EFFECT OF DIFFERENT LEVELS OF PHOSPHORUS AND POTASSIUM ON SOIL HEALTH, ECONOMICS OF HYBRID TOMATO IN INCEPTISOL

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ABSTRACT

An experiment was conducted to study the response of tomato to phosphorus (0, 25, 50 and 75 kg /ha P_2O_5) and potassium (0, 25, 50 and 75 kg/ha K_2O) levels on growth, yield attributes, yield, economics and soil health. Application of 75 kg P_2O_5 /ha recorded the highest plant height, minimum days to first and last picking, higher number of fruits per plants, more available P_2O_5 (kg/ha), highest gross returns, highest net returns and benefit cost ratio. Similarly, application of 75 K_2O/ha recorded the highest plant height, maximum number of picking, more number of fruits per plant, highest fruit yield per plant, highest fruit yield (q/ha) more available K_2O, highest gross return, highest net returns and benefit cost ratio as compared to the lower levels of potassium and control.

KEY WORDS: Benefit cost ratio, Economics, Inceptisol, Phosphorus, Potassium, Tomato

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the major commercial crops grown throughout the country. India produces about 19.7 million tonnes of tomato from an area of 0.809 million ha with average productivity of 24.35 tonnes/ha (Anonymous, 2017). Tomato possess good medicinal value, pulp and juice are digestible, mild appetiser promoter of gastric secretion and blood purifier. Tomato juice contains vitamins. It is good in chronic dyspersia and stimulate torpid liver. Tomato is a rich source of lycopene and vitamins. Lycopene may help counteract the harmful effect of substances called free radicals, which are thought to contribute to age related processes and number of types of cancer (Akand *et al*. 2016). Due to high nutritive value and wide use, the demand for tomato is very high and increasing day by day. The result of large number of long-term experiments clearly showed that even recommended dose of nitrogen application, based on soil test basis, the yield of tomato or of the cropping system could not be maintained at high level continuously. The deficiency of phosphorous and potassium started emerging and limiting vegetable yield after different periods. Balanced use of different nutrients is one of the most important factors for exploiting the yield potential of a genotype. Phosphorous play an important role in metabolism and energy transmission process, root development and flowering and fruiting. Phosphorous also hastening maturity and seed formation, and conferring lodging and disease resistance.

Potash applications maintain ionic balance and water status within plant.

Potassium application decrease the incidence of pest and disease, induce plumpness of vegetables and fruit, thereby, improve the quality. It increases the content of a number of vitamins, important in vegetables for fresh consumption (Marschner, 2012.). Potash also plays an important role for pigment synthesis notably for lycopene. A general dose of phosphorous and potassium for hybrid tomato may not hold good for the entire situation *e.g*. varieties, soil, input level, etc. So far little work has been done nutritional requirement of tomato hybrids. Further the dose of a phosphorous and potassium is likely to change with economic and ecological consideration. Therefor, there is a need to work out the level of phosphorus and potassium for hybrid tomato.

MATERIALS AND METHODS

The study was conducted at Agricultural Research Station, Sardarkrushinagar Dantiwada Agricultural University, Ladol during *kharif* season of 2009-10 to 2013-14. The soil of experimental field was sandy loam in texture, low in organic carbon (0.23%) and available nitrogen (148 kg/ha), medium in available phosphorous (14.4 kg.ha and available potassium (235 kg/ha). The experiment was laid out in Randomized Block Design (Factorial) with three replications. The treatments consisted four level of phosphorous (0, 25, 50, 75 kg P_2O_5/ha) and four levels of potassium (0, 25, 50, 75 kg K_2O/ha) with 16 treatment combinations. Before transplanting of the seedling, 50 per cent nitrogen and full dose of phosphorous and potassium were applied as per treatment combination in different plots. The rest dose of nitrogen was top dressed in two equal splits after 30 and 45 days after transplanting. Quantities of urea for nitrogen application adjusted after subtracts nitrogen gain from DAP as per treatment. Potassium applied through Murate of Potash. Thirty days old seedlings of tomato hybrid Naveen were transplanted in plot of size 4.5 × 4.5 meters at spacing of 90 × 90 cm during all four years. Well decomposed FYM 10 t/ha was applied 30 days before transplanting and mix thoroughly. Standard cultural practices recommended for tomato was followed uniformly for all the experiment plots. The growth fruiting attributed were recorded in five randomly selected plants in each plots were tagged to arrive mean values. After the final harvest, composite soil sample at 0-20 cm depth were collected from each plot and analysed for organic carbon, available nitrogen, available phosphorous and available potassium as per standard procedures suited for the experimental soil. Monetary returns were computed using price of inputs and outputs as per prevailing market rates.

RESULTS AND DISCUSSION

Growth parameters significantly influenced by various levels of phosphorous (Table 1). The plant height at 45 days after transplanting (DATP) and at final picking significantly increased up to 50 kg P_2O_5 /ha over control and lower levels. An application of 50 kg P_2O_5 /ha significantly advanced days to first picking over control and lower levels of phosphorous, but last picking advanced only up to 25 kg application of P_2O_5 over control and at par with higher levels. These results corroborate the finding of Tisdal *et al*. (1995) and Armstrong (1999). Application of 75 kg P_2O_5/ha significantly increased number of picking over lower levels of phosphorus and control. Among different phosphorus levels, application of 50 kg P_2O_5/ha significantly increased number of fruits per plant and average weight of fruit over control and lower level, but statistically at par with higher levels. Significantly higher fruit yield per plant and fruit yield per ha were recorded with 75 kg P_2O_5/ha over control

and lower phosphorous level. Lima *at al.* (2014) and Sutaliya (2017) reported positive fruit yield per plant response to phosphorous application in brinjal. On an average, application of 25, 50 and 75 kg P_2O_5/ha increased tomato fruit yield by 43.7, 69 and 78 per cent, respectively, over control. This might be due to better reproduction performance with phosphorous application. Chauhan *et al.* (2007) also reported positive fruit yield response yield response to phosphorous application.

Plant height at 45 days after transplanting and at final picking significantly increased with application of 50 kg K_2O/ha over control, but statistically at par with lower and upper levels of potassium. Bhuvaneswari *et al.* (2013) also reported higher plant height with potassium fertilization in chilli and Sutaliya (2017) in brinjal. The application of 25 kg K_2O/ha significantly increased number of fruits per plant over control, but statistically at par with higher levels. Average weight of fruit increased up to 50 kg K_2O/ha over control and lower levels. Fruit yield per plant and fruit yield per ha were influenced significantly with potassium fertilization. Potassium application up to 50 kg K_2O/ha significantly increased fruit yield per plant and fruit yield per ha over control and lower levels. The application of potassium up to 50 kg to tomato increased the fruit yield by 5.5 and 21.3 per cent over 25 kg K_2O/ha and control, respectively. Corroborative findings were also reported by Akhtar *et al.* (2010) and Akand *et al.* (2016).

The data of soil health status after harvesting of tomato crop are presented in Table 2. The higher available nitrogen and organic carbon was observed with control of phosphorous and potassium. The available P_2O_5 in soil increased with increasing levels of phosphorous from 25 kg to 75 kg P_2O_5/ha. This was due to addition of phosphorous through fertilizer. The available K_2O content in soil was higher under control of phosphorous. The available P_2O_5 content in soil was higher under control of potassium. The available K_2O in soil increased with increasing level of potassium from 25 to 75 kg K_2O/ha. This was due to addition of potassium through fertilizer. Among the different phosphorous and potassium levels, application of 75 kg P_2O_5 and 75 kg K_2O/ha were found more economical as reflected in terms of gross returns, net returns and benefit : cost ratio (Table: 2). The higher returns from application of 75 kg P_2O_5 and 75 kg K_2O/ha could be attributed to its higher fruit yields.

CONCLUCTION

On the basis of experimentation, it could be concluded that application of 75 kg $P_2O_5$and 50 kg K_2O/ha along with 150 kg N/ha (recommended dose) is more effective, as it produced higher fruit yield of tomato crop through increased number of fruits per plant, average weight of fruit and fruit yield per plant and it is also improve available P_2O_5 and K_2O in soil after crop harvest.

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Table 1: Effects of phosphorous and potassium on, growth, yield attributes and yield of tomato (pooled data of 4 years)

Treatments	Plant Height (cm) at 45 DATP	Plant Height at Final picking(cm)	Days to First Picking	Days to Last Picking	Number of Picking	Number of Fruits Per Plant	Average Weight of Fruit (g)	Fruit Yield Per Plant (g)	Fruit Yield (q/ha)
P_2O_5 levels kg/ha									
0	85.6	112.6	65.2	142.6	10.1	21.9	44.6	975	120.3
25	95.0	136.6	59.7	137.2	11.4	27.1	51.7	1401	172.9
50	102.2	146.3	57.5	135.3	12.0	30.3	54.7	1647	203.3
75	105.3	150.2	56.6	134.2	12.6	31.3	55.8	1743	215.1
CD (0.05)	4.2	5.9	1.5	2.4	0.4	1.2	2.2	74	9.1
K_2O levels kg/ha									
0	92.8	134.1	60.2	136.4	12.6	25.4	48.4	1250	154.3
25	96.7	138.8	59.91	137.3	12.7	27.8	51.2	1437	177.4
50	98.3	140.7	59.3	137.7	12.5	28.5	52.9	1517	187.2
75	100.3	142.0	59.5	137.9	12.7	28.8	53.8	1561	192.7
CD (0.05)	4.2	5.9	NS	NS	NS	1.2	2.2	74	9.1

Table 2: Effects of phosphorous and potassium on soil health and economics of khariftomato (Pooled data of 4 years)

Treatments	Available n Nutrients (kg/ha)			Organic Carbon (%)	Gross Returns (×10^3 Rs/ha)	Net Returns (×10^3 Rs/ha)	Benefit: Cost Ratio
	N	P_2O_5	K_2O				
P_2O_5 levels kg/ha							
0	155	30.8	299.6	0.23	84.21	47.81	1.31
25	146	32.9	291.2	0.23	121.03	81.63	2.07
50	141	34.2	285.8	0.22	142.31	100.67	2.42
75	140	35.3	279.8	0.22	150.57	107.63	2.51
CD (0.05)	6.8	105	12.3	NS	-	-	-
K_2O levels kg/ha							
0	149	34.6	276.0	0.23	108.01	70.35	1.87
25	145	33.5	285.3	0.22	124.18	84.98	2.17
50	144	32.8	293.5	0.22	131.04	90.91	2.26
75	143	32.3	301.6	0.22	134.89	94.06	2.30
CD (0.05)	NS	1.5	12.3	NS	-	-	-

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