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RESEARCH ARTICLE

INFLUENCE OF FERTILIZER MANAGEMENT TO TURMERIC (*CURCUMA LONGA* L.) CV. SALEM UNDER KONKAN CONDITION

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ABSTRACT

A field experiment was carried out at Agriculture Research Station, Awashi, Tal.Khed, Dist.Ratnagiri under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the year 2012 to 2015 in in randomized block design with five treatments with four replications comprising different levels of N fertilizer (150,200,250,300,350 kg ha^{-1}) in two splits i.e 45 days and 90 days of planting, respectively. Application of 200 kg N ha^{-1} showed marked improvement in growth and yield attributes without affecting the quality parameter i.e curcumin content of turmeric. Thus, increasing dose of N upto 200 kg N $ha^{-1}(T_2)$ resulted significantly better with respect to improvement in plant height (110.93 cm), number of leaves $plant^{-1}$, leaf area(cm), fresh rhizome yield (40.95 plot ha^{-1}), fresh rhizome yield (22.93 t ha^{-1}), fresh mother rhizome yield (7.08 t ha^{-1}) and finger yield (15.80 t ha^{-1}) over control whereas it was at par with number of tiller per plant (2.81), number of leaves $plant^{-1}$(18.93) and leaf area(4962.4 cm).The net returns at optimum dose of N (200 kg N ha^{-1}) were Rs.91533200 $ha^{-1}$with benefit cost ratio 2.52. However, there were no variable changes found in soil P^H, EC (dSm^{-1}) and organic carbon content (%).It can be concluded from the experiment that optimum dose of N fertilizer is necessary for sustaining soil fertility and productivity of turmeric.

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INTRODUCTION

India is the largest producer, consumer and exporter of turmeric in the world. Indian turmeric is considered to be the best in the world market because of its high curcumin content. India accounts for about 80 per cent of world turmeric production and 60 per cent of world exports (Angles *et al.,* 2011). Other major producers are Pakistan, China, Haiti, Jamaica, Peru, Taiwan and Thailand. Asian countries consume much of their turmeric production. The important turmeric growing States in India are Andhra Pradesh, Tamil Nadu, Orissa, Maharashtra, Assam, Kerala, Karnataka and West Bengal, in which Andhra Pradesh occupies 40 per cent of total turmeric area followed by Orissa and Tamil Nadu occupying 17 per cent and 13 per cent of total turmeric area respectively. In terms of production Andhra Pradesh accounts 60 per cent of total turmeric production in India followed by Tamil Nadu (13 per cent) and Orissa (12 per cent). The total area of turmeric in India is 233 thousands ha with production of 1190 thousand MT and productivity of 5.1 MT/Ha.). However the area under this crop in konkan region is increasing day by day. Response of turmeric to increase level of fertilizer has been significant (Parthasarathy *et al.*, 2010). Hence, to know the response of fertilizer to turmeric crop in konkan region, the present investigation entitled "Studies on Fertilizer response to turmeric (*Curcuma longa* L.) under Konkan condition" was conducted at Agriculture Research Station, Awashi, Khed, Ratnagiri during the year 2012 to 2015.

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MATERIALS AND METHODS

The trial was initiated at Agriculture Research Station, Awashi by ploughing the field with tractor mounted reversible plough in year 2012. The experimental site was located at $17^0$72'North latitude, $73^0$39' East longitudes and at 240 meters altitude above the mean sea level. The field was levelled by preparing the ridges and furrows with a spacing of 6.0 X 3.0 m. The good quality seed materials treated with fungicide carbendanzim (1%) were planted in the month of April. The FYM was applied at the time of field preparation. Half quantity of N, full quantity of P and K was applied at 45 days after planting while

remaining quantity of half N was applied after 90 days of planting. Experiment was laid out in randomized block design with five treatments with four replications. The treatments were T_1 = 25 T FYM + 150Kg N + 50 Kg P_2O_5 + 150Kg K_2O (Control), T_2 = 25 T FYM + 200Kg N + 50 Kg P_2O_5 + 150Kg K_2O,T3 = 25 T FYM + 250Kg N + 50 Kg P_2O_5 + 150Kg K_2O, T4 = 25 T FYM + 300Kg N + 50 Kg P_2O_5 + 150Kg K_2O, T_5 = 25 T FYM + 350Kg N + 50 Kg P_2O_5 + 150Kg K_2O.The number of pants selected per treatment per replication were five for the observations under study.The harvesting was done in the month of February. The observations recorded were plant height (cm),number of leaves per plant, leaf area (cm^2), number of tillers $plant^{-1}$, Rhizome yield (kg) and curcumin content (%).The initial and final soil status were studied by analysing the soil samples. The initial soil properties of the soil were P^H5.85, EC 0.84 dSm^{-1} available nitrogen 319 ha^{-1}, available phosphorous 11.88 kg ha^{-1}, available potassium 157.77 kg ha^{-1} and organic carbon content 2.12 %.The recorded data were analyzed statistically as specified in the experiment.

RESULTS AND DISCUSSION

The experimental findings obtained from the present studies pertaining to fertilizer response to turmeric cv. Salem under Konkan condition have been discussed here.

Plant height (cm) : Data presented in Table 1 revealed that increasing levels of fertilizer N significantly increased plant height. Maximum plant height of 115.25 cm was recorded with T_5 which was significantly superior over rest of the fertilizer N levels. The treatment T_5(control) has recorded significantly minimum (96.49 cm) plant height. Whereas, treatment T_2, T_3 and T_4 were at par with each other. Govind (1990) also explained that application of N nutrients significantly increase vegetative growth parameters of turmeric than any other nutrients.

Number of leaves per plant: It was noticed that maximum number of leaves per plant(19.07) was observed in treatment T_1 i.e control and it was at par with T2(18.93) while it was found statistically lowest (15.44) in treatment T_5.Further, it is revealed that increasing levels of fertilizer N significantly decreased the number of leaves per plant.

Leaf area (cm^2): It was observed that treatment T_5 recorded maximum leaf area(5362.6 cm) which was significantly higher over rest of the treatments. Treatment T_1 recorded significantly minimum leaf area (4904.63 cm) and it was at par with T_2.It was found that increasing levels of N significantly increased the leaf area. Behura (2001) reported that chemical fertilizer of N & K applied in a certain ratio showed higher efficacy on turmeric yield. N applied alone increased turmeric yield significantly. Satyareddi and angadi (2014) also reported higher dose of fertilizer (270:135:180 kg N:P_2O_5:$K_2O$$ha^{-1}$) significantly increased plant height (75.1 cm), leaf area (45.9 dm^2), number of tiller per plant (6) over other graded levels of fertilizer evaluated.

Number of tillers per plant: From Table 1, it is shown that number of tillers per plant was significantly decreased from optimum levels of fertilizer N. Treatment T_1 (control) significantly recorded maximum numbers of tillers per plant (2.36) but was at par with T_2 and T_3. Whereas, minimum numbers of tillers per plant (1.04) was recorded in treatment T_5 followed by T_4. The results are in accordance with the observations of Jirali (2001) who has reported negative correlation with the tiller number and yielding ability of genotypes

Fresh rhizome yield (kg $plot^{-1}$): Among the treatments, the treatment T_2 recorded significantly maximum fresh rhizome yield (40.95 kg plot $^{-1}$) followed by T_3 (35.55 kg plot $^{-1}$). Lowest fresh rhizome yield (29.46 kg plot $^{-1}$) was noticed in the treatment T_5 which was at par with treatments T_1 and T_4.

Fresh rhizome yield (t ha^{-1}): The treatment T_2 recorded significantly maximum fresh rhizome yield (22.93 t ha $^{-1}$) over rest of the treatments followed by T_3. Lowest fresh rhizome yield (16.37 t ha^{-1}) was noticed in the treatment T_5 which was at par with treatments T_1 and T_4**.** The results are in close conformity with findings of Satyareddi and Angadi (2014) who showed higher fresh rhizomes yield per plot(34.45 kg plot $^{-1}$) and yield per ha (23.41 t ha $^{-1}$) with application of 270:135:180 kg N:P_2O_5:K_2O per ha. over other fertilizer levels.

Mother rhizome (t ha^{-1}): It was observed that treatment T_2 registered maximum mother rhizome yield (7.08 t ha $^{-1}$) which was statistically significant over rest of the treatments. Lowest mother rhizome yield (4.77 t ha^{-1}) was recorded in the treatment T_5. It was found that treatment T_1 and T_4 were at par with each other.

Finger yield (t ha^{-1}): The treatment T_2 has recorded significantly maximum finger yield (15.80 t ha^{-1}) followed by T_3 (14.21 t ha^{-1}).Whereas, treatment T_5 recorded minimum finger yield (11.59 t ha^{-1}) which was at par with T_1 and T_4**.** Similar results were obtained by Satyareddi and angadi (2014) who reported significantly higher weight of mother rhizomes (74.6 g $plant^{-1}$), primary rhizomes (178.0 g $plant^{-1}$), secondary rhizomes (59.4 g $plant^{-1}$) and tertiary rhizomes (16.4 g $plant^{-1}$) in cv. Cudappah. Similarly, Hossain and Ishimine (2005) revealed that turmeric yield increased with application of NPK.

Curcumin content (%): Different levels of N fertilizer did not increase the curcumin content (%) under the study. However, numerically the maximum curcumin content (3.26%) was observed in T_3 and T_4 followed by T_2(3.25%). Akamine *et al*., 2007 also reported that application of NPK resulted in highest yield but did not increase curcumin content.

The details of cost of production ha^{-1} are presented in Table 2. Maximum cost of cultivation Rs.599069 $ha^{-1}$was estimated in T_2 and lowest in T_5 which accounted for Rs.536289 ha^{-1}.

The treatment wise cost of cultivation and their returns revealed that maximum net returns of Rs.91533 was observed in T_2 followed by T_3,T_4 and T_1 with returns per rupee invested of 2.52,2.27,2.09 and 2.09, respectively. However, the lowest net return of Rs.540711 was observed in T5 with returns per rupee invested of 2.00 %.

Table 1. Effect of fertilizers on vegetative growth and yield of Turmeric (pooled-Awashi)

Treatments	Plant height (cm)	Number of leaves/ plant	Leaf area (cm^2)	No. of tillers/ plant	Fresh rhizome yield (kg/plot)	Fresh rhizome yield (t/ha)	Fresh mother rhizome and finger yield (t/ha)		Curcumin content (%)
							Rhizome	Finger	
T_1	96.49	19.07	4904.63	2.36	31.01	17.25	5.11	12.14	3.24
T_2	110.93	18.93	4962.4	2.81	40.95	22.93	7.08	15.80	3.25
T_3	110.94	18.05	5022.13	2.43	35.55	19.77	5.55	14.21	3.26
T_4	112.10	16.99	5188.73	1.82	30.33	17.35	5.20	12.16	3.26
T_5	115.25	15.44	5362.6	1.04	29.46	16.37	4.77	11.59	3.23
S.E+	0.60	0.32	27.88	0.16	1.55	0.83	0.05	0.59	3.24
C.D. at 5%	1.86	0.96	78.92	0.47	4.489	2.238	0.167	1.831	NS

*Figures in paranthesis are arc sin transformed values

Table 2. Economics of Production in turmeric

S. No.	Treat.	Yield per ha (t)		Gross income (Rs. ha^{-1})	Cost of production (Rs. ha^{-1})	Net income (Rs.ha^{-1})	B:C ratio
		Rhizome	Finger				
1.	T_1	5.11	12.14	1137200	543007.00	594193	2.09
2.	T_2	7.08	15.80	1514400	599069.00	915331	2.52
3.	T_3	5.55	14.21	1296600	570698.00	725902	2.27
4.	T_4	5.20	12.16	1145600	546960.00	598640	2.09
5.	T_5	4.77	11.59	1077000	536289.00	540711	2.00

Sale cost @Rs.60/-kg for Finger and Rs.80/-Kg for mother rhizome

Table 3. Final soil analysis report

Treatments	P^H	EC (dSm^{-1})	N (kg ha^{-1})	P_2O_5 (kg 200 kg N ha^{-1})	K_2O (kg ha^{-1})	O C (%)
	Awashi	Awashi	Awashi	Awashi	Awashi	Awashi
T_1	5.87	0.84	344.56	11.99	170.14	2.23
T_2	5.89	0.84	349.38	12.20	176.24	2.25
T_3	5.88	0.83	353.21.	12.15	174.12	2.24
T_4	5.87	0.83	356.92	12.11	173.15	2.23
T_5	5.87	0.83	358.49	12.04	171.24	2.24
C.D. at 5%	NS	NS	2.614	0.116	1.010	NS

From soil analysis report, it is revealed that treatment T_2 recorded significantly highest soil P_2O_5(12.20 kg/ha) and K_2O(176.24kg/ha), whereas treatment T5 recorded highest soil N (358.49 kg/ha) as compared to rest of the treatments. However, there were no variable changes found in soil P^H, EC (dSm^{-1}) and organic carbon content (%).

Conclusion

It is concluded that an additional supply of nitrogen resulted into significant higher yield in vegetative parameters but has negative effect on tuber formation. This might be due to the additional nitrogen above optimum level caused degradation of carbohydrates. Further, number of tillers recorded by the treatment T_2 are significantly more than rest of the treatments which exhibit directly in maximization of rhizome yield. Based on the yield and economics of turmeric cultivation, it is concluded that the treatment T_2 i.e 25 t FYM+200 Kg N+50 Kg P_2O_5+150 Kg K_2O per ha. recorded highest turmeric yield 22.88 t/ha with highest B:C ratio 2.52 with maximum net returns of Rs.915331.

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