Phytology

Effect of nutrients on performance of turmeric (*Curcuma longa* L.) under eucalyptus (*Eucalyptus tereticornis)* based agroforestry system

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Received 19 Sep 2022; Accepted 25 Oct 2022; Published 10 Nov 2022

Abstract

A field experiment was conducted at Herbal Garden Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). During the season of 2021-22 with a view to study the "Effect of Nutrients on Performance of Turmeric (*Curcuma longa* L.*)* Under Eucalyptus (*Eucalyptus tereticornis)* Based Agroforestry System". The field experiment was conducted on turmeric *(Curcuma longa L.)* intercrops under Eucalyptus tree crop were used to grown and treatment was replicated three times in randomized block design (RBD) with plant spacing 40 cm x 30 cm. The soil of experimental field was clay to loam soil. The investigation, There were The fertilizer mixture FYM and NPK were used, which were applied at different concentrations in turmeric intercrop in eight treatments *viz*., T_1: - 100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1}), T_2: - 75 % of fertilizer inorganic, T_3:- 50 % of fertilizer inorganic, T_4:- 75% of fertilizer inorganic + 25 % FYM, T_5:- 50 % of fertilizer inorganic + 50 % FYM, T_6:- 25 % of fertilizer inorganic + 75 % FYM, T_7: - 100 % FYM and T_8:- control zero fertilizer. The crop growth parameters *i.e.*, Plant height (cm), No. of Leaves $tillers^{-1}$, No. of tillers $plant^{-1}$ and Collar diameter (mm) were significantly superior in the treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K- 120:60:60 Kg ha^{-1}) at different crop growth stages at 30, 60, 90, 120 and at harvest. On the basis of above findings, treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1}) stand could be better performance first in position and T_4 (75% of fertilizer inorganic + 25 % FYM) stand in second order of preference. However, treatment T_5 (50 % of fertilizer inorganic + 50 % FYM) comes in next in order. Therefore, it may be concluded that treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K- 120:60:60 Kg ha^{-1})) may be prefer for higher growth in crop turmeric.

Keywords: growth parameter, forestry, turmeric intercrops, eucalyptus tree crop, randomized block design (RBD), fertilizer inorganic, FYM, NPK and agroforestry system

1. Introduction

Turmeric (*Curcuma longa* L.) is an important sacred and ancient spice of India. It is a major rhizomatous spice produced and exported from India. Turmeric is an herbaceous perennial, native to tropical South-East Asia, belonging to the family zingiberaceae. It is cultivated for its underground rhizome which is used as spice and condiment, dye stuff and in cosmetic and drug industry, particularly in the preparation of anticancer medicines. It forms an important adjuvant in Indian culinary as it imparts colour and aromatic flavor to various dishes. Turmeric is widely used as a condiment in the preparation of pickles and curries and as a colouring agent in textile, food and confectionary industries. It is also used as herbal medicine 'Amraharidra', which gives a cooling, aromatic effect and promotes digestion (Srivastava *et al.* 2003). Turmeric has long been used in India for the treatment of sprains and inflammatory conditions. The turmeric rhizome contains major pungent aromatic flavor 'curcumin' which is responsible for colouring.

The beneficial effects of combined application of chemical fertilizers with organic manures *viz*., farmyard manure, vermicompost, biofertilizers and many more of such materials are universally known. Application of organic manures in general improves the availability of micro nutrients like zinc, iron, manganese and copper.

Although turmeric is grown in nearly 20 states in India, it is mainly grown in Andhra Pradesh (31%), Orissa (22%), Tamil Nadu (16%), Karnataka (13%), Maharashtra (6%), Assam (5%), Kerala and North-Eastern region which constitute more than 90 per cent of the total area. The national productivity of crop is 5100 kg per hectare (Anon, 2021).

In India, the production of turmeric is around 11 lakh tonnes during 2019-20. About 2.54 lakh ha of area was covered by turmeric, which is about 6 percent of the total area under spices in India. Chhattisgarh also has a good position in turmeric production. In year 2020- 21, the total area under turmeric was 11925 ha and production were 105509 million tonnes. (Director Horticulture Nava Raipur, Atal Nagar, Chhattisgarh-2020-21).

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2. Materials and methods

The field experiment was conducted at Herbal Garden of Department of Forestry, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Raipur is situated in mid-eastern part of Chhattisgarh at a latitude of 21º16'N, longitude

of 81º36'E and at an altitude of 289.56 meters above the mean sea level. On the basis of prevailing climatic conditions, Raipur is characterized as slightly moist and sub-humid zone where the average annual rainfall received ranges from 1200 to 1400 mm. The soil of experimental field was clay to loam soil. Samples from 20 cm depth were collected randomly from five places a day before layout of experiment. The collected sample was mixed thoroughly and composite sample was analyzed to determine physic-chemical composition of soil.

FYM was applied @ 25 t ha^{-1} at time of field preparation, while NPK were applied in dose of 120kg N, 60kg P & 60kg K per hectare in form of Urea, Single super phosphate & Murate of Potash. The Turmeric rhizomes were sown manually according to sowing experimental design in the cropping system at spacing row and plant 40cm×30cm, with Ranga variety and tree replications. Thus, sowing was done in 24 plots of 2.5 m×2.5 m size. Observations were made in turmeric crop and eucalyptus plantation along with microclimatic featured. Data was collected from five randomly selected plants per plots to represent the crop of each plot.

3. Results and discussion

Data pertaining to growth attributes influenced by various treatments has been given in table 1, 2, 3 & 4 and fig 1, 2, 3 & 4.

The plant height of turmeric showed early growth period of 30 DAS, the significant highest plant of turmeric was recorded in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1}) and it was about 30.10 cm. While significantly minimum plant height (cm) was observed in treatment T_8 (control zero fertilizer) of (22.07). At 60 DAS, significant maximum plant height (61.34) was recorded in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})).While significantly minimum plant height (cm) was observed (22.07) in treatment T_8 (control zero fertilizer). At 90 DAS, significant maximum plant height (85.07) was observed in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})),While Significant minimum plant height (51.03) was observed in treatment T_8 (control zero fertilizer). At 120 DAS, significant maximum plant height (104.07) was observed in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})), while significant minimum plant height (91.00) was observed in treatment T_6 (25 % of fertilizer inorganic + 75 % FYM). At harvest, significant maximum plant height (130.09) was recorded in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})),While Significant minimum plant height (116.42) was observed in treatment T_8 (control zero fertilizer). The results obtained in the present study are supported by the works of Nanda *et al.* (2012) [6] reported that application of 75 per cent NPK + FYM + Zn+ B + Azotobactor + Azospirillum + PSB showed maximum plant height (112 cm).

The number of leaves of turmeric crop was recorded at 30 DAS, the number of leaves per plant of turmeric was recorded significant maximum in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})) and it was about (11.15),while Significantly minimum number of leaves per plant (5.10) was recorded in treatment T_8 (control zero fertilizer). At 60 DAS, significant maximum number of leaves per plant (19.17) was recorded in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})), while Significantly minimum number of leaves per plant (12.25) was recorded in treatment T_8 (control zero fertilizer). At 90 DAS, significant maximum number of leaves per plant (28.00) was recorded in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})), while Significantly minimum number of leaves per plant (22.00) was recorded in treatment T_8 (control zero fertilizer). Similar results were also observed by Chamroy *et al.* (2015) [2] studied the Effect of Organic and Inorganic Manurial Combinations on Turmeric (*Curcuma Longa* L.) The result clearly indicates that the treatment T_5 significantly increased number of leaves/plant and number of tillers/clump followed by T_4 over the control.

The number of tillers per plant of turmeric crop was observed under different treatments with 30 DAS, the number of tillers $plant^{-1}$ of turmeric was recorded in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1}))and it was about (2.25), while significantly minimum number of tillers $plant^{-1}$ (1.00) was recorded in treatment T_8 (control zero fertilizer). At 60 DAS, significant maximum number of tillers per plant (4.00) was observed in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})). While significantly minimum number of tillers per plant (3.00) was observed in treatment T_8 (control zero fertilizer). At 90 DAS, significant maximum number of tillers per plant (5.00) was observed in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})), while significantly minimum number of tillers per plant (3.00) was observed in treatment T_8 (control zero fertilizer). At harvest, significant maximum number of tillers per plant (3.67) was observed in treatment T_7 (100 % FYM), While significantly minimum number of tillers per plant (1.67) was observed in treatment T_8 (control zero fertilizer). Also, similar results were reported by Murmu *et al.* (2013) [5] to evaluate the effect of different organic manures on growth, yield and its attributes of turmeric. Significant enhancements were observed by the application of different organic manures.

The collar diameter of turmeric crop was observed under different treatments with 30 DAS, collar diameter (cm) of turmeric was recorded in treatment T_4 (175% of fertilizer inorganic + 25 % FYM) and it was about (5.91). While significantly minimum collar diameter (cm) (2.00) was recorded in treatment T_8 (control zero fertilizer). At 60 DAS, significant maximum collar diameter (cm) (8.00) was recorded in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})), while significantly minimum collar diameter (cm)(6.00) was recorded in treatment T_8 (control zero fertilizer). At 90 DAS, significant maximum collar diameter (cm) (10.00) was observed in treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})). While significantly minimum collar diameter (cm) (9.00) was recorded in treatment T_8 (control zero fertilizer). At harvest significant maximum collar diameter (cm) (13.00) was recorded in treatment T_1 (100 % recommended dose of

fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})). While significantly minimum collar diameter (cm) (11.00) was recorded in treatment T_8 (control zero fertilizer). Similar results were also observed by Chandravanshi *et al.* (2021) [3], was observed that, all the parameters significantly influenced with the application of organic manures and inorganic fertilizers. Similar result was also reported by Pal, Sharath MV *et al.* (2014) [7] and Sarma *et al.* (2015) [10].

Table 1: Plant height (cm) of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

Tr. No.	Treatments	Plant height (cm)				
		30 Das	60 Das	90 Das	120 Das	At harvest
T_1	100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})	30.10	61.34	85.07	104.07	130.09
T_2	75 % of fertilizer inorganic	24.36	55.79	76.42	96.00	116.79
T_3	50 % of fertilizer inorganic	23.23	54.06	73.53	94.50	118.46
T_4	75% of fertilizer inorganic + 25 % FYM	29.78	59.17	71.08	93.00	127.48
T_5	50 % of fertilizer inorganic + 50 % FYM	28.43	58.31	78.31	92.00	126.79
T_6	25 % of fertilizer inorganic + 75 % FYM	27.06	57.42	78.20	91.00	126.47
T_7	100 % FYM	24.27	56.26	77.13	98.10	118.34
T_8	control zero fertilizer	22.07	52.07	51.03	92.00	116.42
	SEm (±)	1.48	1.59	1.22	1.79	1.28
	CD @ (P=0.05)	4.48	4.84	3.70	5.43	3.89

Table 2: Number of leaves per plant of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

Tr. No.	Treatments	No. of Leaves per plant		
		30 Das	60 Das	90 Das
T_1	100% recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1})	11.15	19.17	28.00
T_2	75 % of fertilizer inorganic	7.00	14.10	24.08
T_3	50 % of fertilizer inorganic	6.20	13.00	23.10
T_4	75% of fertilizer inorganic + 25 % FYM	10.85	18.45	27.31
T_5	50 % of fertilizer inorganic + 50 % FYM	10.00	17.00	26.15
T_6	25 % of fertilizer inorganic + 75 % FYM	9.25	16.45	25.30
T_7	100 % FYM	8.30	15.12	24.78
T_8	control zero fertilizer	5.10	12.25	22.00
SEm (±)		0.67	0.95	0.65
CD @ (P=0.05)		2.02	2.89	1.96

Table 3: Number of tillers $plant^{-1}$ of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

Tr. No.	Treatments	No. of tillers $plant^{-1}$			
		30 Das	60 Das	90 Das	At harvest
T_1	100 % recommended dose of fertilizer inorganic (N:P:K- 120:60:60 Kg ha^{-1})	2.25	4.00	5.00	2.33
T_2	75 % of fertilizer inorganic	1.42	3.31	3.81	1.52.00
T_3	50 % of fertilizer inorganic	1.21	3.15	3.45	1.33
T_4	75% of fertilizer inorganic + 25% FYM	2.08	3.89	4.76	2.25
T_5	50 % of fertilizer inorganic + 50% FYM	1.87	3.78	4.52	2.18
T_6	25 % of fertilizer inorganic + 75% FYM	1.72	3.64	4.24	1.96
T_7	100 % FYM	1.63	3.52	4.00	1.43
T_8	Control zero fertilizer	1.00	3.00	3.00	1.03
SEm (±)		0.16	0.21	0.39	0.26
CD @ (P=0.05)		0.49	0.63	1.19	0.80

Table 4: Collar diameter (cm) of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

Tr. No.	Treatments	Collar diameter (cm)			
		30 Das	60 Das	90 Das	At harvest
T_1	100 % recommended dose of fertilizer inorganic (N:P:K- 120:60:60 Kg ha^{-1})	6.00	8.00	10.00	13.00
T_2	75 % of fertilizer inorganic	2.25	6.52	9.25	11.70
T_3	50 % of fertilizer inorganic	2.20	6.37	9.18	11.35
T_4	75% of fertilizer inorganic + 25 % FYM	5.91	7.62	9.80	12.84
T_5	50 % of fertilizer inorganic + 50% FYM	5.72	7.39	9.48	12.52
T_6	25 % of fertilizer inorganic + 75% FYM	2.54	7.04	9.40	12.28
T_7	100 % FYM	3.36	6.85	9.20	11.60
T_8	control zero fertilizer	2.00	6.00	9.00	11.00
	SEm (±)	0.27	0.33	0.20	0.40
	CD @ (P=0.05)	0.82	1.00	0.61	1.22

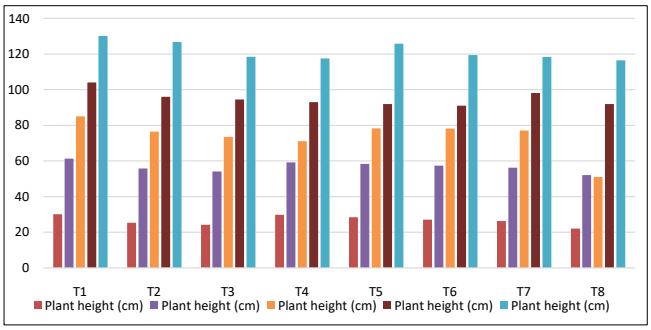

Fig 1: Plant height (cm) of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

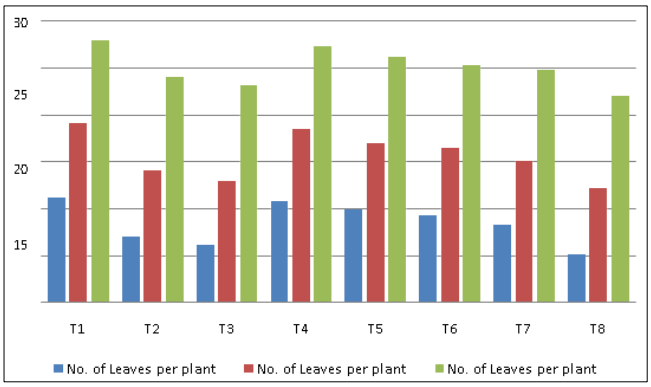

Fig 2: Number of leaves per plant of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

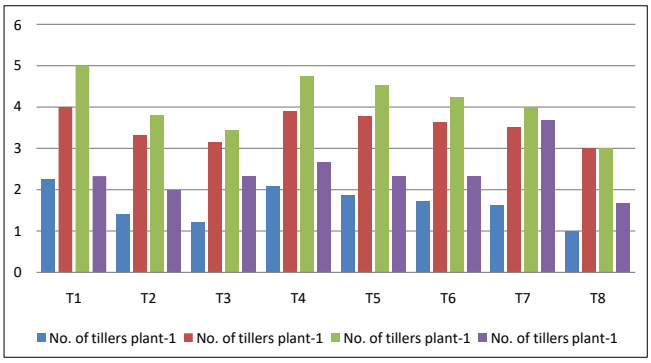

Fig 3: Number of tillers plant^{-1} of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

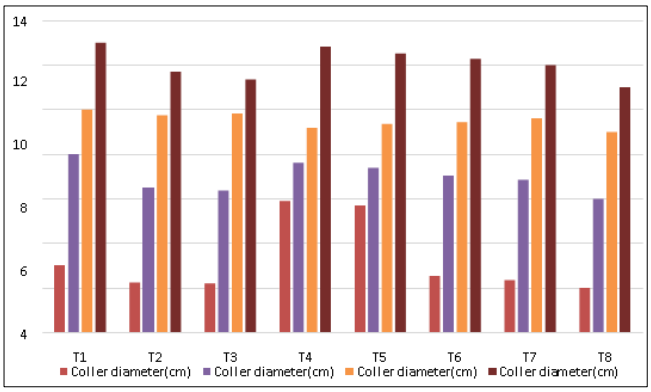

Fig 4: Collar diameter (cm) of Turmeric (*Curcuma longa*) under *E. tereticornis* based Agroforestry system

4. Conclusion

The growth parameters like plant height (cm), no. of leaves tillers^{-1}, no. of tillers plant^{-1} and collar diameter (cm) were significantly higher in the treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1}.) followed by treatment T_4 (75% of fertilizer inorganic + 25 % FYM), T_5 (50 % of fertilizer inorganic + 50 % FYM) and T_6 (25 % of fertilizer inorganic + 75 % FYM).

On the basis of present study treatment T_1 (100 % recommended dose of fertilizer inorganic (N:P:K-120:60:60 Kg ha^{-1}.)) showed significant result for all the parameters followed by treatment T_4 (75% of fertilizer inorganic + 25 % FYM), T_5 (50 % of fertilizer inorganic + 50 % FYM) and T_6 (25 % of fertilizer inorganic + 75 % FYM) respectively.

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