

Effect of Fertigation of N and K on Rhizome Characters of Turmeric Transplants (*Curcuma longa* L.) var CO2

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Abstract An experiment was conducted from 2014 to 2015 to study the effect of fertigation of N and K on yield and quality of turmeric transplants. The experiment consisted of nine treatments replicated three times in a randomized block design. The results showed that the fertigation treatment with 125 % levels of N and K through water soluble fertilizers recorded significantly higher per plant yield (401.00 g) and yield attributing characters such as number and weight of mother (4.00, 147.42 g), primary (12.00, 187.06 g) and secondary (26.00, 92.86 g) rhizomes and quality parameters such as curcumin content (4.405%), curing% (18.15) and essential oil content (4.872%) and 100% levels of N and K through water soluble fertilizers recorded significantly higher oleoresin content (10.162%). On the basis of good performance on per plant yield, yield attributing characters and quality, fertigation with

125% levels of N and K through water soluble fertilizers can be employed for turmeric transplants.

Keywords *Curcuma longa* L., Turmeric transplants, Tertigation, Water soluble fertilizers, Quality.

Introduction

Turmeric (*Curcuma longa* L.) (Family : Zingiberaceae) is used as condiment dye, drug and cosmetic in addition to its use in religious ceremonies. It is one of the vital spice crops and is eminent indigenous herbal medicine. Turmeric has also been used for centuries in Ayurvedic medicine, which integrates the medicinal properties of herbs with food. This extraordinary herb has found its way into the spotlight in the west and rest of globe, because of its wide range of medicinal benefits. Use of turmeric dates back nearly 4000 years to the vedic culture in India. It is extensively used in Ayurveda, Unani and Siddha medicine as home remedy for various diseases [1]. It is utilized for favouring and coloring of a variety of dishes on domestic scale as well as in food industries. The active compound curcumin is believed to have a wide range of biological effects including anti-inflammatory, antioxidant, antitumor, antibacterial, and anti-viral activities, which indicate potential in clinical medicine. A fresh juice is commonly used in many skin conditions, including eczema, chicken pox, shingles, allergy, and scabies. India is the largest producer, consumer and exporter of turmeric in the global arena. Turmeric is culti-

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vated in an area of 2,33,000 hectares in India, with a production of 11, 90,000 tonnes [3].

Being a nutrient exhaustive crop, turmeric has been known to generally respond well to increased soil fertility levels [4]. Owing to its long duration and high productivity, it requires heavy input of fertilizers. Fertigation has found to dramatically improve the yield and quality of many horticultural crops. Turmeric transplants are produced from single bud rhizome. During their growth period, it will require more quantity of nutrients from the external source. As like that of the tissue culture plants, turmeric transplants require frequently nutrition. While fertigation can be practiced using conventional fertilizers such as urea and potash with reduced costs, use of water soluble fertilizers may be effectively employed to improve quality and productivity. With this background in consideration, the present study was taken up in turmeric var. CO₂ to evaluate the effects of different levels of N and K on growth and yield.

Materials and Methods

A field experiment to study the effect of fertigation of N and K fertilizers on growth and yield of turmeric transplants (*Curcuma longa* L.) var CO₂ was carried out at the college orchard, Department of Spices and Plantation Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during the period from 2014 to 2015. The experiment was laid out in randomized block design, replicated three times. Raised beds of 25 m length, 1 m breadth, 20-25 cm height were formed and protary raised turmeric transplants of one month old having two fully opened produced from single bud rhizomes were planted on first week of August in paired row system. A spacing of 45 cm between rows within a paired row, 55 cm between two adjacent paired rows and 15 cm within each row was maintained. In treatments receiving fertigation, drip laterals were laid along the length of each paired row at the center with the spacing kept at 1 m between two adjacent laterals. In control plot, instead of drip laterals, provision for surface irrigation was provided for the paired rows. A venturi assembly was

Table 1. Treatment details.

T ₁	Control—100% recommended dose of NPK — 150.60 : 108 kg/ha—through straight fertilizer i.e., Urea & MOP by soil application + surface irrigation
T ₂	Fertigation of N + K @ 125% through straight fertilizers—once in a week
T ₃	Fertigation of N + K @ 100% through straight fertilizers—once in a week
T ₄	Fertigation of N + K 2 @ 75% through straight fertilizers—once in a week
T ₅	Fertigation of N + K @ 50% through straight fertilizers—once in a week
T ₆	Fertigation of N + K @ 125% through water soluble fertilizers—once in a week
T ₇	Fertigation of N + K @ 100% through water soluble fertilizers—once in a week
T ₈	Fertigation of N + K @ 75% through water soluble fertilizers—once in a week
T ₉	Fertigation of N + K @ 50% through water soluble fertilizers—once in a week

used for mixing fertilizer with irrigation water.

The fertilizers are applied through drip irrigation at weekly intervals by following the schedule by which 40% of total N and 20% of total K were applied from 1st to 4th weeks, 10% of total N and 10% of total K were applied from 5th to 8th weeks, 30% of total N and 30 % of total K were applied from 9th to 17th weeks. The remaining quantity of 20% N and 40 % K were applied from 18th to 34th weeks (Table 1). The standard recommended cultural practices [5] were followed for managing the crop except for the fertigation treatments envisaged in the study. The crop was harvested 240 days after planting and observations on rhizome characters were taken randomly from ten plants in each plot. The various quality parameters viz., curcumin [6], oleoresin [7], essential oil content [8] and curing percentage in the turmeric rhizome were estimated. The data collected were subjected to statistical analysis following standard procedure [9].

Results and Discussion

The fresh rhizome yield per plant varied from 401.00 g to 317.00 g. Among the treatments, T₆ had recorded higher fresh rhizome yield per plant (401.00 g). Significant difference was observed with respect to rhizome characters viz., number and weight of mother,

Table 2. Influence of straight and water soluble fertilizers on yield and rhizome characters of turmeric transplants.

Treatments	Yield per plant (g)	Mother rhizomes		Primary rhizomes		Secondary rhizomes	
		No.	Weight (g)	No.	Weight (g)	No.	Weight (g)
T ₁	317.00	2.33	110.65	7.33	130.54	17.33	60.56
T ₂	389.00	3.67	139.95	10.00	173.54	23.67	86.37
T ₃	374.00	3.00	132.13	9.00	166.23	20.67	78.94
T ₄	350.00	2.67	128.73	8.00	149.21	19.00	67.05
T ₅	329.00	2.67	125.95	7.67	143.65	18.33	65.65
T ₆	401.00	4.00	147.42	12.00	187.06	26.00	92.86
T ₇	396.00	3.67	142.52	11.33	181.65	24.33	88.34
T ₈	381.00	3.33	135.05	9.67	167.65	22.67	81.26
T ₉	365.00	2.67	129.54	9.00	158.24	20.00	78.94
Mean	366.89	3.11	132.44	9.33	161.98	21.33	77.77
SEd	7.0746	0.5000	3.4022	0.5443	3.7425	1.7051	1.7981
CD(0.05)	14.9976	1.0600	7.2123	1.1539	7.9339	3.6147	3.8118
CD(0.01)	20.6641	1.4604	9.9373	1.5899	10.9315	4.9805	5.2520

primary and secondary rhizomes (Table 2). The treatment, T₆ had recorded higher value for all rhizome parameters viz., number and weight of mother rhizomes (4.00 and 147.42 g), primary rhizomes (12.00 and 187.06 g) and secondary rhizomes (26.00 and 92.86 g). Yield is a complex trait and is a product of several other yield attributing characters. Increased yield under drip fertigation with water soluble fertilizers were reported in chillies [10,11]. Hebbar et al. [12] also reported superior yields with fertigation in tomato. Fertigation with the higher levels of N and K especially in water soluble forms has definitely influenced the growth and physiological attributes, which reflected in higher growth, dry matter production, yield and yield related traits. Better nutrient availability in these treatments could be the crucial factor as have pointed out that application of N and K in combination with drip irrigation maximize the mobility of nutrients around the root zone [13].

The results on quality parameters found varied significantly with different treatments (Table 3). The treatment T₆ registered higher curcumin content of 4.405% while T₁ recorded the least (3.931%). Curing percentage varied significantly from 17.64 to 18.15% with a mean of 17.80%. The treatment, T₆ had recorded higher curing percentage of 18.15 followed by T₇ (17.95). The treatment, T₁ had produced the lower curing percentage of 17.64. Fresh yield data could not alone be considered to measure the

economic benefits that grower may get because only cured rhizomes were marketed and market prices are again influenced by quality criteria. The treatment, T₆ produced higher essential oil content (4.872%) followed by T₇ (4.601%). The treatment, T₇ recorded higher oleorsin content (10.162%) and this followed by T₆ (9.873%). Lesser oleoresin (8.705%) was recorded in T₅. The quality of turmeric is often valued on the basis of the color intensity of the rhizome which depends on the presence of curcumin content in the rhizomes [14].

Higher concentration of NPK, given through

Table 3. Influence of straight and water soluble fertilizers on quality parameters of turmeric transplants.

Treatments	Curing (%)	Curcumin (%)	Essential (%)	Oleoresin (%)
T ₁	17.64	3.931	3.784	8.973
T ₂	17.87	4.339	4.335	9.715
T ₃	17.76	4.263	4.260	9.037
T ₄	17.68	4.185	4.095	8.945
T ₅	17.66	3.982	3.674	8.705
T ₆	18.15	4.405	4.872	9.873
T ₇	17.95	4.368	4.601	10.162
T ₈	17.81	4.292	4.423	9.387
T ₉	17.71	4.228	3.657	8.732
Mean	17.80	4.221	4.189	9.281
SEd	0.4047	0.0684	0.0739	0.1684
CD(0.05)	0.8579	0.1449	0.1566	0.3571
CD(0.01)	1.1821	0.1997	0.2158	0.4920

fertigation, might have resulted in better accumulation of assimilates leading to improved quality. It was reported that potassium as well as nitrogen and phosphorus significantly improved the curcumin content of rhizomes at harvest [15]. Hikaru et al. [16] also reported that applied N alone could not increase quality contents of rhizome, whereas P or K increased curcumin content significantly. Application of phosphorus is thus essential though in low levels as basal dose. The role of potassium in improving quality traits is known to be predominant. Potassium is responsible for energy production in the form of ATP and NADPH in chloroplasts by maintaining balanced electric charges. This high energy status promotes synthesis of secondary metabolites. Imbalanced fertilization could not promote quality of turmeric [17].

It was found that the fresh rhizome yield and quality parameters such as curcumin content, curing percentage and essential oil content increased significantly up to 125% of N and K level through fertigation of water soluble fertilizers.

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