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EFFECT OF NITROGEN AND POTASSIUM ON GROWTH YIELD AND NUTRIENT UPTAKE OF TURMERIC GENOTYPES

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ABSTRACT

A field experiment was conducted during rainy-cum-winter seasons of 2011-12 and 2012-13 to study the effect of nitrogen and potassium on growth, yield and nutrients uptake of turmeric genotypes. Roma recorded the maximum plant height, leaves/plant, length and breadth of leaves, number and length of clumps/plant and length of mother rhizome and fresh rhizome yield (101.72 q ha^{-1}) with net income of ₹.474564 ha^{-1}. Fertility level upto $N_{200}K_{200}$ resulted in maximum growth, yield attributes and rhizome yield (100.90 q ha^{-1}) with net income of `₹. 468560 ha^{-1}. Thus, Roma may be grown with $N_{200}K_{200}$ to achieve maximum profit under the existing agro-climatic conditions. Roma producing 101.72 q ha^{-1} fresh rhizomes took up the maximum nutrients (162.0 kg N, 53.6 kg P and 109.9 kg K ha^{-1}). Application of $N_{200}K_{200}$ resulted in highest uptake of N, P and K (158.6 kg N, 51.9 kg P and 107.8 kg K ha^{-1}). The findings suggest that due to heavy withdrawal of nutrients by turmeric genotypes, the succeeding crop must be nourished properly based on soil test values.

Key words: Nitrogen, potassium, turmeric genotypes, nutrients uptake

INTRODUCTION

India accounts for 80% of the world output of turmeric, though major part of its produce is being utilized within the country. Despite its excellent 45% export potential, the output of turmeric has not kept pace with increasing domestic and export demand for one or the other reasons *viz.*, marginal farming, unscientific techniques of cultivation and incomplete nourishment with the essential plant nutrients. Turmeric is a long-duration and fertilizer responsive crop. Nitrogen is considered as one of the key elements in deciding the yield potential of high-yielding varieties. Importance of N and K fertilization in turmeric has been reported by various research workers in relation to quality and productivity of the crop (Haque *et al.*, 2007 and Ahirwar *et al.*, 2010). Turmeric is a long-duration and fertilizer responsive crop. Nitrogen and potassium are considered as one of the key elements in deciding the yield potential and quality of high-yielding varieties. The importance of nitrogen and potassium fertilizers for higher productivity of turmeric has been reported by many researchers (Haque *et al.*, 2007 and Ahirwar *et al.*, 2010). However, there exist wide differences between addition and uptake of such fertilizers by the crops. The general tendency is that the total crop removal of nutrients is never replenished. That is why soil health and sustainable productivity of crops are becoming great threat. Due to fertility variations in different soil types, the response of a certain turmeric genotype to direct fertilizer application is highly inconsistent, location and even site specific. Hence, fertilizer recommendation for a particular soil type and crop variety should be made based on soil test values. Many turmeric genotypes have been developed in India possessing a high genetic diversity towards production potential and medicinal qualities under a given set of agro-climatic and environmental conditions. Consequently, their nutritional requirement towards major nutrients is also varied. Therefore, the scrutiny of newly developed genotypes for their actual N and K requirement is essential for securing higher productivity and quality of turmeric. So far no such work has been done under the soil and climatic conditions of Rewa region, the present research was therefore, initiated.

MATERIALS AND METHODS

The field experiment was conducted at the Private Research Farm, Beena-Semaria Road, Rewa (M.P.) during 2011-12 and 2012-13. The soil was silty clay-loam having pH 7.5, electrical conductivity 0.34 dS m^{-1}, organic carbon 6.40 g kg^{-1}, available N, P_2O_5 and K_2O 228, 24 and 381 kg ha^{-1}, respectively. The rainfall received during June to March was 760 and 795 mm in both the years. The treatments comprised three genotypes (Roma, PCT-8 and Suroma) in the main plots and nine fertility levels (N_{100} K_{100}, N_{100} K_{150}, N_{100} K_{200}, N_{150} K_{100}, N_{150} K_{150}, N_{150} K_{200}, N_{200} K_{100}, N_{200} K_{150}, $N_{200}K_{200}$) in the sub-plots. The experiment was laid out in split plot design replicated three times. Mother rhizomes of turmeric genotypes were planted during 16 and 19 July in both the years keeping 30 cm row distance and 15 cm plant distance. Urea, diammonium phosphate and muriate

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of potash were used to maintain the fertility levels for N, P and K, respectively. As per treatments, half of the N and K were applied as basal, ¼ N at 45 DAS and the remaining ¼ N and ½ doses were applied at 90 DAS. Application of 60 kg P_2O_5 ha^{-1} was done as basal in all the treatments. Light and frequent irrigations were ensured throughout the growth period. Other cultural practices of turmeric cultivation were adopted as per recommendation. The digging of rhizomes was done during the last week of March in both the years. The N, P and K contents in rhizomes were determined by adopting standard procedures (Jackson 1973). The nutrients uptake was calculated by multiplying the turmeric yield with the percentage of nutrient content in turmeric. The economics of treatments was computed on the basis of prevailing market price of inputs and prduce.

RESULTS AND DISCUSSION

Growth and yield attributes

Data (Table 1) reveal that out of three genotypes, Roma enhanced the growth parameters as well as yield attributes upto the maximum extent. The second and third position was attained by PCT-8 and Suroma, respectively. The maximum growth parameters in Roma were 102 cm plant height, 10.43 leaves / plant, 37.59 cm leaves length, 14.41 cm leaves breadth, 6.81 clumps/plant and 35.36 cm clumps length. Suroma genotype recorded significantly lowest all these parameters. The significant differences in growth parameters and yield attributes in different genotypes might be owing to their genetic variability. The best performance of Roma over others might be ascribed to its physiological role in synthesis and partitioning of the biomass (Harinkhede, 2005 and Patel *et al.*, 2012). The different fertility levels did not influence the growth parameters and yield attributes upto significant extent except number and length of clumps/plant and length of mother rhizome which were found significant. However, the highest $N_{200}K_{200}$ level recorded the highest whereas $N_{100}K_{100}$ level recorded the lowest values of these parameters. The increased supply of nitrogen and potassium resulted in enhanced photosynthesis process. In fact, leaf is the factory for the conversion of solar energy into chemical energy by the process of photosynthesis. The beneficial influence of applied N and K on these parameters may be due to increased translocation of more photosynthates towards the sink as a result of increased availability of N and K nutrients for the actively growing plants (Haque *et al.*, 2007, Ahirwar *et al.*, 2010 and Pandey *et al.*, 2012).

Table 1: Growth, yield attributes of turmeric as influenced by genotypes and fertility levels (Pooled for two years)

Treatment	Plant height (cm) 150 DAS	Leaves /plant 150 DAS	Length of leaves (cm) 150 DAS	Breadth of leaves (cm) 150 DAS	Number of clumps/ plant 150 DAS	Length of clumps/ plant (cm) 150 DAS	Length of mother rhizome (cm)
Genotypes							
Roma	102.00	10.43	37.59	14.41	6.81	35.36	6.93
PCT-8	98.24	9.42	36.37	13.39	6.77	34.40	6.79
Suroma	93.90	8.69	35.49	11.89	6.13	33.49	6.51
CD (P=0.05)	**0.78**	**0.27**	**NS**	**0.26**	**NS**	**0.17**	**NS**
Fertility levels							
$N_{100}K_{100}$	97.53	9.34	36.38	13.08	**6.57**	34.25	6.50
$N_{100}K_{150}$	98.04	9.45	36.51	13.17	6.70	34.35	6.75
$N_{100}K_{200}$	98.03	9.53	36.65	13.26	6.82	34.43	6.85
$N_{150}K_{100}$	98.14	9.44	36.45	13.12	6.59	34.42	6.64
$N_{150}K_{150}$	97.92	9.41	36.50	13.20	6.69	34.48	6.68
$N_{150}K_{200}$	98.06	9.53	36.72	13.35	6.80	34.48	6.89
$N_{200}K_{100}$	97.82	9.42	36.38	13.21	6.59	34.32	6.59
$N_{200}K_{150}$	98.16	9.57	36.53	13.29	6.78	34.38	6.80
$N_{200}K_{200}$	98.65	9.64	36.77	13.44	6.92	34.57	7.00
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**0.21**	**0.17**	**0.23**

NS= Non -significant

Yield of turmeric

The fresh yield of turmeric rhizomes (101.72 q ha^{-1}) and dry matter recovery (37.39%) were significantly higher in case of Roma genotype compared to PCT-8 and Suroma. The Suroma genotype produced the significantly lowest turmeric yield (96.13 q ha^{-1}) being less than 5.59 q ha^{-1} than Roma. The dry matter recovery was lowest (35.24%) in Suroma. The increased yield and dry matter recovery from Roma over others might be owing to its maximum yield `rhizomes (100.90 q ha^{-1}) against all the remaining fertility levels. The dry matter recovery was not changed significantly, however $N_{200}K_{200}$ gave the maximum dry matter recovery (36.53%), whereas the minimum recovery (36.14%) was noted from $N_{100}K_{100}$ fertility level. These results are in accordance with the findings of Ahirwar *et al.*, (2010) and Pandey *et al.*, (2012).

Table 2: Yield, economics and uptake of nutrients by turmeric as influenced by genotypes and fertility levels (Pooled for two years)

Treatments	**Fresh yield of rhizomes (q ha^{-1})**	**Dry matter recovery (%)**	**Net income (₹ ha^{-1})**	**B:C ratio**	**Nutrients uptake (kg ha^{-1})**		
					N	**P**	**K**
Genotypes							
Roma	101.72	37.39	474564	4.50	162.0	53.6	109.9
PCT-8	99.51	36.33	461350	4.40	155.7	49.3	101.7
Suroma	96.13	35.24	441094	4.25	147.1	44.4	95.1
CD (P=0.05)	0.39	0.73	--	--	4.90	4.18	3.82
Fertility levels							
$N_{100}K_{100}$	97.30	36.14	449210	4.34	151.5	46.3	96.9
$N_{100}K_{150}$	98.00	36.20	452880	4.35	152.5	47.2	98.2
$N_{100}K_{200}$	98.14	36.31	453210	4.34	153.7	47.6	100.5
$N_{150}K_{100}$	99.09	36.26	459320	4.40	154.0	48.7	100.9
$N_{150}K_{150}$	99.16	36.31	459230	4.39	155.1	49.0	102.5
$N_{150}K_{200}$	99.33	36.46	459760	4.38	155.9	50.0	104.1
$N_{200}K_{100}$	99.94	36.28	463770	4.42	155.8	50.3	104.0
$N_{200}K_{150}$	100.24	36.40	465080	4.42	157.4	51.0	105.5
$N_{200}K_{200}$	100.90	36.53	468560	4.43	158.6	51.9	107.8
CD (P=0.05)	0.39	NS	-	-	4.90	4.18	3.82

NS= Non -significant

Economics

Amongst the three genotypes, Roma gave the maximum net income (₹.474564 ha^{-1}) and B:C ratio (4.50). The second best genotype was PCT-8 giving a net profit of ₹. 461350 ha^{-1} with B:C ratio 4.40. Suroma stood the third best genotype. Thus Roma and PCT-8 gave extra net income of ₹. 33470 and ₹. 20256 ha^{-1}, respectively over Suroma. The difference in net income amongst the genotypes was in accordance with the variation in their rhizome yield. Amongst the fertility levels, $N_{200}K_{200}$ resulted in highest net income of ₹.468560/ha, whereas it was only ₹.449210 ha^{-1} from the lowest $N_{100}K_{100}$ fertility level. The extra net income from $N_{200}K_{200}$ against $N_{100}K_{100}$ was upto ₹.19350 ha^{-1}. Similarly, the net income was ₹. 15870 ha^{-1} from $N_{200}K_{150}$ as against $N_{100}K_{100}$. The net income was further augmented by ₹.483860 ha^{-1} when Roma was fertilized with $N_{200}K_{200}$ fertility level.

Uptake of nutrients

The N, P and K uptake by rhizomes was found to deviate significantly due to different genotypes. Roma producing 101-72 q ha^{-1} rhizomes recorded significantly higher N, P and K uptake over the other two genotypes. The maximum N, P and K uptake was 162.0, 53.6 and 109.9 kg ha^{-1}, respectively (Table 2). The significant increase in the uptake of NPK in Roma might be due to similar increases in NPK contents in rhizomes as well as increased rhizome yields. The similar trend was also followed in PCT-8 and Suroma genotypes which ranked in the second and third positions, respectively. The fertility levels did not affect the N uptake upto significant extent, whereas P and K uptake were influenced significantly due to fertility levels. The highest fertility level ($N_{200}K_{200}$) resulted in maximum uptake of N (158.6 kg ha^{-1}), P (51.9 kg ha^{-1}) and K (107.8 kg ha^{-1}). In case of P and K uptake by rhizomes, higher fertility levels ($N_{200}K_{100}$, $N_{200}K_{150}$ and $N_{200}K_{200}$) proved significantly superior to the lower fertility levels ($N_{100}K_{100}$, $N_{100}K_{150}$ and $N_{100}K_{200}$). The increased uptake of NPK due to increased levels of applied N and K was due to increase in the NPK contents in rhizomes as well as increased rhizome yield. The positive influence of N and K fertilizers on root-shoot growth, yield attributes, yield and nutrients uptake might be due to increased number of leaves and their size development, increased photosynthates and their effective translocation towards developing reproductive organs (rhizomes). The present findings corroborate with those of other workers (Reddy *et al.* 2008), Chaurasa *et al*. (2009) and Pandey *et al.* (2012).

From the results, it can be concluded that Roma genotype may be grown with N_{200} K_{200} to achieve maximum yield and income from turmeric.

REFERENCES

Ahirwar, Kamlesh, Singh, Jagdish and Kumar, M.M. (2010) Effect on nitrogen and potassium on growth and yield of turmeric. *Annals of Plant and Soil Research,* **12** (1): 71-72.

Chaurasia, Anand, Singh, S.B. and Namdeo, K.N. (2009) Integrated nutrient management in relation to nutrient contents and uptake of Ethiopian mustard (*Brassica carinata*). *Research on Crops.* **10**(2): 246-249.

Haque, M.M., Rahman, A.K.M.M., Ahmed, M., Maksud, M.M. and Sarker, M.M.R. (2007) Effect of nitrogen and potassium on the yield and quality of turmeric in hill slope *International Journal of Sustainable Crop Production,* **2**(6): 10-14.

Harinkhede, D.K. (2005) Response of turmeric varieties to nitrogen and phosphorus levels. *Vaniki Sandesh*, **29**(1): 30-31.

Jackson, M.L. (1973) *Soil Chemical Analysis*. Prentice Hall of India Private Limited, New Delhi

Pandey, Gaura, Pandey, Rajshree, Ahirwar, Kamlesh and Namdeo, K.N. (2012) Effect of organic and inorganic sources of nutrients on growth and yield of turmeric (*Cucuma longa* L.). *Crop Research*, **44**(1&2): 246-249.

Patel, M.P., Richhariya, G.P., Sharma, R.D. and Namdeo, K.N. (2012) Effect of fertility levels on growth, yield and quality of soybean (*Glycine max.*) genotypes. *Crop Research*, **44**(1&2): 68-70.

Reddy, R. Uma and Reddy, M. Suryanarayan (2008) Uptake of nutrients by tomato and onion as influenced by integrated nutrient management in tomato-onion cropping system. *Crop Research,* **36**(1, 2 & 3): 174-178.