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Influence of planting methods, spacing and farmyard manure on growth, yield and nutrient content of turmeric (*Curcuma longa* L.)

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Abstract

Investigations carried out at Ludhiana (Punjab), with different methods of planting (flat and ridge), spacings (60 cm x 10 cm and 60 cm x 15 cm) and farmyard manure levels (0, 30 and 60 t ha^{-1}) on turmeric (*Curcuma longa*) revealed that fresh rhizome yield was significantly higher in ridge method of planting than flat method of planting with significantly taller plants and more number and weight of primary and secondary rhizomes. Farmyard manure application significantly improved plant height, number and weight of mother, primary and secondary rhizomes and fresh rhizome yield. Plant spacing did not influence growth and yield. Nitrogen, phosphorus and potassium contents in leaf and rhizome improved with farmyard manure application.

Key words: *Curcuma longa*, farmyard manure, planting methods, spacing, turmeric, yield.

Introduction

Turmeric (*Curcuma longa* L.) offers good scope for diversification of cereal based cropping systems in Punjab. The productivity of the crop can be enhanced by introducing high yielding varieties and modifying the existing package of practices which are location specific. The present study was initiated to study the response of turmeric to different planting methods, plant spacing and farmyard manure levels under Punjab conditions.

Materials and methods

The study was carried out at Students' Farm, Department of Agronomy and Agrometeorology, Punjab Agricultural University, Ludhiana (Punjab) (30° 54' N, 75° 48' E, 247 m MSL) during 2000 and 2001. The climate of the experimental location has three distinct seasons, namely, hot and dry, hot and humid and winter. The average annual rainfall is 650 mm, out of which 75% is received during July to September. The experimental field was loamy sand in texture, normal with respect to soil reaction (pH : 7.7) and soluble salts (electrical conductivity 0.20 ds m^{-1} at 20° C) and low in organic carbon (0.15%). The soil was low in available nitrogen (125.4 kg ha^{-1}) and medium in available phosphorus (12.7 kg ha^{-1}) and potassium (139.4 kg ha^{-1}). The treatments consisted of different combinations of two methods of planting (flat and ridge), two plant spacings (60 cm x 10 cm and 60 cm x 15 cm) and three farmyard manure (FYM) levels (0, 30 and 60 t ha^{-1}). The gross plot size was 6.0 m x 3.3 m. The experiment

was laid out in a randomized block design (factorial) with four replications. The crop was sown in the first week of May with a basal dose of 25 kg ha^{-1} each of phosphorus and potash. Irrigation was given immediately after planting. Pendimethalin @ 0.75 kg ha^{-1} was applied 3-4 days after planting and two hoeings (at 50 and 75 days after sowing) were also undertaken to keep the weeds under check. After each hoeing, earthing up was done. Light and frequent irrigations were ensured throughout the growth period. Leaf senescence was recorded at 200 days after sowing. The crop was harvested during the second fortnight of December. Data on plant height, number of weeds, dry weight of weeds, number of rhizomes $plant^{-1}$ and weight of rhizomes were recorded at harvest.

Results and discussion

Planting methods

The effect of planting methods on yield and yield attributes of turmeric was significant during both the years of study. Fresh rhizome yield of 190.0 and 117.7 q ha^{-1} was obtained in ridge method of planting as compared to 120.1 and 93.3 q ha^{-1} in flat method of planting during 2000 and 2001, respectively. Ridge planting produced taller plants though the differences were not significant in 2000. The number of mother rhizomes did not change due to different planting methods. The number of secondary rhizomes improved significantly in ridge planting compared to flat planting. A similar trend was observed in primary rhizomes though the differences were not significant. The weight of mother, primary and secondary rhizomes improved in ridge planting though the differences were significant only in secondary rhizomes during 2001. The overall better growth in ridge planting might be due to its smothering effect on weeds as evident from the number and dry weight of weeds which decreased significantly in ridge planting as compared to flat planting during 2000. Leaf senescence was significantly higher in flat planting as compared to ridge planting during both the years (Tables 1 and 2). Singh *et al.* (2001) reported that ridge planting affords more favourable environment namely, aeration, light interception, drainage and nutrient uptake for plant growth and this might have resulted in better growth and yield attributing characters as well as decreased leaf senescence in ridge planting which was reflected in significantly increased rhizome yield. Maximum net returns and benefit : cost

Table 1. Effect of planting methods, plant spacing and farmyard manure levels on yield attributes, occurrence of weeds, net returns and benefit : cost ratio in turmeric

Treatment	Plant height (cm)		Leaf senescence (%)		No. of weeds m^{-2}	Weed dry wt. (q ha^{-1})	Net returns (Rs ha^{-1})		Benefit : Cost ratio	
	2000	2001	2000	2001	2000	2000	2000	2001	2000	2001
Planting method										
Flat	34.3	47.4	29.85	48.19	265.24	57.07	26,481	11,579	0.79	0.33
Ridge	38.2	57.8	24.18	40.69	192.60	47.04	61,431	23,779	1.83	0.67
CD (P=0.05)	NS	4.6	4.91	5.09	34.58	8.88	-	-	-	-
Plant spacing										
60 cm x 10 cm	37.0	54.4	28.91	43.34	222.93	50.38	40,898	18,481	1.21	0.48
60 cm x 15 cm	35.5	47.7	25.13	45.54	234.92	53.73	46,864	16,856	1.52	0.52
CD (P=0.05)	NS	4.6	NS	NS	NS	NS	-	-	-	-
Farmyard manure										
0 t ha^{-1}	29.1	42.9	35.54	59.78	259.74	61.24	25,113	5199	0.87	0.17
30 t ha^{-1}	38.3	49.6	27.28	38.82	234.93	49.44	40,131	15,979	1.19	0.45
60 t ha^{-1}	42.3	60.8	18.24	34.74	189.10	45.49	66,600	31,856	1.73	0.80
CD (P=0.05)	5.1	5.6	6.02	6.23	42.35	10.87	-	-	-	-

Table 2. Effect of planting methods, plant spacings and farmyard manure levels on yield of turmeric

Treatment	Number of rhizomes plant^{-1}						Weight of rhizome (g)						Fresh rhizome yield (q ha^{-1})	
	Mother		Primary		Secondary		Mother		Primary		Secondary			
	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001
Planting method														
Flat	2.68	2.03	7.01	5.01	5.15	5.02	27.05	20.00	11.35	10.10	4.95	2.88	120.0	93.3
Ridge	2.63	2.18	7.48	5.20	7.37	5.63	32.79	21.80	13.91	10.44	5.28	3.38	190.0	117.7
CD (P=0.05)	NS	NS	NS	NS	1.22	0.50	NS	NS	NS	NS	NS	0.49	11.6	15.8
Plant spacing														
60 cm x 10 cm	2.66	2.20	6.86	5.41	6.28	5.84	29.14	20.75	13.43	10.97	5.04	3.17	154.7	112.8
60 cm x 15 cm	2.65	2.01	7.63	4.80	6.24	5.21	30.66	21.06	12.88	9.58	5.13	3.10	155.1	98.2
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Farmyard manure														
0 t ha^{-1}	2.31	1.72	6.25	3.78	4.08	4.25	26.03	18.07	9.34	8.95	4.22	2.71	107.6	71.1
30 t ha^{-1}	2.68	2.07	7.40	5.45	6.37	5.27	31.33	21.08	12.60	10.14	4.90	3.01	147.4	102.1
60 t ha^{-1}	2.98	2.53	8.08	6.08	8.34	6.47	31.58	23.56	15.33	12.64	6.74	3.68	210.1	143.3
CD (P=0.05)	0.29	0.36	1.14	1.31	1.49	0.83	2.10	3.60	2.30	2.79	0.70	0.60	14.2	19.4

ratio were obtained in ridge planting (Table 1). Nitrogen and potassium contents in leaves and rhizomes decreased in ridge planting as compared to flat planting though the differences were significant in case of potassium only during 2000 and this might be due to increased rhizome yield in ridge planting method (Table 3).

Plant spacing

Plant spacing of 60 cm x 10 cm produced significantly taller plants compared to wider spacing of 60 cm x 15 cm during 2001. A similar trend was observed during the first year though the differences were not significant. Fresh rhizome yield and other growth and yield attributing characters were not influenced by different plant spacings during both the years (Tables 1 and 2). Plant spacing did not affect the contents of nitrogen, phosphorus and potassium in leaves as well as rhizomes. Rashid *et al.* (1996) also reported that plant to plant spacing had no significant effect on fresh rhizome yield and this was due to non-significant effect on different growth and yield contributing characters.

Farmyard manure

Each increase in FYM level increased rhizome yield, plant height, number and weight of mother, primary and secondary rhizomes and nitrogen and phosphorus contents in leaves and rhizomes (Tables 1, 2 and 3). A maximum fresh rhizome yield of 210.1 and 143.3 q ha^{-1} was produced with 60 t ha^{-1} FYM during 2000 and 2001, respectively, which was significantly better than 30 and 0 t ha^{-1}. The benefit : cost ratio recorded continuous increase with increasing level of FYM and was maximum in 60 t ha^{-1} (Table 1). These results are in conformity with those reported by Gill *et al.* (1999). Each increase in FYM level increased plant height significantly during both the years. Application of FYM significantly increased the number as well as weight of mother, primary and secondary rhizomes giving the maximum values at 60 t ha^{-1} during 2000 and 2001. The increased availability of plant nutrients in FYM treatments might have resulted in overall better plant growth which

Table 3. Effect of planting methods, plant spacing and farmyard manure levels on nitrogen, phosphorus and potassium contents in leaf and rhizome of turmeric

Treatment	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	Leaf	Rhizome	Leaf	Rhizome	Leaf	Rhizome
Planting method						
Flat	1.67	1.40	0.20	0.31	1.59	3.81
Ridge	1.59	1.32	0.20	0.31	0.86	3.74
CD (P=0.05)	NS	NS	NS	NS	0.05	NS
Plant spacing						
60 cm x 10 cm	1.65	1.37	0.20	0.31	1.25	3.90
60 cm x 15 cm	1.60	1.34	0.20	0.31	1.20	3.63
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Farmyard manure						
0 t ha^{-1}	1.57	1.35	0.17	0.31	1.06	3.65
30 t ha^{-1}	1.60	1.36	0.20	0.31	1.22	3.67
60 t ha^{-1}	1.71	1.38	0.22	0.31	1.40	3.98
CD (P=0.05)	0.10	NS	0.01	NS	0.06	NS

might have resulted in increased plant height and more number as well as weight of fingers/rhizomes. Leaf senescence decreased significantly with each increase in FYM level during both the years of study and this indicated that with FYM application, the crop remained photosynthetically active for longer period. The number of weeds and dry weed weight was maximum in control plots and it decreased significantly in 60 t ha^{-1} of FYM. Khanda & Mohapatra (2003) also reported that application of 15 t FYM ha^{-1} resulted in taller plants, more branches and higher yield than 0, 5 and 15 t of FYM ha^{-1} in *Amaranthus hypochondriacus*. Nitrogen and potassium contents in leaf and rhizome and phosphorus content in leaf improved with each increase in FYM level (Table 3).

The study thus indicated that fresh rhizome yield of turmeric was significantly higher in ridge planting than flat planting. Ridge planting produced taller plants with more number and weight of primary and secondary rhizomes. Plant spacing did not influence growth and yield of turmeric. FYM application significantly improved plant height, number and weight of mother, primary and secondary rhizomes and fresh rhizome yield. Nitrogen, phosphorus and potassium contents in leaves and rhizomes improved with FYM application.

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