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Effect of organic nutrient management on quality, processed finger yield and economics in turmeric

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Abstract
The experiment was conducted at Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2015-16 and 2016-17 in Randomized Block Design replicated thrice with twelve treatments consisting of different organic manures, recommended dose of fertilizers and different biofertilizers. For essential oil content of leaves and processed finger yield treatment T_7 i.e. application of Neem cake @ 4 t ha^{-1} + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}) found to be superior over other treatments with maximum gross monetary returns. However, effect on quality parameters of rhizomes *viz.* curcumin, oleoresin content and recovery per cent of processed fingers were non-significant.

Keywords: Organic nutrient, quality, processed fingers, economics

Introduction
Turmeric (*Curcuma longa* L.), a herbaceous perennial medicinal plant belonging to family Zingiberaceae is one of the most valuable spices all over the world and is cultivated in the country since ancient times. It is also one of the second most important spice crops after chilli. India is the largest producer of turmeric in the world accounts for 75 per cent in world production and 60 per cent in world export share (Anonymous, 2018) [3]. The turmeric is native of South-East Asia, cultivated extensively in India, Myanmar, Nigeria, Pakistan, Sri Lanka, Indonesia, Bangladesh, Taiwan and China. Curumin (diferuloylmethene) is responsible for the yellow colour and its comprised of curcumin I (94%) and curcumin II (6%) and curcumin III (0.3%) (Ruby *et al.*, 1995) [10]. Major turmeric producing states in India are Telangana, Andhra Pradesh, Tamil Nadu and Karnataka, Orissa, West Bengal and Maharashtra. The area under turmeric in the country is around 248000 hectares and the production is 1149000 MT with average national productivity 4.63 t ha^{-1} (Anonymous, 2019) [4].

Considering the economic importance of turmeric and environmental problems caused by chemicals application, it is important to cultivate turmeric organically. Different organic manures influence differently in terms of yield and quality of turmeric. The commonly used organic manures are farm yard manure, vermicompost, different concentrated non-edible oil cakes, biofertilizers etc. Hence, it is necessary to know the best source of organic manure which could help in increasing the yield and quality of turmeric. In view of this background, this study is aimed to evaluate the effect of organic nutrient management on quality parameters of fresh rhizomes, essential oil content of leaves, processed finger yield and economics of cultivation in turmeric.

Material and Methods
The experiment was carried out during year 2015-16 and 2016-17 at Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola located in subtropical region between 22.42ºN latitude and 77.02º E longitude at an altitude of 307.42 m above the mean sea level. The experimental plot was having very loose soil with uniform texture and structure with good drainage. The soil of experimental plots was slightly alkaline in reaction (pH 8.23), EC (0.62 dSm^{-1}), low in organic carbon (3.50 g kg^{-1}), available N (168.72 kg ha^{-1}), available P (16.72 kg ha^{-1}) and high in available K (318.24 kg ha^{-1}). The experiment was laid out in Randomized Block design with twelve treatments *viz.*, T_1 - Recommended Dose of Fertilizers (200:100:100 NPK kg ha^{-1}), T_2 – Farm Yard Manure @ 20 t ha^{-1}, T_3 – Vermicompost @ 13.2 t ha^{-1}, T_4 – Neem cake @ 4 t ha^{-1}, T_5 – Farm Yard Manure @ 20 t ha^{-1} + *Azatobacter* (10 kg ha^{-1})

+ PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}), T_6 – Vermicompost @ 13.2 t ha^{-1} + *Azatobacter* (10kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}), T_7 – Neem cake @ 4 t ha^{-1} + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}), T_8 – *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}), T_9 - Recommended Dose of Fertilizers (200:100:100 NPK kg ha^{-1}) + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}), T_{10} - Fermented cow dung slurry @ 12500 l ha^{-1} in three equal split doses at 30, 60 and 90 DAP, T_{11} - Fermented cow dung slurry @ 12500 l ha^{-1} in three equal split doses at 30, 60 and 90 DAP + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}) and T_{12} - Absolute control. The treatments were replicated thrice. The planting was done in *Kharif* season of 2015-16 and 2016-17on broad bed furrow at spacing of 30 X 22.5 cm. Recommended package of practices was followed. The high curcumin containing cultivar "PDKV Waigon" developed by Dr. PDKV, Akola, Maharashtra was used. Quality parameters *viz.* oleoresin (Pruthi, 1999) [8], curcumin (Anonymous, 1984) [2] and essential oil content of leaves (Soxhelt method) were analyzed. Also yield of processed fingers, length of processed fingers, length of processed fingers were recorded with estimation of cost of cultivation on the basis of average of two years. The statistical analysis of data for Randomized Block was done as suggested by Panse and Sukhatme (1967) [7].

Result and Discussion

Quality parameters (Oleoresin, curcumin and essential oil of leaves)

In context to quality parameters, no significant differences were observed among the treatments imposed for oleoresin and curcumin content of fresh turmeric rhizomes. The essential oil content of leaves was influenced significantly due to organic nutrient management (Table 1). Concerning to essential oil content of leaves, maximum oil content (7.04, 7.16 and 7.10) was obtained in treatment T_7 i.e. application of Neem cake @ 4 t ha^{-1} + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}) during year 2015-16, 2016-17 and pooled, respectively. The treatment T_7 was at par with T_9 and T_6 during both the years and when data was pooled. The minimum essential oil content of leaves (4.49, 5.25 and 4.87) was obtained in absolute control during 2015-16, 2016-17 and pooled, respectively. The high essential oil content of leaves as influenced by different organic nutrient management treatments opted might be due to high available nutrients, better phosynthetic assimilates in leaves. The results are in conformity with Sanwal *et al.* (2007) [11].

Table 1: Effect of organic nutrient management through different sources on quality parameters of turmeric

Treatment	Quality Parameters								
	Oleoresin (%)			Curcumin (%)			Essential oil content of leaves (%)		
	2015 -16	2016 -17	Pooled	2015 -16	2016 -17	Pooled	2015 -16	2016 -17	Pooled
T_1	7.46	7.56	7.51	6.49	6.39	6.44	6.11	6.19	6.15
T_2	7.03	7.09	7.06	5.74	5.84	5.79	5.29	5.42	5.36
T_3	7.11	7.15	7.13	5.93	5.93	5.93	5.35	5.45	5.40
T_4	7.35	7.41	7.38	6.23	6.23	6.23	5.71	6.18	5.95
T_5	7.32	7.37	7.34	5.97	6.09	6.03	5.37	5.81	5.59
T_6	7.56	7.78	7.67	6.55	6.47	6.51	6.96	7.12	7.04
T_7	7.95	8.11	8.03	6.88	6.79	6.84	7.29	7.42	7.36
T_8	6.71	6.56	6.64	5.37	5.21	5.29	5.16	5.26	5.21
T_9	7.82	7.91	7.86	6.76	6.51	6.64	7.04	7.16	7.10
T_{10}	6.81	6.77	6.79	5.67	5.52	5.60	5.21	5.31	5.26
T_{11}	6.93	6.87	6.90	5.73	5.66	5.70	5.27	5.32	5.30
T_{12}	6.05	6.28	6.17	5.10	5.21	5.16	4.49	5.25	4.87
'F' test	NS	NS	NS	NS	NS	NS	Sig.	Sig.	Sig.
SE (m) ±	0.46	0.46	0.46	0.39	0.38	0.38	0.49	0.51	0.39
CD at 5%	-	-	-	-	-	-	1.45	1.49	1.15

Yield of processed fingers, recovery per cent and length of processed fingers

It was observed that, yield and length of processed finger of turmeric was significantly influenced by organic nutrient management (Table 2). However, effect on recovery percentage was non- significant. In context to yield of processed finger, treatment T_7 i.e. application of Neem cake @ 4 t ha^{-1} + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}) gave maximum yield (33.54, 42.53 and 38.03 q ha^{-1}) during 2015-16, 2016-17 and pooled, respectively. The treatment T_7 was at par with T_9, T_6, T_1 and T_4 in 2015-16 and with T_9 and T_1 during 2016-17 and for pooled. However, it was followed by T_6 i.e. Vermicompost @ 13.2 t ha^{-1} + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}) and T_4 i.e. Neem cake @ 4 t ha^{-1}. The higher processed finger yield obtained in treatment T_7 might be due to the higher nutrient content in neem cake coupled with their easy and extended availability and better uptake brought about by enhanced microbial action with the combination of biofertilizers viz. *Azatobacter*, PSB and VAM resulting in higher finger yield. The results are in agreement with Kumar *et al.* (2013) [6] and Sarma *et al.* (2015) [12, 6]. The better length of fingers might be due better soil physical texture, structure and porosity which allow development of the finger rhizomes to grow in the better space which ultimately reflects the processed finger yield. The results are in agreement with Kamal and Yusuf (2013) [5] in turmeric.

Table 2: Effect of organic nutrient management through different sources on yield and recovery of processed finger

Treatment	Yield of processed fingers (q ha^{-1})			Recovery (%)			Length of processed finger (cm)		
	2015 -16	2016 -17	Pooled	2015 -16	2016 -17	Pooled	2015 -16	2016 -17	Pooled
T_1	27.95	36.30	32.12	18.82	18.97	18.90	6.12	6.12	6.12
T_2	23.56	26.52	25.04	18.39	18.39	18.39	5.44	5.42	5.43
T_3	24.52	27.40	25.96	18.50	18.54	18.52	5.81	5.68	5.75
T_4	26.66	31.00	28.83	18.72	18.82	18.77	6.12	5.97	6.05
T_5	26.19	29.02	27.60	18.61	18.61	18.61	5.97	5.84	5.91
T_6	29.41	31.87	30.64	18.84	19.05	18.95	6.24	6.38	6.31
T_7	33.54	42.53	38.03	19.35	19.42	19.39	7.26	7.52	7.39
T_8	23.68	22.96	23.32	18.09	17.86	17.98	5.12	5.12	5.12
T_9	32.51	39.65	36.08	19.10	19.37	19.24	6.39	7.47	6.93
T_{10}	24.08	25.05	24.57	18.11	18.11	18.11	5.26	5.24	5.25
T_{11}	24.66	25.57	25.11	18.32	18.31	18.32	5.39	5.29	5.34
T_{12}	18.58	18.04	18.31	16.25	16.13	16.19	5.02	4.93	4.98
'F' test	Sig.	Sig.	Sig.	NS	NS	NS	Sig.	Sig.	Sig.
SE (m) ±	2.51	3.09	2.35	1.18	1.18	0.66	0.38	0.38	0.31
CD at 5%	7.35	9.05	6.88	-	-	-	1.12	1.11	0.91

Table 3: Effect of organic nutrient management through different sources on economics of cultivation of turmeric (average of two years)

Treatment	Cost of cultivation (Rs ha^{-1})	Gross Monetary Return (Rs ha^{-1})	Net Monetary Return (Rs ha^{-1})	B:C Ratio
T_1	106032	417599	311567	3.94
T_2	135226	325478	190252	2.41
T_3	187790	337469	149679	1.80
T_4	160046	374783	214737	2.34
T_5	144944	358810	213866	2.48
T_6	197995	398321	200326	2.01
T_7	171195	494400	323205	2.89
T_8	104039	303187	199148	2.91
T_9	116020	469033	353013	4.04
T_{10}	110165	319352	209187	2.90
T_{11}	119419	326452	207033	2.73
T_{12}	93927	238004	144077	2.53

Economics

For cost of cultivation and economics estimated on the basis of average of two years, the maximum gross monetary returns Rs. 494400/- ha^{-1} was obtained in treatment T_7 i.e. application of Neem cake @ 4 t ha^{-1} + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}). This might be due to the higher yield recorded by the same treatment reflected in higher GMR. However, the maximum net monetary returns (Rs. 353013/- ha^{-1}) and B:C ratio (1:4.04) was achieved in treatment T_9 i.e. Recommended Dose of Fertilizers (200:100:100 NPK kg ha^{-1}) + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}). This was due to low input cost of chemical fertilizers. The slightly higher cost of cultivation in organic treatment has been on account of the more labour needed for the application and incorporation of manures compared to fertilizer use. Nevertheless, the cost of organic inputs in integrated system may be ignored as these are available *in situ*. The cost analysis was in line with findings reported by Roy and Hore (2011) [9] in their experimental study and Amarnath and Shridhar (2012) [9, 1] for an economic analysis of organic farming.

Conclusion

For essential oil content of leaves and processed finger yield treatment T_7 i.e. application of Neem cake @ 4 t ha^{-1} + *Azatobacter* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) + VAM (65 kg ha^{-1}) found to be superior over other treatments with maximum gross monetary returns. It was observed that, increase in yield levels were attained over the years which can increase with continuous application of organic nutrient sources and biofertilizers as well as would found more economically beneficial to the growers.

References

1. Amarnath JS, Sridhar V. An economic analysis of organic farming in Tamil Nadu, India. Bangladesh J Agric. Econs. 2012; 25(1-2):25-40.
2. Annonymous. Indian Standard Method of sampling and test of spices and condiments (First revision), 1984.
3. Annonymous. Agricultural Market Intelligence Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, India, 2018, 1-4
4. Anonymous. Spices Board India, 2019. www.indianspices.com
5. Kamal MZU, Yousuf MN. Effect of organic manures on growth, rhizome yield and quality attributes of turmeric (*Curcuma longa* L.). The Agriculturists, 2012; 10(1):16-22.
6. Kumar R, Kumar S, Jeet R, Kumar S, Singh H. Growth, yield and quality of turmeric (*Curcuma longa* L.) as influenced by organic manures. Agriways. 2013; 1(2):113-117.
7. Panse VG, Suhatme PV. Statistical methods for Agricultural Workers, ICAR, New Delhi, 1967.
8. Pruthi JR. Spices and condiments, Publication and information division, Krishi Anusandhan Bhawan, Pusa New Delhi, 1999.
9. Roy SS, Hore JK. Effect of organic manures and microbial inoculants on yield, root colonization and total bacterial population in turmeric (*Curcuma longa* L.) intercropped in (*Areca catechu* L.) garden. J. Spices and Aromatic Crops. 2011; 20(2):66-71.
10. Ruby AJ, Kuttan G, Dinesh Babu K, Rajasekharan KN, Kuttan R. Antitumor and antioxidant activity of natural curuminiods. Cancer Letter. 1995; 94:79-83.

11. Sanwal SK, Laxminarayana K, Yadav RK, Rai N, Yadav DS, Mousumi Bhuyan. Effect of organic manures on soil fertility, growth, physiology, yield and quality of turmeric. Indian J Hort. 2007; 64(4):444-449.
12. Sarma I, Phukon M, Roopa Borgohain. Effect of organic manure, vermicompost and neem cake on growth, yield and profitability of turmeric (*Curcuma longa* L.) variety–Megha Turmeric- 1. Asian J Bio Sci. 2015; 10(2):133-137.