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Effect of diffferent levels of NPK and foliar application of enriched humic substances on growth and yield of tomato

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ABSTRACT

A field experiment was conducted in a silty clay loam soil (Typic haplustalf) to study the response of tomato to different levels of NPK and foliar fertilization of enriched humic substances. The experiment was carried out in split plot design. The treatments consisted of three levels of NPK (75%, 100%, 125% of recommended dose of NPK) and eleven sub treatments which includes S_0-control, S_1-Humic acid (HA) 0.2%, S_2-Polycarboxylic acid (PCA) 0.2 %, S_3- Naphthalene acetic acid (NAA) 50 ppm, S_4- Micro nutrient mixture, S_5- HA + NAA, S_6- PCA + NAA, S_7- NAA+NM, S_8- HA+NM, S_9 PCA+NM, S_{10}-HA+NM +NAA (enriched HA), S_{11}-PCA +NM+ +NAA (Enriched PCA). The sub treatments were applied through foliar application. Tomato var-S- 22 was grown as test crop. The observation on growth, yield, yield attributes were recorded and the soil samples collected were analysed for available N, P and K. The results revealed that foliar application of micronutrients and NAA enriched PCA to the plants supplied with 125% NPK recorded the highest fruit yield, at the same level without causing any nutrient depletion in post harvest soil. Though foliar application of enriched PCA to the plants supplied with 100% NPK improved the yield at par with treatment receiving 125% NPK and enriched PCA foliar spray, the depletion of NPK in post harvest soil is noticed. Therefore it is concluded that increased dose of 25% NPK is required when foliar application of growth stimulants are applied to tomato so as to compensate the increased nutrient removal.

Key words : NPK, Tomato, Falian fertilization.

INTRODUCTION

Tomato (*Lycopersicon esculentum* .Mill) is one of the most important vegetable crop cultivated allover the world. It responds well to fertilizer application and foliar spray of growth stimulants. It requires heavy dose of inorganic fertilizer to maximize the production. Humic substances (Humic acid and Polycorboxylic acid), an elixir to plants, have long been known to scientist on account of its influence on nutrient availability in soil and growth promoting effects on crops. The recent scientific investigation revealed that low molecular weight humic substances are directly taken up by plants and influence the plant metabolism. (Schinitzier and Khan, 1972). In the present study an attempt was made to find out the influence of foliar application of two humic substances viz, humic acid and polycorboxylic acids extracted from lignite and enriched with NAA and micronutrients on the growth and yield of tomato grown under different levels of NPK in a silty clay loam soil.

MATERIALS AND METHOD

A field experiment was carried out in silty clay loam soil having pH 7. 34, EC 0.92 dsm^{-1}, organic carbon 4.7 g kg^{-1}, available NPK of 196, 80, 420 kg/ha^{-1} respectively. The experiment was carried out in split plot design with three replications. The treatments consisted of three main treatments M_1- 75% recommended dose(R .D) of NPK, M_2-100% R.D of NPK, M_3-125% R.D of NPK, eleven sub treatments.The sub treatments were applied through foliar spray which includes S_0 –control, S_1- Humic acid 0.2%, S_2 Polycarboxylic acid (PCA) 0.2 %, S_3- NAA 50 ppm, S_4-Micro nutrient mixture, S_5-HA + NAA, S_6- PCA + NAA, S_7 - NAA+NM, S_8-HA+NM, S_9 - PCA+NM, S_{10}-HA+NM +NAA (enriched HA), S_{11}-PCA +NM+ NAA (Enriched PCA). Tomato var-S22 was grown as test crop. The required quantity of N, P_2O_5 and K_2O were apllied through urea, super phosphate, muriate of potash respectively. Humic acids were extracted from lignite by differential solubility technique in alkali and acid. The polycorboxylic acids were prepared by treating lignite with 11N HNO_3. The micro nutrient mixture are prepared by mixing $ZnSO_4$ 0.1%, $FeSO_4$ 0.1%, $MnSO_4$ 0.1%, $CuSO_4$ 0.05%, H_3BO_3 0.05% and $NH_4(MoO_4)_2$ 0.01% foliar spray were given on 30^{th} and 50^{th} days of transplanting. Growth and yield parameters and yield of tomato were recorded. The post harvest soil samples collected were analyzed for available N, P and K. (Jackson, 1975).

RESULTS AND DISCUSSION

In the present study, a field experiment was conducted with three levels of NPK (75% NPK, 100% NPK and 125% NPK), and eleven foliar spray treatments. The humic substances, NAA and micronutrients are applied through foliage both individually and in combination. Application of graded level of NPK gradually increased the growth and yield parameters of tomato. Foliar application of enriched humic substances to NPK applied plants more favourably improved the growth and yield of tomato. The results of the experiment clearly revealed that when no foliar spray was given, the crops responded well even for higher dose of NPK (125% recommended dose). But the same level of response is obtained at 100% NPK when foliar sprays of enriched humic substances were applied. The foliar application of enriched humic substances to 100% NPK applied treatments also produced a comparable fruit yield with 125% NPK, but post harvest nutrient status was considerably reduced. Similar observation was again clearly observed in the treatment receiving 75% NPK with enriched

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Table 1 : Effect of different levels of NPK and foliar application of enriched humic substances on plant height (cm) of tomato (45 and 60 DAT).

	45 DAT				60 DAT			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_0	30.2	33.9	35.6	33.2	51.6	52.9	60.9	55.1
S_1	41.6	41.3	41.7	41.5	52.2	56.9	62.8	57.3
S_2	42.7	45.1	45.2	44.3	48.7	58.0	57.3	54.6
S_3	35.5	36.7	40.7	37.6	52.5	53.9	64.3	56.9
S_4	32.2	33.8	42.2	36.0	55.4	57.1	67.0	59.8
S_5	34.3	44.9	47.1	42.1	52.7	52.0	63.2	55.9
S_6	43.3	44.2	44.8	44.1	51.7	57.3	65.9	58.3
S_7	48.7	52.2	51.4	50.7	62.8	66.3	67.2	65.4
S_8	37.6	42.4	42.5	40.8	52.4	54.8	65.6	57.6
S_9	45.7	50.3	52.3	49.4	63.6	68.7	66.0	66.1
S_{10}	49.5	52.5	55.3	52.4	61.2	67.5	73.1	67.2
S_{11}	51.3	53.9	56.0	53.7	64.4	68.8	74.7	69.3
Mean	41.0	44.2	46.2		55.8	59.5	65.7	

	S Ed	CD(p=0.05)	S Ed	CD (p=0.05)
Main	0.69	1.39	0.84	1.69
Sub	1.21	2.39	1.46	2.89
M x S	2.12	4.21	2.57	5.09
S X M	2.09	4.15	2.53	5.02

Table 2 : Effect of different levels of NPK and foliar application of enriched humic substances on number of flowers plant^{-1} and number of fruits plant^{-1}.

	Number of flowers plant^{-1}				Number of fruits plant^{-1}			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_0	15.3	18.5	20.5	18.1	8.0	11.2	12.5	10.5
S_1	16.0	22.2	24.1	20.7	8.5	11.5	13.1	11.0
S_2	16.9	23.9	25.9	22.2	8.9	12.0	14.5	11.8
S_3	16.9	24.9	26.9	22.9	8.8	11.3	13.5	11.2
S_4	15.9	22.6	24.7	21.0	8.5	11.3	13.4	11.0
S_5	15.1	22.3	24.3	20.5	8.7	11.1	13.3	11.0
S_6	15.2	22.2	24.5	20.6	8.8	11.1	13.2	11.0
S_7	18.2	25.7	28.0	23.9	9.7	13.9	14.7	12.7
S_8	17.6	23.9	25.9	22.4	9.3	13.3	15.3	12.6
S_9	17.8	26.8	27.0	23.8	9.5	13.5	15.4	12.8
S_{10}	20.1	27.0	28.5	25.2	9.7	13.8	15.7	13.0
S_{11}	20.5	27.5	29.5	25.8	10.0	14.3	16.0	13.4
Mean	17.1	23.9	25.8		9.0	12.3	14.2	

	S Ed	CD(p=0.05)	S Ed	CD (p=0.05)
Main	0.10	0.21	0.09	0.18
Sub	0.32	0.64	0.15	0.31
M x S	0.55	1.12	0.27	0.55
S X M	0.56	1.12	0.27	0.55

Table 3 : Effect of different levels of NPK and foliar application of enriched humic substances on fruit set percentage of tomato.

	Fruit set percentage of tomato				Fruit volume of tomato			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mea
S_0	53.5	60.1	65.1	59.5	39.0	45.0	47.9	43.9
S_1	63.4	66.3	67.1	65.6	43.0	49.5	48.0	46.8
S_2	65.6	67.5	69.7	67.6	46.9	52.0	50.4	49.7
S_3	66.9	67.8	68.9	67.8	42.6	50.1	52.6	48.4
S_4	62.1	63.5	65.1	63.6	40.9	49.0	52.6	47.5
S_5	56.7	64.0	66.8	62.5	40.3	50.3	50.1	46.9
S_6	57.8	67.0	69.4	64.7	41.6	49.0	49.0	46.5
S_7	69.7	74.5	76.8	73.6	51.6	51.3	52.2	51.7
S_8	64.8	69.7	73.4	69.3	47.8	52.0	53.8	51.2
S_9	66.9	73.5	75.9	72.1	51.9	50.9	51.9	51.5
S_{10}	76.5	76.8	76.8	76.7	50.0	52.1	52.1	51.4
S_{11}	76.6	77.8	78.5	77.6	52.9	52.9	54.1	53.3
Mean	65.04	69.0	71.0		45.7	50.3	51.2	

	S Ed	CD(p=0.05)	S Ed	CD (p=0.05)
Main	0.28	0.57	0.78	1.57
Sub	0.40	0.79	1.57	3.12
M x S	0.72	1.43	2.73	5.41
S X M	0.69	1.37	2.73	5.40

Table 4 : Effect of different levels of NPK and foliar application of enriched humic substances on single fruit weight and fruit yeld of tomato.

	Fruit weight (g $fruit^{-1}$)				Fruit yield (t ha^{-1})			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_0	38.0	42.0	45.0	41.6	21.2	23.4	36.9	27.2
S_1	42.9	50.1	50.6	47.8	23.7	24.6	32.8	27.0
S_2	45.9	51.2	51.2	49.4	24.4	25.3	23.7	24.4
S_3	43.6	49.5	52.1	48.4	24.0	26.2	25.3	25.1
S_4	41.9	45.7	47.7	45.1	26.1	25.7	25.5	25.8
S_5	40.1	48.5	48.5	45.7	27.2	26.0	26.8	26.7
S_6	40.9	49.5	50.9	47.1	27.7	27.3	26.3	27.1
S_7	50.1	51.7	52.9	51.5	30.5	29.4	26.3	28.7
S_8	46.7	50.2	51.3	49.4	32.1	33.6	28.0	31.2
S_9	50.0	50.1	51.7	50.6	32.6	35.9	30.5	33.0
S_{10}	50.9	51.9	52.9	51.9	33.5	36.9	33.7	34.7
S_{11}	52.0	53.9	54.1	53.3	34.8	36.9	35.7	35.8
Mean	45.3	49.5	50.7		28.1	29.3	29.3	

	S Ed	CD(p=0.05)	S Ed	CD (p=0.05)
Main	0.26	0.52	0.36	1.01
Sub	0.52	0.96	0.89	1.77
M x S	0.91	1.80	1.55	3.07
S X M	0.91	1.80	1.52	3.09

Table 5 : Effect of different levels of NPK and foliar application of enriched humic substances on available N status of post harvest soil.

	N status of post harvest soil (mg kg^{-1})			
	M_1	M_2	M_3	Mean
S_0	85.0	92.5	97.5	91.6
S_1	82.5	92.0	96.3	90.2
S_2	81.9	91.4	96.6	89.9
S_3	83.2	91.9	97.1	90.7
S_4	84.5	92.3	98.3	91.7
S_5	84.8	92.1	97.2	91.3
S_6	84.4	92.8	96.9	91.3
S_7	81.6	91.0	93.4	88.6
S_8	82.9	91.3	95.4	89.9
S_9	82.8	91.8	92.9	89.1
S_{10}	82.6	90.2	93.7	88.8
S_{11}	82.9	91.5	94.3	89.5
Mean	83.2	91.7	95.8	

	S Ed	CD(p=0.05)
Main	1.18	2.38
Sub	2.36	NS
M x S	4.09	NS
S X M	4.08	NS

PCA foliar sppray. Result of the experiment proved the importance of NPK in influencing the yield and quality of tomato. Similar observations were made by Pandey et al., (1998) and Baskar and Saravanan. (1998). In the present study, irrespective of level of NPK, foliar application of humic substances enhanced the yield of tomato. It is more vivid that humic substances application to crops promotes the proliferation of roots and root hair formation (Aso and Mariyama., 1979; Aso and Yamaguchi, 1971; Fortun and Lopez Fando, 1982; Kumazawa, 1984 and Moriyama,1982) this would have helped in more adsorption of nutrients resulted in high content of elements in tomato plants supplied with humic substances through foliar spray.

In present study, the humic substances were applied both individually and in combination with micro nutrient mixture. Mortenson (1963) reported that the formation of humic acid complexes with trace elements. Formation of soluble humic acid application complexes with Fe, Zn, Mn and Cu would have promoted mobilization of these nutrients in to plant systems resulting in the better yield and quality of crops. Further the low molecular weight humic substances reported to be directly adsorbed by plants when it is applied to plants and behaves like a growth promotor (Flaig, 1984; Vaughan and Malcolm, 1985) it has been speculated that an increase in the yield of tomato might be due to an increased nutrient uptake from soil, effective utilization of foliar applied nutrients, promotion of photosynthesis and respiration contributed by the proteins and quinine groups respectively of the accumulated humic substances and also

Table 6 : Effect of different levels of NPK and foliar application of enriched humic substances on single fruit weight of tomato and available P and K status of post harvest soil.

	P status of post harvest soil (mg kg^{-1})				K status of post harvest soil (mg kg^{-1})			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_0	7.8	8.8	10.3	8.9	196.0	205.4	208.2	203.2
S_1	6.8	8.0	8.7	7.8	194.0	204.3	206.8	201.7
S_2	6.3	7.3	8.2	7.3	193.3	204.8	206.0	201.3
S_3	6.7	6.8	8.6	7.4	193.5	203.5	205.4	200.8
S_4	7.0	8.6	9.3	8.3	194.6	203.7	205.5	201.3
S_5	7.2	6.9	9.3	7.8	195.3	204.2	207.7	202.4
S_6	6.9	6.8	9.4	7.7	195.8	203.8	207.3	202.3
S_7	5.5	8.5	8.7	7.5	191.1	197.8	201.5	196.8
S_8	6.1	6.8	8.1	7.0	192.9	203.8	204.7	200.4
S_9	5.6	6.4	8.4	6.8	193.4	202.5	203.9	199.9
S_{10}	5.4	8.4	8.8	7.5	193.4	195.8	204.0	197.7
S_{11}	5.3	8.4	8.6	7.4	191.0	196.0	201.1	196.0
Mean	6.4	7.6	8.8		193.7	202.1	205.2	

	S Ed	CD(p=0.05)	S Ed	CD (p=0.05)
Main	0.09	0.18	2.56	5.15
Sub	0.20	0.40	3.83	NS
M x S	0.35	0.69	6.85	NS
S X M	0.35	0.69	6.64	NS

the influence of humic acid on cell divisition and cell elongation. (Mato, *et al*).

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