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VARIABILITY STUDIES OF YIELD AND QUALITY IN TURMERIC (*CURCUMA LONGA L.*) AS INFLUENCED BY DIFFERENT TYPES AND LEVELS OF ORGANIC MANURES & BIO-FERTLIZERS BASED ON STRATIFICATION OF PHYSIOLOGICAL TRAITS

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Abstract- An investigation was made to determine the "effect of bio-fertilizers and organic manures on growth and yield of turmeric during *Kharif* and *Rabi* season of 2012-2013. On the basis of present investigation, it is concluded that the turmeric variety Guntur responded well in terms of morphological, yield and its attributing and quality characters. The finding will help to a great extent in treatment of bio-fertilizers and organic manure, the treatment O_4 (Poultry manure) was found significantly superior as compared to other treatments of organic manures. Highest growth characters (*viz.,* plant height, number of leaves, leaf length, leaf width, number of clumps per plant, length of clumps per plant treatment) and yield attributes (*viz.*, weight of primary and secondary rhizomes per plant, fresh weight of rhizomes per plant, dry matter recovery (%), leaf area index, leaf area duration, dry leaves per plot, rhizomes yield per plot and per hectare) were found in the treatment O_4 (Poultry manure @ 5 t/ha) as compared to O_1 (O_1 i.e. control). Under the treatment of biofertilizers, B_2 (PSB 5 kg/ha) obtained maximum yield over all other doses and the lowest yield was reported under treatment B_0 (No biofertilizer). Hence it was identified that Poltry manure 5 t/ha and biofertilzers @ 5 kg/ha individually proved the best for "Kymorepleatue and Satpura hills" of Madhya Pradesh.

Keywords- Bio-fertilizer, Growth, Organic manure, Turmeric and Yield.

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Introduction

Turmeric (*Curcuma longa* L.) is one of the most important and ancient spice of India. It belongs to the family *Zingiberacease*. It has diversified uses. The people of India use it in all preparation for its typical color and flavor. Besides, it is used in medicine and cosmetics and as dye in textile industries. It contains about 69.49 carbohydrate 6.30 protein, 5.10 oil and 3.50% mineral and other important elements in dry turmeric (Shakur, 2000). Turmeric widely used as spice as well as most important crop for medicinal use. Curcumin a pigment which constitute yellow color is very useful in food industry. Turmeric is widely used in pharmaceutical due to its anti-cancers, anti-inflamatory, anti-septic properties. Turmeric contains up to 5% essential oils and up to 5% curcumin. Most usage of turmeric is in the form of rhizome powder, in some regions (especially in Maharashtra, Goa and Konkan), leaves of turmeric are used to wrap and cook food. Constant use of chemical fertilizers under monoculture over a long period of time was found to impair the ecological balance in huge dimensions. Therefore, it is inevitable to adopt a strategy for judicious use of organic manures and biofertilizers. Likewise the use of biofertilizers have a supplementary nutritive role in productivity are eco-friendly, cost effective and enhance the soil fertility status [1].

Materials and Methods

An experiment was conducted at Department of Horticulture, JNKVV Jabalpur (MP) during 2012-13 to study the effect of biofertlizers and organic manures on growth and yield of turmeric. The two factors were chosen as a treatment. Factor A consisted of Organic manure and factor B related with biofertilizers. The treatment details are presented [Table-1]. The average annual rainfall was 1350 mm, which was mostly received during June to October from South-west monsoon. The average maximum temperature was 46^{0}C and minimum temperature 6.8^{0}C. The average annual relative humidity was 74%. Organic carbon 0.22%, available nitrogen 332.50 (kg/ha), available phosphorus 40.60 (kg/ha), available potash 312.27 (kg/ha), soil pH 7.03, electrical conductivity 0.14 (m mhos per cm) indicates the status of soil type. The previous crop in the field was onion. The seed rhizomes of turmeric var. Guntur was obtained from Horticultural research station Guntur Andhra Pradesh. Doses of organic manure and bio fertilizers were applied as per treatment plot as basal dose. The experimental sowing was done on 26 June, 2012 maintaining the spacing of 70 cm between two rows and 30 cm between plants. The furrows were opened with the help of kudali and seeds were sown in furrows by manual labour and were covered immediately with soil. Harvesting was done on 22 March 2013 when the leaves turned yellow. The net plots were marked and border rows were harvested before harvesting of net plot area. The crop was harvested plot-wise and the produce of each of the plot was, weighed with the help of electronic balance.

Table-1 *Treatment Combinations*

Factor A –	Organic manure	(i). O_1 - No organic manure
		(ii). O_2 - FYM 15t/ha
		(iii). O_3-Vermicompost 5t/ha
		(iv). O_4-Poultry Manure 5t/ha
factor B –	Bio-fertilizers	(i). B_0 - No biofertilizer
		(ii). B_1 - Azospirillum 5kg/ha
		(iii). B_2 - PSB 5kg/ha

Results and Discussion

Effect of different treatments of bio-fertilizer and organic manure on pre harvest observation of turmeric

Among pre harvest observations, the plant height, number of leaves per plant, length of leaves, width of leaves, number of clumps per plant and length of clumps were studied in turmeric. It was observed that the plant height was significantly increased by various treatments of bio-fertilizer and organic manure at all the growth stages (i.e. at 30, 60, 90, 120 and 150 days after sowing) [Table-2].

The significantly maximum plant height was recorded in treatment O_4 (Poultry manure 5 t/ha), followed by O_3 (Vermicompost 5 t/ha) and O_2 (FYM 15 t/ha) at 30, 60, 90, 120 and 150 DAS and which were at par with each other. However, the minimum plant height was observed under the treatment O_1 (without organic manure) at 30, 60, 90, 120 and 150 DAS. Similar results have been reported by [2-6]. The plant height of turmeric was responded significantly due to bio-fertilizers at 90, 120 and 150 DAS only. The significantly maximum plant height were recorded under treatment B_2 (PSB 5 kg/ha), and B_1 (Azospirillum 5 kg/ha.) at 90, 120 and 150 DAS and which were at par with each other, while minimum plant height was recorded in treatment B_0 (No biofertilizer) at 30, 60, 90, 120 and 150 DAS. This may be due to application of major and minor nutrients, through bio-fertilizers and organic manure, increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improving the plant height. These findings are in agreement with the findings of [1,7,8].The number of leaves per plant of turmeric increased significantly with the different treatment of bio-fertilizers and organic manures. In case of organic manures, the maximum leaves per plant were recorded under the treatment O_4 (Poultry manure 5t/ha) at 30, 60, 90, 120 and 150 DAS, while, it was lowest leaves per plant at 30, 60, 90, 120 and 150 DAS in treatment O_1 (No organic manures). Similar results have been reported by [3-6]. The maximum number of leaves per plant was recorded in treatment B_2 (PSB 5 kg/ha) whereas, it was minimum in treatment B_0 (No biofertilizer). These findings are in agreement with the findings of [1,7,8]. Probable reasons for enhanced more number of leaves, may be due to promotive effects of macro and micronutrients on vegetative growth which ultimately lead to more photosynthetic activities.

Amongst organic manures, at 30, 60, 90, 120 and 150 DAS treatment O_4 (Poultry manure 5t/ha) were recorded significantly higher number of clumps per plant as compared to other treatments. The lowest number of clumps per plant was recorded under treatment O_1 at 30, 60, 90, 120 and 150 DAS. These findings supported the findings of [3] reported that the application of NPK 120:60:60 kg ha^{-1} followed by FYM (10 t ha^{-1}) + Azoto + PSB (250 g per 10 kg of seed) increased number of tillers $plant^{-1}$ significantly. Similar results have been reported by [4,1,7-8].

The length of clumps per plant of turmeric increased significantly with the different treatment of bio-fertilizers and organic manures. In case of organic manures, the maximum length of clumps per plant were observed under the treatment O_4 (Poultry manure 5t/ha) at 30, 60, 90, 120 and 150 DAS, while, it was lowest length of clumps per plant at 30, 60, 90, 120 and 150 DAS in treatment O_1 (No organic manures). The maximum length of clumps per plant were recorded in treatments B_2 (PSB 5 kg/ha), whereas, it was minimum in treatment B_0 (No biofertilizer) at 30, 60, 90, 120 and 150 days after sowing. This may be due to application of major and minor nutrients, through bio-fertilizers and organic manure, increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improved the length of clumps per plant [4,5].

Effect of different treatments of bio-fertilizer and organic manure on post harvest observation of turmeric

It is obvious from the data that the weight of primary rhizomes per plant was significantly influenced by different treatments of bio-fertilizers and organic manures [Table-1]. With respect to organic manures, significantly highest weight of primary rhizomes per plant was obtained in treatment O_4 (Poultry manure 5 t/ha) and O_3 (Vermicompost 5 t/ha) and which were at par with each other while, the lowest weight of primary rhizomes per plant were harvested in treatment O_1 (No organic manures). Similar results have been reported by [2,5]. Moreover, primary rhizomes per plant (5.19) were also highly accelerated by neem cake application. Bio-fertilizers B_2 (PSB 5 kg/ha) was recorded highest weight of primary rhizomes per plant as compared to other treatments. However, it was found lowest in B_0 (No biofertilizer).

In the application of bio-fertilizers treatment B_2 (PSB 5 kg/ha) has recorded maximum weight of secondary rhizomes followed by B_1 (Azospirillum 5 kg/ha) and which were at par with each other. Therefore, minimum weight of secondary rhizomes per plant was observed in B_0 (No bio-fertilizers). Similar results have been reported by [8].This could be due to slower release of nutrients from soil resulting in greater uptake of nutrients, which might have exerted greater weight of primary rhizomes per plant. Organic manure improves soil physical texture; structure and decreased soil bulk density and retained more moisture, consequences paved the way for greater weight of primary rhizomes per plant [2,5].

Fresh weight of rhizomes per plantwas significantly affected by the different treatments of bio-fertilizers and organic manures. With regards to organic manures, the treatment O_4 (Poultry manure 5t/ha) showed the in maximum fresh weight of rhizomes per plant followed by O_2 (FYM 15 t/ha) and O_3 (Vermicompost 5t/ha) and which were at par with each other. However, it was the minimum under the treatment O_1 (No organic manures). Similar results have been reported by [3,5]. Treatment B_2 (PSB 5 kg/ha) was exhibited maximum fresh weight of rhizomes per plant, while the treatment B_0 (No biofertilizer) was recorded the minimum fresh weight of rhizomes per plant. Probable region for increased fresh weight of rhizomes per plant due to humus substances present in organic manure could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes [3,5].

As regards to organic manures the significantly maximum 37.10% dry matter recovery was noted in treatment O_4 (Poultry manure 5t/ha) as compared to other treatments, while the lowest dry matter recovery(33.94%) was found in O_1 (No organic manure). These findings are in agreement with the findings of [5,9-11] Neem cake application had the highest dry weight of rhizome per plant (40.35 g), total dry matter yield (6.85 t ha-1) than those received other types of manures. Maximum 37.27% dry matter recovery was recorded under the treatments B_2 (PSB 5 kg/ha). However, the minimum dry matter recovery (33.73%) was observed in B_0 (No bio-fertilizer). Probable reason for increased dry matter recovery percent due to humus substances present in organic manure. Orthodihydric phenols of humic acid that inhibits the IAA oxidase leads to prolonged persistence of IAA in the plant and promoted the dry matter production. The leaf area index increased significantly with the different treatment of bio-fertilizers and organic manures at 120 and 150 DAS. In case of organic manures, the maximum leaf area index were observed under the treatment O_4, while, it was lowest leaf area index in treatment O_1 (No organic manures). These findings are in agreement with the findings of [3,4] reported that the cow manure and goat manure showed an excellent efficacy on leaf area of turmeric than chicken manure. The maximum leaf area index were recorded in treatments B_2 (PSB 5 kg/ha). Therefore, it was minimum in treatment B_0 (No biofertilizer) at 120 and 150 DAS. These findings are in agreement with the findings of [1].This could be due to the higher uptake of nutrients especially iron and magnesium from the soil resulting in greater photosynthetic activity and humic acid contributed to the increased leaf area index [1].

In case of organic manures, the maximum leaf area duration were observed under the treatment O_4 (PM 5 t/ha), while, it was lowest leaf area duration in treatment O_3 (Vermicompost 5 t/ha). The data on leaf area duration (LAD) indicated significant differences due to treatments at the stages (120-150 DAS). Significantly maximum leaf area duration were recorded in treatments B_2 (PSB 5 kg/ha). However, it was the minimum with treatment B_0 (No biofertilizer).With regards to organic manures, the treatment O_4 (Poultry manure 5t/ha) was observed in maximum dry leaves per plot and it was minimum under the

Table-2 *Individual effect of bio-fertilizers and organic manures on growth and rhizome yield of turmeric*

Code	Treatment details	Plant height	No of leaves/plant	No of clumps/ plant	Length of clumps per plant	Wt. of primary rhizomes/plant	Wt. of secondary rhizomes/plant	Fresh wt. of rhizomes/plant (g)	Dry matter recovery (%)	Leaf area index at 150 DAS	Leaf area duration at 120 - 150 DAS	Rhizomes yield per hectare (q)
Organic manure												
O_1	No organic manure	89.52	5.76	4.56	30.48	32.13	35.76	338.39	33.94	0.204	-0.002	161.20
O_2	FYM 15t/ha	99.59	6.63	5.25	30.69	39.25	42.61	394.23	35.72	0.227	-0.001	182.46
O_3	VC 5t/ha	99.85	7.01	5.55	31.21	42.89	49.92	390.00	36.54	0.236	-0.003	187.12
O_4	PM 5t/ha	100.70	7.28	5.80	31.21	43.55	52.08	406.82	37.10	0.281	0.002	192.60
SEm±		1.71	0.21	0.15	0.29	0.50	1.31	5.73	0.53	0.002	0.002	3.30
CD at 5% levels		5.05	0.64	0.44	0.88	1.49	3.86	16.92	1.59	0.006	0.001	9.75
Bio-fertilizer												
B_0	No bio-fertilizer	95.14	5.96	4.74	29.53	35.84	40.76	368.23	33.73	0.212	-0.004	174.90
B_1	Azospirillum 5kg/ha	98.44	6.86	5.45	31.05	40.42	45.88	385.41	36.47	0.231	-0.001	183.09
B_2	PSB 5kg/ha	98.67	7.20	5.68	32.11	42.11	48.62	393.43	37.27	0.269	0.002	184.54
SEm±		1.28	0.18	0.13	0.25	0.43	1.13	4.96	0.46	0.002	0.001	2.86
CD at 5% levels		3.37	0.56	0.38	0.76	1.29	3.34	14.65	1.37	0.007	0.001	8.44

Where, FYM=Farm Yard Manure, VC=Vermicompost, PM=Poultry Manure, PSB=Phosphorus Solubilizing Bacteria

treatment O_1 (No organic manures). These findings are in agreement with the findings of [4,5,10].Treatment B_2 (PSB 5 kg/ha) was exhibited maximum dry leaves per plot, while the treatment B_0 (No biofertilizer) was recorded the minimum dry leaves per plot.

The analysis of variance showed that turmeric rhizomes yield per hectare (q/ha) was significantly affected due to individual effect of bio-fertilizers and organic manures. In cases of organic manures, the treatment O_4 (Poultry manure 5t/ha) was recorded maximum 14.162 kg/plot and 192.60 q/ha rhizomes yield followed by O_3 (Vermicompost 5t/ha (187.12 q/ha). Whereas the lowest 11.860 kg/plot and 161.20 q/ha rhizomes yield was noted in O_1 (No organic manures). These findings are in agreement with the findings of [3,4,611,12]**.** The maximum 13.570 kg/plot and 184.54 q/ha rhizomes yield was recorded under the treatment B_2 (PSB 5 kg/ha) which was significantly higher as compared to other treatment. However, the lowest 12.865 kg/plot and 174.90 q/ha rhizomes yield was observed in treatment B_0 (No biofertilizer). The present findings are in consonance with earlier findings of Selvarajan (2001) found that the 16% increase in yield by the application of 25 kg *Azospirillum* with 50% of the recommended dose of inorganic N and 5 tonnes FYM/ha over the recommended dose of fertilizer application. [8] reported that the rhizome yield and quality (curcumin and oleoresin contents) of turmeric cv. DK Local. Inoculation of *Azospinillum* in combination with N profoundly increased the growth, yield and quality of turmeric over the control. Azotobacter also affected the performance of turmeric but the effect was lower than that of *Azospirillum*. [8] reported that the biofertilizers, *Azospirillum*+ AM were superior as compared to other combinations. The higher yield might be due to increase in plant height, number of leaves, leaf length, leaf width, number of clumps per plant, length of clumps per plant, and yield attributes *viz*., weight of primary and secondary rhizomes per plant and fresh weight of rhizomes. This might be due to the availability of the nutrients in readily available form during organic manuring and bio-fertilizer, the C: N was high over control (Selvarajan,2001) and[8].

References

[1] Padmapriya S. and Chezhiyan N. (2009) *Indian J. of Horti.,* 66(3), 333-339

[2] Gill B.S., Kaur S. and Saini S.S. (2004) *Journal of Spices and Aromatic Crops,* 13(2),117-120.

[3] Poinkar M.S., Shembekar R.Z., Chopde N., Bhaladhare N., Khewale A. and Dongarkar K. (2006) *Journal of Soils and Crops,* 16(2), 417-420.

[4] Hossain M.A. and Ishimine Y. (2007) *Plant Production Science,* 10(1), 146-150.

[5] Kamal M.Z.U. and Yousuf M.N. (2012) *The Agriculturists,* 10(1),16-22.

[6] Yanthan T.S., Singh V.B., Kanaujia S.P. and Singh A.K. (2012) *Journal of Soils and Crops,* 22(1),1-9.

[7] Roy S.S. and Hore J.K. (2009) *Journal of Plantation Crops,* 37(1), 56-59.

[8] Roy S.S. and Hore J.K. (2010) *Environment and Ecology,* 28(4A), 2587-2590.

[9] Rao A.M., Rao P.V., Reddy Y.N. and Reddy M.S.N. (2005) *J. of Plantation Crops,* 33(3), 198-205.

[10] Detpiratmorkol S., Ubolkerd T., Yoosukyingsatapron S. and Phakamas N. (2009) *Effects of organic manure son growth and yield of turmeric. Proceedings of the 47th Kasetsart University Annual Conference, Kasetsart.* 17-20 March, 473-480.

[11] Manhas S.S., Gill B.S., Khajuria V. and Kumar S. (2010) *Karnataka Journal of Agricultural Sciences,* 14(1), 194-196.

[12] Sanwal S.K., Laxminarayana K., Yadav R.K., Rai N., Yadav D.S. and Bhuyan M. (2007) *Indian Journal of Horticulture,* 64(4), 444-449.