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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (4): 593-595, 2000

Effect of Different Spacing and Potassium Levels on the Growth and Yield of Turmeric var. Sinduri

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Abstract: An experiment was conducted during 1998-99 to study the effect of different spacing (50 cm x 20 cm, 50 x 30 cm and 50 x 40 cm) and K_2O rate (0, 40, 75, 120 and 150 Kg ha^{-1}) on the growth, dry matter, production and yield of turmeric (*Curcuma longa* L.). Close spacing produced the tallest plants (87.89 cm), medium spacing produced the plants (87.89 cm), medium spacing produced the plants with the highest finger breadth (6.95 cm) and primary finger per plant (2.71) while wide spacing produced with the highest number of tillers per hill (3.42), leaves per plant (8.56), total dry weight per plant (53.79 g) and highest yield per plant (189.35 g). But total yield (t ha^{-1}) was highest with close spacing. Almost all of the characters studied showed increasing trend with increasing rate of potassium and the highest yield (15.4 t ha^{-1}) was obtained with 120 Kg ha^{-1} K_2O. The interaction effect of spacing and potassium exhibited insignificant variation in most of the characters.

Key words: Growth, dry matter, production, yield of turmeric

Introduction

Turmeric (*Curuma longa* L.) is one of the important spice crop used all over Bangladesh for cooking purpose. It is used for its typical colour and flavour. Besides, it is used in medicine, cosmetics and as dye in textile industries (Pruthi, 1976). In our country, farmers follow indigenous practices for its cultivation and generally used local varieties. The common picture of its cultivation is under fruit orchard and mainly shady places (Ahmed, 1984). Although turmeric is a major spice crop of Bangladesh but its method of production has not been standardized from the scientific point of view. The yield of turmeric in Bangladesh is very low (7.3 t ha^{-1}) as compared to that of other major turmeric growing countries like India where its range from 25 to 30 t ha^{-1} (Anonymous, 1978). The lower yield in Bangladesh is mainly due to lack of high yielding varieties and sub-optimal management practices like fertilizer, adequate plant population etc. Plant spacing is important factor for turmeric production as it influences interplant competition. Plant spacing significantly affects the turmeric production (Ahmed and Rahman, 1987) and in India Aiyadural (1966) found best results from a spacing of 22.5 x 22.5 cm. As an essential element potassium is necessary for many physiological functions including carbohydrate metabolism, enzyme activation, osmotic regulation and efficient use of water, nitrogen uptake, protein synthesis and translocation of assimilates (Singh, 1991). For successful growth of tuber and rhizome crops, potassium is essential. Banafar and Tiwari (1995) investigated the effect of potassium on the growth and yield of turmeric in India and they observed that growth, number of leaves, number of tillers, girth of pseudostem and yield increased with increasing rate of potassium. But information about these are not available in Bangladesh. Moreover these investigations did not consider the effect of spacing in relation to potassium in turmeric. Therefore, the present investigation was undertaken to find out the optimum plant spacing and potassium level for better yield and yield attributes of turmeric.

Materials and Methods

The experiment was carried out during the period of May 1998 to January 1999 at Hajee Mohammad Danesh Agricultural College farm, to study the response of turmeric (*Curcuma longa* L.) to different plant spacing and different levels of potassium. Recently released HYV var. Sindury by Bangladesh Agricultural Research Institute was used to carryout the experiment. The treatment consists of 3 plant spacing (20 x 50, 30 x 50 and 40 x 50 cm) and 5 levels of potassium (0, 40, 75, 120 and 150 Kg ha^{-1} K_2O) which were arranged in factorial RCBD with 3 replications. The unit plot size was 3 x 2 m. Plant population was maintained as 10, 8 and 5 per sq. m. The whole amount of TSP (Triple super phosphate) and other organic manures were applied at the time of land preparation and urea was applied at 3 splits as the rate recommended by Anonymous (1989). MP (muriate of potash), as a source of potassium was applied as per treatment through side dressed in 3 splits at 60, 120 and 180 days after sowing (DAS). Two small rhizomes were sown in each pit and on emergence the plants were thinned to one plant/hill. Earthling up was done at 60 DAS during the first application of potash. The plots were kept weed free and water was applied as and when required.

Table 1: Physical and chemical properties of the experimental soil

Sand (%)	61.00%
Silt (%)	24.80%
Clay (%)	14.10%
Texture Sandy loam	
pH	5.80
Organic Carbon (%)	0.68%
Total N (%)	0.05
Available P(ppm)	30.00
K-me/100	0.18

Source: Rahman *et al*. (1998) and Tarafder *et al*. (1995)

From the experimental plots following data was collected carefully viz, date of germination, date of finger initiation, plant height and total leaf number at maturity. The crop was harvested when the plants became completely yellow and the leaves including the base of the pseudostem dried up completely. At maturity two rows of inner side were selected and data were recorded for plant height, leaf number per plant, number of total fingers, finger length and breadth (Table 1). Total yield of turmeric was recorded on whole plot harvest basis. The data were analyzed through partitioning the total variance with the help of Computer by using MSTAT-C program and the mean differences were tested by LSD.

Results and Discussion

Effect of plant spacing: This results of the effect of different plant spacing on various morphological, yield and yield contributing characters of turmeric are shown in Table 2. The plant height, shoot dry weight/plant, primary finger and total finger per plant, dry weight of turmeric (fingers), finger breadth, yield per plant and total yield (t ha^{-1}) differed significantly with different plant spacing. While other characters viz. days to finger initiation, plants

Table 2: Effect of plant spacing and potassium on the growth, yield and yield attributing characters of tumeric

Treatment	Plant height (cm)	Finger initiation (days)	Plants/ hill	Leaves /plant (no.)	Girth of pseudo stem (cm)	Maturity (days)	Shoot dry wt. /plant (g)	Finger dry wt. /plant (g)	Total dry wt. /plant (g)	Primary finger/ /plant (no.)	Total finger/ /plant (no.)	Finger length (cm)	Finger breadth (cm)	Fresh Yield (g/ plant)	Fresh Yield (t ha^{-1})
A. Plant Spacing (cm)															
50x20	87.89	113.53	2.38	7.96	4.39	240.20	8.47	26.72	35.99	2.03	12.55	5.87	6.18	141.57	13.21
50x30	84.92	112.07	2.33	8.24	4.71	241.13	12.05	32.67	46.12	2.71	14.85	6.52	6.95	162.53	12.25
50x40	78.83	112.87	2.43	8.56	4.76	238.40	13.94	39.44	53.79	2.59	19.51	6.22	6.90	189.35	10.35
LSD(0.05)	5.04	NS	NS	NS	NS	NS	3.34	1.92	3.30	0.30	3.21	NS	0.38	9.15	0.62
CV (%)	8.04	2.31	10.94	8.95	11.50	2.82	18.92	7.81	9.75	16.26	13.42	14.79	7.59	7.73	7.14
B. Potassium doses (Kg ha^{-1})															
0	77.34	115.45	2.25	7.22	3.94	242.11	11.27	20.99	31.48	1.95	13.06	6.19	6.41	100.68	7.32
40	77.99	114.67	2.38	7.95	4.10	241.34	11.04	28.27	39.53	2.08	15.00	6.28	6.26	135.65	9.87
75	85.12	114.11	2.39	8.48	4.91	241.89	12.49	38.17	51.26	2.54	18.21	6.52	6.96	184.52	12.76
120	91.29	111.44	2.53	8.86	5.10	236.44	11.14	43.45	57.36	3.01	16.02	6.49	6.94	209.49	15.40
150	87.16	108.44	2.34	8.76	5.04	237.78	11.51	33.89	46.84	2.62	15.89	5.56	6.83	192.07	14.31
LSD(0.05)	6.50	NS	NS	0.71	0.51	NS	NS	2.48	4.24	0.38	NS	NS	0.50	11.81	0.80
CV (%)	8.04	2.31	10.94	8.95	11.50	2.82	18.92	7.81	9.75	16.26	13.42	14.79	7.59	7.73	7.14

Table 3: Combined effect of plant spacing and potassium on the growth, yield and yield attributing characters of turmeric

Treatment combination Spacing (cm)	K_2O (Kg ha^{-1})	Plant height (cm)	Finger initiation (days)	Plants/ hill	Leaves /plant	Girth of pseudo	Maturity (days)	Shoot dry wt. /plant stem	Finger dry wt. /plant (g)	Total dry wt. /plant (g)	Primary finger/ /plant (g)	Total finger/ /plant	Finger length (cm)	Finger breadth (cm)	Fresh Yield (g/plant)	Fresh Yield (t ha^{-1})
50x20																
	0	79.51	115.67	2.23	7.17	4.17	239.00	8.81	16.41	25.21	1.60	9.90	6.12	6.07	78.71	7.87
	40	79.39	115.33	2.67	7.73	4.20	241.67	6.99	20.99	27.99	1.50	12.30	5.67	6.00	100.7	10.07
	75	90.01	114.67	2.57	8.07	4.58	242.67	10.90	32.32	43.22	2.53	17.86	5.96	6.39	155.0	14.48
	120	97.46	111.33	2.30	8.27	4.34	237.33	6.85	37.84	46.69	2.73	15.67	6.26	6.26	180.7	18.14
	150	93.07	110.67	2.13	8.57	4.66	240.33	8.81	26.01	36.82	1.80	11.80	5.34	6.17	192.7	15.50
50x30																
	0	79.02	115.67	2.13	7.10	3.82	247.33	12.99	20.30	33.30	2.23	14.13	6.39	6.54	97.39	7.79
	40	81.67	113.33	2.30	7.90	3.93	239.67	12.58	29.67	42.92	1.97	16.63	6.77	6.56	142.3	11.39
	75	86.25	113.67	2.37	8.50	5.26	245.67	11.46	38.32	50.11	3.30	13.53	6.53	7.09	188.8	13.32
	120	51.13	111.33	2.57	8.97	6.30	239.33	11.18	40.44	55.63	3.30	13.67	6.28	7.23	197.6	15.54
	150	86.55	106.33	2.30	8.73	5.24	233.67	12.01	34.60	48.62	2.73	16.26	6.65	7.33	186.5	13.17
50x40																
	0	73.48	115.00	2.40	7.40	3.82	240.00	12.02	26.25	35.93	2.03	15.73	6.04	6.61	125.9	6.30
	40	72.90	115.33	2.17	8.23	4.17	242.67	13.55	34.13	47.69	2.77	18.47	6.42	6.21	163.9	8.20
	75	79.11	114.00	2.23	8.86	4.89	237.33	15.10	43.71	60.44	1.80	18.73	7.06	7.38	209.7	10.49
	120	85.29	111.67	2.73	9.33	5.68	232.67	15.38	52.06	69.77	3.00	23.23	6.92	7.33	250.2	12.51
	150	81.86	108.33	2.60	9.00	5.22	239.33	13.70	41.06	55.09	3.33	21.40	4.68	6.93	197.0	14.26
LSD (0.05)		11.26	NS	NS	1.24	1.19	NS	NS	NS	NS	0.89	7.17	NS	0.85	NS	1.39
CV (%)		8.04	2.31	10.94	8.95	11.50	2.82	18.92	7.81	9.75	16.25	13.42	14.79	7.59	7.73	7.14

per hill, leaves per plant, girth of pseudostem and days to maturity did not differ significantly.

Plant height was significantly improved in the closer spacing compared with wider spacing. The closest spacing (50 x 20 cm) produced the tallest plant (87.89 cm) which was statistically identical to that recorded at medium spacing (50 x 30 cm). Wider spacing increased the average plant/hill, leaves/plant, girth of pseudostem, fingers/plant which in turn produced maximum fresh and dry yield of the plant. This was probably due to better availability of plant nutrients, moisture and light in wider spaced plants. The highest yield (13.21 t h^{-1}) was obtained when plants were spaced closer (50 x 20 cm) followed by 50 x 30 cm (12.25 t ha^{-1}). At widest spacing (50 x 40 cm) yield was the lowest (10.35 t ha^{-1}). The former two treatments did not differ significantly. The former two treatments did not differ significantly. The significant increase in yield under closer spacing may solely be ascribed on the function of higher plant density per unit area of land. Similar findings were observed by many scientists (Rahman and Faruque, 1974; Shashidhar *et al*., 1997). These indicate that plant population is one of the most important factor for yield in turmeric. Similar results were found by Ahmed *et al*. (1988) in ginger. Randhawa and Mishra (1974) obtained increased yield in turmeric with a increase number of plants per unti area.

Response of potassium: The level of potassium showed a marked influence on different plant characters, yield and yield components of turmeric (Table 2). The plant height was found to be increased significantly with the increase n the level of potassium and the tallest plant (91.29 cm) was obtained from the dose of 120 Kg ha^{-1} K_2O. The shorter plant was found from the dose of 0 and 40 Kg ha^{-1} K_2O. Finger initiation and plants/hill do not very due to spacing or levels of K_2O in turmeric. The number of leaves/plant and girth of pseudostem varied significantly among different levels of potassium. The highest number of leaves (8.86) and pseudostem diameter (5.10 cm) was produced with the application of 120 Kg ha^{-1} K_2O. However, the variation was insignificant among the treatment of 75, 120 and 150 kg K_2O per hectare. The lowest pseudostem diameter and lowest number of leaves per plant were produced the plots received no K_2O. Increasing trend of leaves formation and greater stem diameter with increased dose of K_2O was also reported by Rahman and Rashid (1982) in a tuber crop potato, finding of which is an agreement with the present study.

Maturity do not affect significantly by the levels of potassium but higher dose of potassium accelerate maturity in turmeric. The effect of potassium on the number of fingers/plant and finger size were much more pronounced. The higher number of primary fingers/plant were produced when K_2O were applied at the rate of 120 kg ha^{-1}, followed by 75 and 150 kg ha^{-1}. But the later two treatments did not differ significantly. Finger length and finger breadth also showed the similar trend. Variation of finger length among the treatments was insignificant. The total dry matter production and fresh turmeric (rhizome) yield varied significantly due to different levels of potassium. The highest total dry matter (57.36 g/plant) and the highest yield (15.40 t ha^{-1}) were obtained with the application of potassium at the rate of 120 kg ha^{-1}. The total dry matter per plant and yield produced from 75 and 150 Kg ha^{-1} were statistically identical.

Interaction effect: The combine effect of spacing and potassium was found to be insignificant for almost all the characters except plant height, number of leaves per plant, girth of pseudostem, total fingers per plant, finger breadth and yield (Table 3). Almost all the characters of turmeric were found to be increased with the increasing level of potassium irrespective of spacing. Plant height was influenced by both spacing and potassium. The tallest plant being obtained from a plant spacing of 50 x 20 cm with 120 kg K_2O/ha. Except yield (t ha^{-1}) other parameters showed superiority with a combination of plant spacing of 50 x 40 cm and K_2O dose of 125 Kg ha^{-1}. The closest spacing (50 x 20 cm) accompanied with a dose of 120 kg K_2O/ha gave the highest yield (18.14 t ha^{-1}) of turmeric although in respect of yield of single plant the widest spacing with a highest dose of K_2O gave the maximum rhizome production. The result obtained from this study indicates that there was a general trend of yield increase with the increase dose of K_2O and plant population per unit area. However, further investigation are needed for confirmation of the results of present study.

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