number of secondary fingers differed significantly. The maximum secondary fingers (18.80) was noted in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}) and it was found significantly at par with O_2B_3 (Vermicompost 7.5 t ha^{-1} and Azotobactor 2.5 kg ha^{-1}) (17.87), whereas treatment combination O_1B_1 (FYM 25 t ha^{-1} and No Bio-fertilizers) recorded the minimum number of secondary fingers (9.20).

The effectiveness of organic manures could not be fully demonstated by their sigle application during the development of secondary fingers. It had been assumed that the production of secondary fingers during the reproductive stage was greatly influence by organic manure, particularly vermicompost and bio-fertilizers. Similarly, Sahoo *et al*. reported that maximum 7.6 numbers of secondary fingers with the application of 100% chemical fertilizers along with bio-fertilizers and vermicompost.

Table 3: Influence of bio-fertilizers and organic manures on number of tillers

Number of tillers per plant									
Treatments	**2021**			**2022**			**Pooled**		
	O_1	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**
B_1	1.80	2.13	1.97	0.70	0.83	0.77	1.25	1.48	1.37
B_2	2.20	2.53	2.37	0.90	0.93	0.92	1.55	1.73	1.64
B_3	2.73	3.00	2.87	1.00	1.30	1.15	1.87	2.15	2.01
B_4	3.73	4.10	3.92	1.07	1.63	1.35	2.40	2.87	2.63
B_5	2.47	2.67	2.57	0.77	1.00	0.88	1.62	1.83	1.73
Mean	2.59	2.89	2.74	0.89	1.14	1.01	1.74	2.01	1.87
	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test
O	0.01	0.03	S	0.02	0.07	S	0.02	0.04	S
B	0.02	0.06	S	0.04	0.11	S	0.02	0.07	S
O x B	0.03	0.08	S	0.05	0.16	S	0.03	0.10	S
O_1 - FYM (25 t ha^{-1})	O_2 -Vermicompost (7.5 t ha^{-1})								
B_1 -No Bio-fertilizers	B_2 -VAM (3 kg ha^{-1})	B_3 -Azotobactor (2.5 kg ha^{-1})		B_4 -PSB (5 kg ha^{-1})			B_5 - Azospirillum (5 kg ha^{-1})		

Table 4: Influence of bio-fertilizers and organic manures on number of primary fingers.

Number of primary fingers									
Treatments	**2021**			**2022**			**Pooled**		
	O_1	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**
B_1	8.53	9.60	9.07	8.17	7.67	7.92	8.35	8.63	8.49
B_2	9.70	10.23	9.97	9.00	8.50	8.75	9.35	9.37	9.36
B_3	10.33	11.07	10.70	10.03	10.60	10.32	10.18	10.83	10.51
B_4	12.73	16.67	14.70	12.13	15.83	13.98	12.43	16.25	14.34
B_5	9.10	10.77	9.93	8.90	10.40	9.65	9.00	10.58	9.79
Mean	10.08	11.67	10.87	9.65	10.60	10.12	9.86	11.13	10.49
	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test
O	0.26	0.76	S	0.22	0.62	S	0.23	0.66	S
B	0.41	1.20	S	0.34	0.99	S	0.36	1.04	S
O x B	0.59	1.69	S	0.48	1.40	S	0.51	1.48	S
O_1 - FYM (25 t ha^{-1})	O_2 -Vermicompost (7.5 t ha^{-1})								
B_1 -No Bio-fertilizers	B_2 -VAM (3 kg ha^{-1})	B_3 -Azotobactor (2.5 kg ha^{-1})		B_4 -PSB (5 kg ha^{-1})			B_5 - Azospirillum (5 kg ha^{-1})		

The interaction influence of bio-fertilizers and organic manures on yield of fresh turmeric per plot for both successive years including pooled data exhibited similar trend and it varied significantly (Table 6). Pooled data also revealed that yield per plant varied significantly. The highest yield of fresh turmeric per plot (11.38 kg) was recorded in O_2B_4 (VC 7.5 t ha^{-1} and PSB 5 kg ha^{-1}), whereas the treatment interaction O_1B_1 (FYM 25 t ha^{-1} and No Bio-fertilizers) recorded lowest yield per plant (5.68 kg). The increased height of plant, leaves, number of tillers, weight of primary and secondary rhizomes and fresh weight of rhizomes per plant are all possible causes of the higher yield. This may be because organic manuring and biofertilizer make the nutrients readily available in readily available form. Singh (2013) [8] reported that the highest yield of green turmeric per plot in organic manures and bio-fertilizers combination.

The interaction influence of bio-fertilizers and organic manures on turmeric yield per hectare for both successive years including pooled data exhibited similar trend and it varied significantly (Table 7). During 2021, the maximum turmeric yield per hectare (38.43 t) was recorded in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}). During 2022, the highest turmeric yield per hectare (37.40 t) was obtained in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}) and it was significantly superior over all interaction Pooled data, the highest turmeric yield per hectare (37.91 t) was recorded in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}). By enhancing soil microbial activity, biofertilizer may have had a significant impact in raising rhizome production.

Vermicompost increased the soil's physical, chemical and biological properties which helps in better nutrients absorption and utilization by plant which resulting higher rhizome yield. The higher plant height, number of leaves, number of tillers and ultimately a higher photosynthetic rate could all contribute to the higher yield. This was in conformity with results Singh (2013) [8] reported that highest yield per hectare.

Table 5: Influence of bio-fertilizers and organic manures on number of secondary fingers

Number of secondary fingers									
Treatments	**2021**			**2022**			**Pooled**		
	O_1	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**
B_1	9.33	10.73	10.0	9.07	9.87	9.5	9.20	10.30	9.8
B_2	10.20	11.80	11.0	9.90	10.73	10.3	10.05	11.27	10.7
B_3	15.60	18.23	16.9	15.27	17.50	16.4	15.43	17.87	16.7
B_4	16.87	19.07	18.0	16.43	18.53	17.5	16.65	18.80	17.7
B_5	12.50	16.33	14.4	12.17	16.03	14.1	12.33	16.18	14.3
Mean	12.90	15.23	14.06	12.57	14.53	13.55	12.73	14.88	13.81
	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test
O	0.19	0.56	S	0.15	0.44	S	0.17	0.48	S
B	0.30	0.88	S	0.24	0.70	S	0.27	0.77	S
O x B	0.43	1.24	S	0.34	0.99	S	0.38	1.09	S
O_1 - FYM (25 t ha^{-1})	O_2 -Vermicompost (7.5 t ha^{-1})								
B_1 -No Bio-fertilizers	B_2 -VAM (3 kg ha^{-1})	B_3 -Azotobactor (2.5 kg ha^{-1})		B_4 -PSB (5 kg ha^{-1})			B_5 - Azospirillum (5 kg ha^{-1})		

Table 6: Influence of bio-fertilizers and organic manures on yield of fresh turmeric per plot (kg)

Yield of fresh turmeric (kg)									
Treatments	**2021**			**2022**			**Pooled**		
	O_1	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**
B_1	5.87	6.36	6.12	5.49	5.96	5.73	5.68	6.16	5.92
B_2	6.49	6.78	6.63	6.09	6.45	6.27	6.29	6.61	6.45
B_3	7.71	8.67	8.19	7.37	8.32	7.84	7.54	8.49	8.02
B_4	8.76	11.53	10.14	8.50	11.22	9.86	8.63	11.38	10.00
B_5	6.38	7.63	7.00	6.10	7.26	6.68	6.24	7.44	6.84
Mean	7.04	8.20	7.61	6.71	7.84	7..27	6.88	8.02	7.44
	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test
O	0.06	0.18	S	0.06	0.17	S	0.06	0.17	S
B	0.10	0.29	S	0.09	0.27	S	0.09	0.27	S
O x B	0.14	0.41	S	0.13	0.38	S	0.13	0.39	S
O_1 - FYM (25 t ha^{-1})	O_2 -Vermicompost (7.5 t ha^{-1})								
B_1 -No Bio-fertilizers	B_2 -VAM (3 kg ha^{-1})	B_3 -Azotobactor (2.5 kg ha^{-1})		B_4 -PSB (5 kg ha^{-1})			B_5 - Azospirillum (5 kg ha^{-1})		

Table 7: Influence of bio-fertilizers and organic manures on yield per hectare (t)

Yield per hectare (t)									
Treatments	**2021**			**2022**			**Pooled**		
	O_1	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**	**O_1**	**O_2**	**Mean**
B_1	19.57	21.21	20.39	18.29	19.88	19.08	18.93	20.55	19.74
B_2	21.62	22.59	22.10	20.31	21.50	20.90	20.96	22.04	21.50
B_3	25.71	28.91	27.31	24.57	27.72	26.15	25.14	28.31	26.73
B_4	29.18	38.43	33.81	28.34	37.40	32.87	28.76	37.91	33.34
B_5	21.26	25.43	23.35	20.33	24.18	22.26	20.80	24.81	22.80
Mean	23.47	27.31	25.39	22.37	26.13	24.25	22.92	26.72	24.82
	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test	S.Em ±	CD 5%	F- test
O	0.21	0.60	S	0.19	0.56	S	0.20	0.58	S
B	0.33	0.95	S	0.31	0.89	S	0.32	0.91	S
O x B	0.47	1.35	S	0.43	1.26	S	0.45	1.29	S
O_1 - FYM (25 t ha^{-1})	O_2 -Vermicompost (7.5 t ha^{-1})								
B_1 -No Bio-fertilizers	B_2 -VAM (3 kg ha^{-1})	B_3 -Azotobactor (2.5 kg ha^{-1})		B_4 -PSB (5 kg ha^{-1})			B_5 - Azospirillum (5 kg ha^{-1})		

Table 8: Economics of the turmeric cultivation (B: C Ratio)

No	Treatments	Yield (t)	Total Cost	Gross Return	Net Return	B:C Ratio
1.	O_1B_1 (FYM 25 t ha^{-1} and No Bio fertilizer)	18.93	397679	429720	32041	1.08
2.	O_1B_2 (FYM 25 t ha^{-1} and VAM 3 kg ha^{-1})	20.96	405479.1	476520	71041	1.18
3.	O_1B_3 (FYM 25 t/ha and Azotobactor 2.5 kg ha^{-1})	25.14	422041.58	573720	151678	1.36
4.	O_1B_4 (FYM 25 t ha^{-1} and PSB 5 kg ha^{-1})	28.76	436044	655560	219516	1.50
5.	O_1B_5 (FYM 25 t ha^{-1} and Azospirillum 5 kg ha^{-1})	20.80	405864.1	474480	68616	1.17
6.	O_2B_1(Vermicompost 7.5 t ha^{-1} and No Bio fertilizer)	20.55	389919	470160	80241	1.21
7.	O_2B_2(Vermicompost 7.5 t ha^{-1} and VAM 3 kg ha^{-1})	22.04	325946	503880	177934	1.55
8.	O_2B_3 (Vermicompost 7.5 t ha^{-1} and Azotobactor 2.5 kg ha^{-1})	28.31	419561.58	645840	226278	1.54
9.	O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1})	37.91	456184	863400	407216	1.89
10.	O_2B_5 (Vermicompost 7.5 t ha^{-1} and Azospirillum 5 kg ha^{-1})	24.81	406844.1	567360	160516	1.39

Plate 3: Influence of bio-fertilizers and organic manures on rhizome

Influence of bio-fertilizers and organic manures on economics of turmeric was analyzed and data are presented in Table 8. Pooled data reported that the highest gross return (Rs.863400) as well as highest B:C ratio (1.54) was noted in O_2B_4 (Vermicompost 7.5 t ha^{-1} and PSB 5 kg ha^{-1}), whereas treatment combination O_1B_1 (FYM 25 t ha^{-1} and No Bio-fertilizers) recorded the lowest gross return (Rs. 429720) and lowest B:C ratio (1.08).

For obtaining larger returns, features with a higher monitory value and lower cultivation costs are desired. As a result, the treatments economics were determined. Singh (2013) [8] reported the maximum rhizome yield of 194.50 q/ha was obtained in turmeric variety Guntur Local.

Conclusion

In the experiment, treatment combination (O_2B_4 Vermicompost 7.5 t ha^{-1} + PSB 5 kg ha^{-1}) was found significantly superior in all pre harvest, post harvest parameter, B:C ratio as compared to other treatments. The combination of organic manure with biofertilizer *i.e.* vermicompost (7.5 t ha^{-1}) with PSB (5 kg ha^{-1}) was superior for turmeric cultivation in Konkan region.

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