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INFLUENCE OF PLANTING DATES AND VA-MYCORRHIZA ASSOCIATION ON GROWTH, YIELD AND YIELD ATTRIBUTES OF TURMERIC

Uttam Tripura[*1] and N.K. Hegde[2]

Department of Spices and Plantation Crops, KRC College of Horticulture, Arabhavi- 591310, UHS, Bagalkot, Karnataka (India).
[1*]Department of Horticulture, Lovely Professional University, Jalandhar, Phagwara (Punjab), India.
[2]College of Horticulture, Sirsi, UHS, Bagalkot (Karnataka), India.

Abstract

Planting dates in turmeric play a vital role in the growth and development of the crop which eventually decide the yield and quality of rhizome. In this present investigation, we studied the association effect on turmeric to find out the suitable planting dates and VA-Mycorrhiza application. Planting dates started from 2nd fortnight of April influenced the growth and yield of turmeric with or without inoculation of VA-Mycorrhiza. The growth parameters, yield and yield attributes were significantly differed at 180 days after planting in turmeric with or without inoculation of VA-Mycorrhiza. Among different planting dates, 2nd fortnight of May planted crops recorded highest growth parameters, yield and yield attributes of turmeric compared to the crops planed in the month of July. Hence, planting of turmeric during May month with inoculation of VAM can be more profitable by increasing yield and yield attributes of turmeric under northern dry zone of Karnataka.

Key words: Turmeric, Planting dates, VA-Mycorrhiza, rhizome yield.

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 a herbaceous perennial plant, native to tropical South-East Asia, belonging to the family Zingiberaceae. It is used as spice and forms an important adjuvant in Indian culinary as it imparts color and aromatic flavor to various dishes. The rhizome is noticeable by its yellow dye comprising the 'curcumin'. It is also used as herbal medicine 'Amraharidra', which gives a cooling, aromatic effect and promotes digestion (Srivastava *et al.*, 2003). India is the world's largest producer and exporter of turmeric and it contributes nearly 50 percent of global production. It is grown in an area of 2.38 lakh hectares with an average production of 11.33 lakh MT (Anon, 2018). Planting dates in turmeric play an important role in the germination/sprouting, growth and development of the crop which ultimately decide the yield and quality of rhizome production under different agro-climatic conditions. Planting rhizome in the second week of March showed highest growth attributes and highest rhizome yield (Sengupta and Dasgupta, 2010). Mycorrhizal fungi mostly occur in soils and colonize roots of plant. They are act as a symbiosis relationship with plant roots and are directly implicated in plant mineral nutrition. The symbiotic association increases the uptake of Phosphorus and micronutrients like zinc (Zn) and copper (Cu) and has also been reported as influencing water uptake. The effect of mycorrhiza association in plant has been well documented by many workers in many plants species (Smith, 1980; Bolan, 1991; Hernandez *et al.,* 2000). Mycorrhizae inoculation resulted in higher biomass production, yield, curcumin content and nutrient uptake of turmeric under green house conditions (Yamawaki *et al.,* 2013). There are very limited reports on VA-mycorrhiza association with turmeric. Therefore, an investigation was made to study the influence of date of planting and VA-mycorrhiza association on growth, yield and yield attributes of turmeric.

***Author for correspondence :** E-mail: uttam_uhs@yahoo.in

Material and Methods

A field investigation was carried out at Dept. of Spices and Plantation Crops, KRC College of Horticulture,

Arabhavi at (16°15' N, 74°45'E), 612m above mean sea level in northern dry zone of Karnataka. The annual receiving rainfall of this area is about 449.25 mm with temperature ranges between 14.31°C and 36.59°C. The experimental site is having sandy clay loam soil with available N:P:K @ 125:18.2:334.5 kg/ha. Experiment was laid out in Split Plot Design with 3 replications and consisting six fortnight planting dates starting from 2nd fortnight of April to 1st fortnight of July as main treatment and two sub plot treatments *viz*., with or without application of VAM. Rhizomes of 20-25g were used for planting after treating with captan (3 g/l) and endosulphon (2 ml/l) for 30 minutes. Recommended dose of fertilizer (FYM @ 25 t/ha and 180:90:90 kg NPK/ha) were applied as basal dose. The inoculation of VAM fungus (*Glomus fasiculatum*) to turmeric was done during planting by applying 5 grams (soil form) per rhizome, just before planting (Singh *et al.,* 2012). The uninoculated VAM rhizomes served as a control. The crop was harvested in the month of second week of February. Observations on growth parameters, yield attributes and yield per hectare at 180 days after planting were worked out and statistical

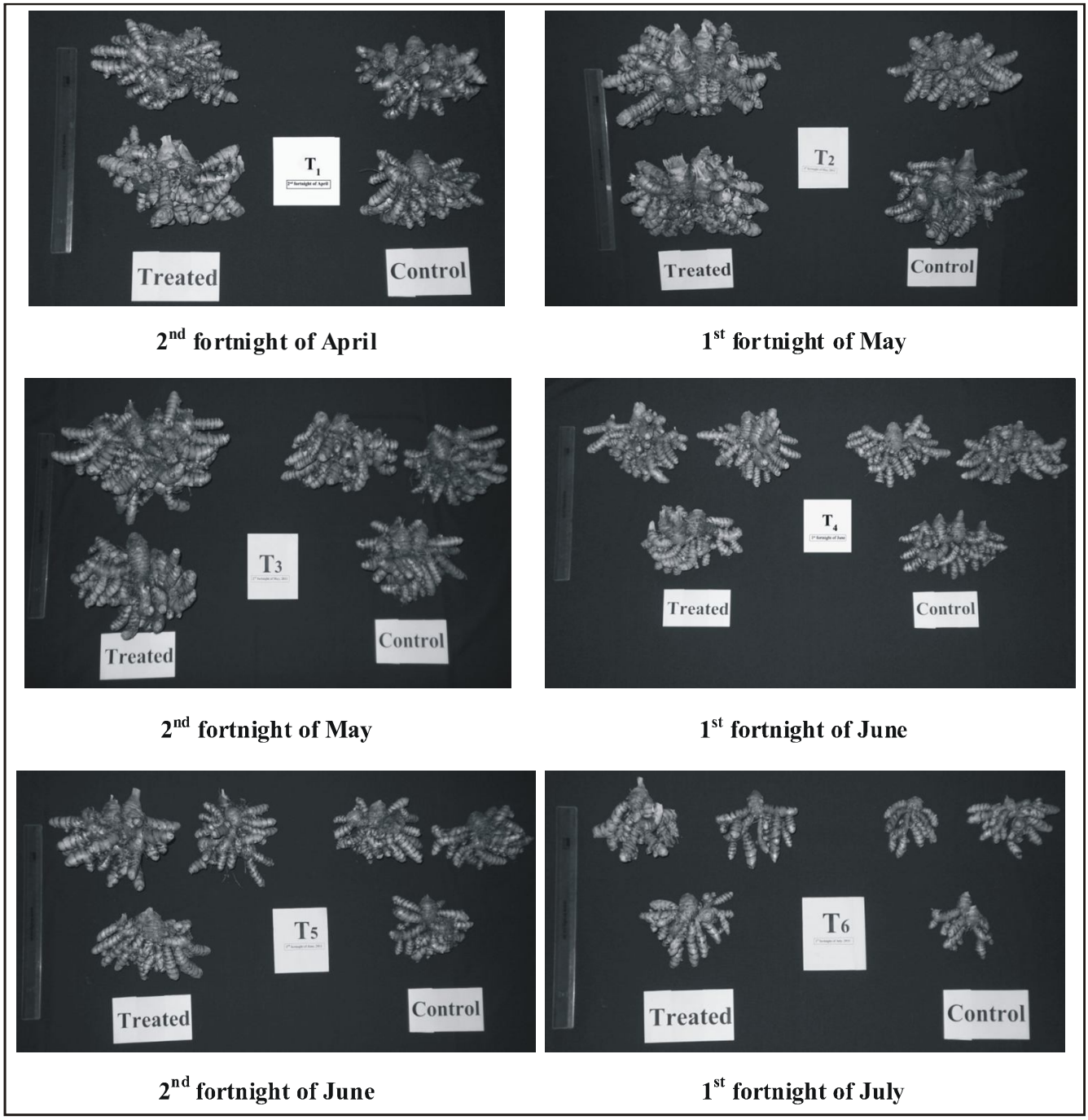

Fig. 1: Influence of planting dates and VA-Mycorrhiza association on yield performance on turmeric.

Table 1: Effect of planting dates and VA-Mycorrhiza inoculation on growth parameters of turmeric at 180 days after planting.

Planting dates	Plant height (cm)			Pseudostem diameter (mm)			No. of leaves per tiller			Leaf area (cm^2)			Leaf area index		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
PD_1	93.86	86.98	90.42	15.68	14.61	15.15	9.60	9.27	9.43	581.60	499.30	540.45	5.75	4.94	5.32
PD_2	98.21	93.87	96.04	17.99	16.97	17.48	10.27	9.73	10.00	647.40	555.90	601.65	6.40	5.49	5.94
PD_3	105.79	99.79	102.79	24.54	22.19	23.37	9.93	9.40	9.67	688.30	582.80	635.55	6.79	5.75	6.27
PD_4	91.89	86.63	89.26	20.00	17.67	18.83	9.40	9.00	9.20	535.40	461.30	498.35	5.29	4.56	4.92
PD_5	80.96	76.50	78.73	18.95	17.51	18.23	9.60	9.13	9.37	506.10	429.40	467.75	5.00	4.24	4.62
PD_6	70.47	65.15	67.81	15.86	14.44	15.15	9.20	8.60	8.90	416.20	342.40	379.30	4.11	3.39	3.73
Mean	90.20	84.82		18.84	17.23		9.67	9.19		562.50	478.52		5.55	4.73	
For comparison of mean															
	SEm ±	**CD (p =0.05)**	**CV (%)**	**SEm ±**	**CD (p =0.05)**	**CV (%)**	**SEm ±**	**CD (p =0.05)**	**CV (%)**	**SEm ±**	**CD (p =0.05)**	**CV (%)**	**SEm ±**	**CD (p =0.05)**	**CV (%)**
PD	1.76	5.55	4.93	0.55	1.74	7.48	0.09	0.31	2.49	1.23	3.89	5.81	0.12	0.38	5.81
V	0.92	2.85	4.48	0.16	0.49	3.82	0.11	0.35	5.17	1.08	3.33	8.81	0.11	0.33	8.81
PD × V	2.26	6.96		0.40	1.22		0.28	0.87		2.65	8.15		0.26	0.81	

Main plot (PD): Dates of planting; PD_1 - April first fortnight, 2011; PD_2 - May first fortnight, 2011; PD_3 - May second fortnight, 2011; PD_4 - June first fortnight, 2011; PD_5 - June second fortnight, 2011; PD_6 - July first fortnight, 2011.
Sub plot (V): VAM inoculation; V_1- With VAM; V_2- Without VAM.

analysis was carried out by using OPSTAT software package.

Result and Discussion

The data related to growth parameters differed significantly as influenced by date of planting and VA-mycorrhiza inoculation (Table 1). The growth parameters, *viz.* plant height, pseudo-stem diameter, no. of leaves per tiller, leaf area and LAI (leaf area index) differed significantly in VAM inoculated plants than uninoculated VAM. Among the different planting dates, planting in 2nd fortnight of May recorded the highest plant height (102.79 cm), pseudo-stem diameter (23.37 mm), leaf area (635.55 cm^2) and leaf area index (6.27) compared to the lowest recorded by 1st fortnight of July (67.81cm, 15.15 mm, 379.30 cm^2 and 3.73 respectively). However, the number of leaves per tiller was higher in 1st fortnight of May (10.00) which were on par with 2nd fortnight of May (9.67). Similarly, the rhizome planted with VAM inoculation recorded higher yield and yield attributes of turmeric than the uninoculated VAM (Table 2). The maximum number of rhizomes per clump (40.53), rhizome

Table 2: Effect of planting dates and VA-Mycorrhiza inoculation on yield attributes and yield of turmeric at 180 Days after planting.

Planting dates	Number of rhizomes/clumps		Mean	Rhizome size (cm^2)		Mean	Rhizome diameter (mm)		Mean	Yield (t/ha)		Mean
	V_1	V_2		V_1	V_2		V_1	V_2		V_1	V_2	
PD_1	27.33	26.47	26.90	34.20	27.60	30.90	35.90	33.49	34.69	31.29	22.72	27.00
PD_2	38.53	34.07	36.30	41.30	34.40	37.85	37.51	36.37	36.94	41.56	34.50	38.03
PD_3	42.60	38.47	40.53	45.60	34.20	39.90	38.99	35.31	37.15	50.62	44.03	47.32
PD_4	31.20	28.20	29.70	28.70	26.00	27.35	36.73	34.00	35.36	18.93	18.11	18.52
PD_5	28.73	24.33	26.53	26.50	24.10	25.30	30.68	29.75	30.22	15.77	13.67	14.72
PD_6	17.27	14.73	16.00	15.20	12.50	13.85	25.57	23.03	24.30	5.35	4.05	4.70
Mean	30.94	27.71		31.92	26.47		34.23	31.99		27.25	22.85	
For comparison of mean												
	SEm±	CD (p=0.05)	CV (%)	SEm±	CD (p=0.05)	CV (%)	SEm±	CD (p=0.05)	CV (%)	SEm±	CD (p=0.05)	CV (%)
PD	0.60	1.90	5.04	0.12	0.37	9.70	0.85	2.67	6.27	1.85	5.82	18.07
V	0.56	1.73	8.15	0.07	0.22	9.99	0.37	1.13	4.68	1.41	4.36	23.92
PD × V	1.38	4.25		0.17	0.52		0.89	2.76		3.46	10.67	

Main plot (PD): Dates of planting; PD_1 - April first fortnight, 2011; PD_2 - May first fortnight, 2011; PD_3 - May second fortnight, 2011; PD_4 - June first fortnight, 2011; PD_5 - June second fortnight, 2011; PD_6 - July first fortnight, 2011.
Sub plot (V): VAM inoculation; V_1- With VAM; V_2- Without VAM

size (39.90 cm^2), rhizome diameter (37.15 mm) and yield (47.32 t/ha) were recorded by rhizome planted in 2nd fortnight of May and minimum was recorded by 1st fortnight of July (16.00, 13.85 cm^2 24.30 mm and 4.70 t/ha, respectively).

The higher growth parameters during May planting might be due to the inoculation of VAM which might have increases the uptake of phosphorus and micronutrients like zinc (Zn) and copper (Cu) and increase water uptake. Moreover, the atmosphere was also congenial for better growth as it was comparatively hot and humid during this period, helped the plants to get better establishment and rapid growth thereby producing better vegetative performance compared to early and late planting. However, the growth parameters of turmeric beyond May resulted poor performance which may be attributed to reduced physiological conditions due to poor field establishment. Similar results were also reported by (Shadap, 2010 and Singh *et al.,* 2013).

May planting of turmeric showed higher fresh yield and yield attributes which might be owing to better growth and development during the growth period *viz*., higher number of functional leaves, higher leaf size, higher Leaf area index and higher Pseudostem diameter. The vital plant growth must have contributed for higher yield due to higher photosynthesis. Further, it also must have resulted in higher sink capacity and accumulation of more of carbohydrates towards the rhizome, thus increased the fresh rhizome yield. Moreover, Inoculation of VAM must have helped to increase the mineral phosphorous uptake in the plant and might have resulted in the higher fresh rhizomes yield. Similar results were also reported by Vijaya *et al.,* (2008); Manhas *et al.,* (2010) and Munda *et al.,* (2013).

Conclusion

It can be concluded that planting of rhizome during May month with inoculation of VAM can improved the growth, yield and yield attributes of turmeric in northern dry zone of Karnataka and beyond May months its gave poor performance for the commercial cultivation.

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