Effect of nitrogen, phosphorus and potassium levels on growth and yield of turmeric (*Curcuma longa* L.) in the hill zone of Karnataka

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ABSTRACT

A nutritional trial on turmeric (*Curcuma longa*) variety CO-1 conducted for three seasons at Regional Research Station, Mudigere, Karnataka indicated that a nutrient level of 120 : 60 : 120 kg NPK/ ha is optimum for growth and yield of the crop in the hill zone of Karnataka.

Key words : *Curcuma longa*, nutrition, turmeric, yield.

Introduction

Turmeric (*Curcuma longa* L.) is grown in an area of 3700 ha in Karnataka with an annual production of 53,000 t. The hill zone in the State with an annual rainfall of 2400mm has great potential for the crop even under rainfed conditions. One of the constraints in turmeric production is low productivity which is attributed to poor nutrient management. The crop is known to respond well to fertilizer application. Significant influence of major nutrients on growth and yield of turmeric was reported by several workers (Nair 1964; Rao 1973; Rao, Reddy & Subbarayudu 1975; Rao & Reddy 1977; Rao & Swamy 1984). However, very few studies have been reported in the State on the nutritional aspects of the crop. Hence, the present investigation was taken up to know the optimum nutrient needs of the crop especially in the hill zone of Karnataka.

Materials and methods

The trials were laid out at the Regional Research Station, Mudigere (University of Agricultural Sciences, Bangalore), Karnataka during 1990-93 in the same location every year. The soil of the experimental block was well drained sandy loam with pH of 6.0 to 6.5, high in organic carbon (1.23%), available potassium (430 kg/ha) and low in available phosphorus (4.53 kg/ha). The experiment was conducted in a Randomised Block Design with 10 treatments (NPK levels) and 3 replications. There were 5 levels of N(30,60,90,120 & 180 kg/ha), 3 levels of P (30,60 & 90 kg/ ha) and 5 levels of K (60,90,120,180 & 270 kg/ha). Farm yard manure was applied at the rate of 25 t/ha before

planting. Planting of CO-1 variety was taken up during first week of June at a spacing of 30cm x 20cm in a plot size of 3.60m x 1.5m. The recommended cultural practices were followed. Ten clumps were selected from each plot at random at 120 days after planting and the same plants were used for studying growth characters. Data on plant height, leaves per clump, tillers per clump and leaf area were recorded and statistically analysed.

Leaf area was computed by multiplying the product of length and breadth of leaf with a conversion factor, 0.72 (Rao & Swamy 1984). The crop was grown under rainfed conditions with three protective irrigations from November to February. There were 108 rainy days during the crop growth period and the mean total rainfall was 2350mm per annum. The crop was harvested 280 days after planting and fresh yield was recorded immediately.

Results and discussion

Growth characteristics

The effect of major nutrients on growth parameters of turmeric is presented in Table 1. All the growth parameters were significantly influenced by NPK levels. In general, there was increase in plant height, leaves per clump, tillers per clump and leaf area with an increase in fertilizer levels. Maximum plant height (39.22cm) and leaf area (419.65 sq. cm) were recorded at a nutrient level of 120:60:120 kg NPK/ha, whereas highest level of nutrients viz., 180:90:270 kg/ha resulted in highest number of leaves/clump (16.47) and suckers/clump (3.8). But this treatment was on par with the former level in plant height and leaf area. Increase in growth parameters was also not significant beyond 120 kg N/ha indicating that while fertilizer application increases growth parameters, the increase does not take place proportionately beyond a certain level. Another reason for lack of proportionate increase in growth parameters may be due to initial higher nitrogen and potassium status of soil. Although the treatments 120:60:120, 180:90:180, 120:60:180 and 180:90:270 kg NPK/ha recorded similar growth, the treatment 120:60:120 kg NPK/ha, being a lower level seems optimum for attaining higher growth ultimately contributing to the final yield.

Positive response of turmeric to increased fertilizer application is expressed by enhanced tillering and luxurious foliage (Rao 1973; Rao, Reddy & Subbarayudu 1975). In ginger, a linear influence of NPK levels on growth was reported by Randhawa & Nandpuri (1969) and a similar response was observed in turmeric by Rao & Swamy (1984). However, maximum growth was observed at 120 kg N/ha (Balashanmugam & Chezhiyan 1986); 150 kg N/ha (Singh & Singh 1988) and 60 kg N/ha (Govind, Gupta & Ramchandra 1990) under different agroclimatic conditions.

Rhizome yield

In turmeric, increased vegetative growth results in increased production and storage of photosynthates in rhizomes which accounts for higher yield. In the present study also a significant increase in rhizome yield was observed with increased NPK levels (Table 2). In general, yield levels increased with an increase in fertilizer levels and highest yield of fresh rhizome (39.3 t/ha) was recorded at highest level of NPK (180:90:270 kg/ha). This may be due to increased uptake of nutrients resulting

Table 1. Effect of NPK levels on growth characters of turmeric

Treatment (kg NPK/ha)	Plant height (cm)	Leaves per clump	Tillers per clump	Leaf area of 3rd leaf (sqcm)
T_0 Control	34.27	12.27	2.60	312.02
T_1 30:30:60	34.54	12.95	2.80	330.30
T_2 60:60:120	36.03	14.32	3.20	346.80
T_3 90:90:180	36.49	14.40	3.20	345.92
T_4 60:30:60	35.59	14.10	3.20	364.92
T_5 120:60:120	39.22	15.35	3.40	419.65
T_6 180:90:180	37.67	14.90	3.60	361.08
T_7 60:30:90	35.29	13.31	3.00	331.01
T_8 120:60:180	38.06	15.15	3.50	386.30
T_9 180:90:270	39.05	16.47	3.80	403.87
C D at 5%	2.34	0.98	0.25	36.43
C V%	5.65	6.04	6.90	8.94

Values are pooled data for 1990-92

in higher growth and production of metabolites for rhizome development. The treatment 120:60:120 kg NPK/ha resulted in an yield of 35.2 t/ha which was statistically on par with the treatments 180:90:180, 120:60:180 and 180:90:270kg NPK/ha and significantly superior over other treatments. The

Table 2. Yield of turmeric rhizomes as influenced by NPK levels

Treatment (kg NPK/ha)	1990-91	1991-92	1992-93	Pooled
T_0 Control	23.051	26.381	26.217	25.240
T_1 30:30:60	24.656	27.088	33.711	28.485
T_2 60:60:120	27.865	33.355	31.188	30.803
T_3 90:90:180	30.437	37.407	31.703	33.178
T_4 60:30:60	24.749	32.037	33.222	30.007
T_5 120:60:120	33.295	35.652	36.644	35.229
T_6 180:90:180	30.169	38.692	32.962	34.278
T_7 60:30:90	30.413	32.122	30.851	31.130
T_8 120:60:180	31.691	39.451	32.807	34.648
T_9 180:90:270	29.110	39.695	38.988	35.930
C D at 5%	5.43	4.85	4.22	2.25
C V%	12.67	12.50	11.33	6.23

Values indicate yield of fresh rhizomes in t / ha

treatment 120:60:120 kg NPK/ha being a lower level seems optimum for higher yield in the hill zone of Karnataka.

Muralidharan & Balakrishnan (1972), Rao & Reddy (1977), Rao & Swamy (1984) and Shankaraiah & Reddy (1988) observed increased rhizome yield with increase in level of nutrients in turmeric. Randhawa & Nandpuri (1969) reported significant influence of NPK levels on rhizome yield in ginger. Our findings are in agreement with the earlier workers. However, Ahmed & Muthuswamy (1981), Umate, Latchanna & Bidigire (1984) and Balashanmugam & Chezhiyan (1986) recorded maximum yield at 120:60:60 kg/ha, while Muralidharan, Verma & Nair (1974) and Govind, Gupta & Ramchandra (1990) obtained higher yield at 70 and 50 kg N/ha in ginger and turmeric, respectively. However, Muthuvel *et al.* (1989) could not obtain significant response to applied N and K for three continuous seasons.

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