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EFFECT OF SPECIALTY FERTILIZERS ON GROWTH AND YIELD OF TOMATO (*SOLANUM LYCOPERSICUM* L.)

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Abstract

Research had been carried out by soil application of specialty fertilizers during *kharif* 2011 and *rabi* 2012, to know the effect of specialty fertilizers influenced on growth, yield and yield attributing characters of tomato. The results showed that significant effect on maximum plant height, higher number of branches, maximum number of fruits per plant, maximum fruits yield per plant, maximum fruits yield per plot and estimated fruit yield per hectare were recorded by the application of OSV-5 and OSV-4 containing 60 kg ha^{-1} and 75 kg ha^{-1} with 60 kg ha^{-1} each organic carbon respectively, along with the recommended dose of fertilizers N, P and K 250 kg ha^{-1} each with 25 t ha^{-1} of farm yard manure.

Key words : Specialty fertilizers, silicon, organic carbon, N, P and K.

Introduction

Tomato (*Solanum lycopersicum* L.) belongs to family solanaceae and it is world's largest grown vegetable crop after potato and onion. In the world, the estimated area under tomato cultivation is 4.50 m ha with a production of 150.50 mt and productivity of 32.80 t ha^{-1}. In India, tomato is grown in an area of 0.87 m ha with a production of 16.83 mt and the productivity being 19.50 t ha^{-1} (Anonymous, 2011). There is a wide gap between world and Indian productivity; to overcome this gap may specialty fertilizers play a vital role in rose the Indian tomato productivity due to specialty fertilizers are ideal, highly water soluble, crop specific fertilizers containing primary, secondary and micro nutrients along with beneficial elements resulting low salt index. Specialty fertilizers are made with well balanced nutrients proportions, which meet the exact nutrients required by the plants. Specialty fertilizers are successfully used in vegetable crops with well developed root system, soil application of specialty fertilizers effect on rapid improvement of plant nutrition. They are known to increase the uptake of nutrients from the soil, applied fertilizers input by avoiding losses through leaching and runoff. The specialty fertilizers may considered as a source of nutrients after plant growth regulators, pesticides and herbicides to achieve crop productivity (Anonymous, 2012). The specialty fertilizers have a great contribution to modifying and controlling the growth behavior of tomato crop. Therefore, they become one of the most important inputs for horticulturist to boost up vegetable production and productivity. Hence, the study had been conducted to know the influence of specialty fertilizers on growth and yield of tomato.

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Materials and Methods

The study carried out during *kharif* and *rabi* seasons of 2011-12 at College of Horticulture, Kolar (Karnataka), India. The experiment laid as per randomized complete block design (RCBD) with 13 treatments (tables 1 and 2) in three replications using F_1 hybrid US-3140. The treatment details are namely. $\mathbf{T_1}$-Recommended dose of fertilizers (RDF), RDF contains 250 kg ha^{-1} each N P K with 25 t ha^{-1} farm yard manure. $\mathbf{T_2}$- RDF P through OPV-1, OPV-1 contains 18% N, 38% P and 3% organic carbon (OC). $\mathbf{T_3}$- RDF P as OPV-2, OPV-2 contains 18% N, 38% P and 6% OC, $\mathbf{T_4}$- RDF P as OPV-3, OPV-3 contains 18% N, 38% P and 6% OC. $\mathbf{T_5}$-RDF along with 750 kg OSV-1 ha^{-1}, OSV-1 contains 22% Si and 8% OC. $\mathbf{T_6}$-RDF along with 750 kg OSV-2 ha^{-1}, OSV-2 contains 35% Si and 8% OC. $\mathbf{T_7}$-RDF along with

750 kg OSV-3 ha^{-1}, OSV-3 contains 20% Si and 8% OC, **T_8**-RDF along with 750 kg OSV-4 ha^{-1}, OSV-4 contains 10% Si and 8% TC. **T_9**-RDF along with 750 kg OSV-5 ha^{-1}, OSV-5 contains 8% Si and 8% OC. **T_{10}**-RDF N as through UVM-1 (381 kg ha^{-1}), UVM-1 contains 40% N, 2% zinc sulphate, 0.75% copper sulphate, 0.25% manganese sulphate and 2.4% Si with 1.1% K_2O, **T_{11}**- RDF N as through OUV-3, OUV-3 contains 41% N, **T_{12}**- RDF N as through OUV-9, OUV-9 contains 45% N, 0.14% zinc sulphate, 0.023% copper sulphate, 0.012% manganese sulphate and 0.12% Si with 0.06% K_2O and **T_{13}**-Absolute control without any manure and fertilizers treatment. The treatments received a common basal dose of 50% N as urea and full dose of P as di ammonium phosphate and K as murate of potash at the time of transplanting and remaining 50% N top dressed at 30 days after transplanting (DAT) and FYM at the rate of 25 t ha^{-1} applied 15 days in advance of transplanting. One month old seedlings were transplanted in plots of 3 m × 3.6 m size at a spacing of 90 cm × 60 cm. Recommended package of practice by UAS Bangalore (Anonymous, 2008) were followed to raise the crop under drip irrigation. The mean data were subjected to statistical analysis. The study was undertaken with F_1 hybrid US-3140 popular among farmer of Kolar district, which is high yielding, resistant to heat and leaf curl virus.

Results and Discussion

The data presented in table 1 revealed that the application of OSV-5 at 750 kg ha^{-1} [containing 60 kg Si and 60 kg organic carbon (OC)] along with RDF (recommended dose of fertilizers) recorded the maximum plant height (104.13 cm and 103.07 cm) as well as number of branches (24.85 and 23.20) in both *kharif* 2011 and *rabi* 2012 seasons (**T_9**), closely followed by OSV-4 at 750 kg ha^{-1} (75 kg Si and 60 kg OC) along with RDF (**T_8**). Decreased in occurrence of diseases with application of silicon fertilizer resulting in increased the plant height and growth of tomato plants (Liu, 1997). Similarly in potato the increased growth with silicon fertilizers was reported by Luz *et al*. (2008) and also reported the increased plant growth in rose with application of silica in salt stress condition (Saeed *et al*., 2009).

Plants receiving OPV-3 at 658 kg ha^{-1}, which is equivalent to P in RDF containing OC at 30 kg ha^{-1} (**T_4**) recorded the highest chlorophyll-b and total chlorophyll content (table 1), whereas the plants which received OSV-1 at 750 kg ha^{-1} (165 kg Si and 60 kg OC) along with RDF (**T_5**) recorded the maximum chlorophyll-b content in both *kharif* and *rabi* seasons. Similar results were observed by Liu (1997) with the application of silicon fertilizers increased the chlorophyll content in leaves of tomato plants. Similar results in tomato were also reported by Emrich *et al.* (2011).

On perusal of the data obtained in the present investigation revealed that in general, the treatment containing organic carbon (60 kg ha^{-1}) and silicon (60-75 kg ha^{-1}) have recorded better growth (table 1). The increase in growth parameter due to the stimulation of growth by silicon could be either indirect, owing to the protective effects of silicon against pathogens or direct as it impacts both morphological changes and physiological processes in plants. It seems that it is involved directly or indirectly in cell metabolism, though in most cases the mode of action is still unclear (Liang *et al*., 1993). Adatia and Besford (1986) and Seung *et al*. (2005) reported the increased plant height with the application of silica as salicylic acid in cucumber plant. Similar findings were also reported by Elawad *et al*. (1982), Savant *et al*. (1999) and Yoshida (1975) in zinnia. The addition of organic carbon to soil has an important role in enhancing crop production (Geo Jose, 2006; Post and Kwon, 2000), through its influence on the soil physical, chemical and biological properties (Katyal, 2000).

The maximum number of fruits per plant (94.24 and 79.85), the maximum fruit yield per plant (3.90 kg and 3.47 kg), the maximum fruit yield per plot (66.08 kg and 53.74 kg) and the maximum estimated fruit yield per hectare (61.19 kg ha^{-1} and 49.76 kg ha^{-1}) in both *kharif* and *rabi* seasons was recorded with the application of OSV-5 (**T_9**), closely followed by OSV-4 (**T_8**). The maximum average fruit weight (41.83 g *kharif* and 44.50 g *rabi* seasons) recorded with the application of OSV-2 (262.5 kg Si with 60 kg OC) and OSV-1 (165 kg Si with 60 kg) **T_5** and **T_6** in *kharif* and *rabi* seasons, respectively (table 2).

The treatment containing silicon (60 kg ha^{-1}) and organic carbon (60 kg ha^{-1}) influenced the increase in yield and yield attributing parameters significantly. Although, silicon is considered not as an essential element, positive effect has been reported in case of increase in yield, enhanced pollination and most commonly increased disease resistance has been very well documented in melons (Gilman *et al*., 2003). Similarly, Tesfagiorgis *et al*. (2008) reported that increased plant yield with the application silicon fertilizer results in maximum growth in Zucchini and Zinnia by decreasing the disease incidence. Similarly, the results of the present study has also found similar with the findings of Adatia and Besford (1986) in cucumber. Aziz *et al*. (2001) reported that increased

Table 1 : Effect of soil application of specialty fertilizers on growth attributes of F_1 tomato hybrid US-3140.

Treatments	Plant height (cm)		Branches plant^{-1}		Chlorophyll–a mg g^{-1}		Chlorophyll–b mg g^{-1}		Total chlorophyll	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1-RDF (NPK 250 kg + 25 t FYM ha^{-1})	92.87	99.00	17.08	19.27	0.71	0.59	0.44	0.44	1.32	1.01
T_2- P as OPV-1 (658 kg ha^{-1}) in RDF	96.00	93.47	17.48	19.77	0.99	0.94	0.70	0.63	1.66	1.56
T_3- P as OPV-2 (658 kg ha^{-1}) in RDF	97.47	95.20	18.95	21.27	1.42	1.45	1.47	1.40	2.54	2.43
T_4- P as OPV-3 (658 kg ha^{-1}) in RDF	98.80	95.47	19.55	22.67	1.53	1.59	1.37	1.37	2.66	2.55
T_5-RDF + 750 kg OSV-1 ha^{-1}	99.07	99.17	22.55	21.73	1.15	1.10	1.57	1.51	2.18	2.08
T_6-RDF + 750 kg OSV-2 ha^{-1}	100.80	99.47	23.55	22.47	1.06	0.90	1.52	1.48	2.04	1.83
T_7-RDF + 750 kg OSV-3 ha^{-1}	98.40	97.33	23.35	21.80	1.04	0.99	1.57	1.50	2.03	1.66
T_8-RDF + 750 kg OSV-4 ha^{-1}	102.60	102.10	24.55	24.33	0.97	0.93	1.20	1.17	1.81	1.67
T_9-RDF + 750 kg OSV-5 ha^{-1}	104.13	103.07	24.85	23.20	0.97	0.92	1.14	1.07	1.78	1.71
T_{10}-N as UVM-1(381 kg ha^{-1}) in RDF	98.67	97.13	19.55	19.67	0.84	0.79	1.12	1.05	1.59	1.48
T_{11}- N as OUV-3 (372 kg ha^{-1}) in RDF	100.33	101.50	23.55	23.23	0.86	0.81	1.13	1.07	1.63	1.52
T_{12}- N as OUV-9 (338 kg ha^{-1}) in RDF	103.17	103.20	24.08	23.13	0.87	0.83	1.24	1.17	1.68	1.64
T_{13}-Absolute control	82.13	81.13	9.75	10.40	0.34	0.44	0.66	0.59	0.74	0.70
S. Em ±	**0.58**	**0.54**	**0.25**	**0.55**	**0.01**	**0.03**	**0.03**	**0.02**	**0.08**	**0.07**
CD @ 5%	**1.69**	**1.58**	**0.73**	**1.61**	**0.03**	**0.09**	**0.08**	**0.07**	**0.24**	**0.21**
CV%	**1.02**	**0.96**	**2.10**	**4.57**	**5.38**	**1.63**	**3.75**	**3.28**	**7.57**	**7.86**

Table 2 : Effect of soil application of specialty fertilizers on yield and yield attributes of F_1 tomato hybrid US-3140.

Treatments	Fruits plant^{-1}		Average fruit weight (g)		Yield plant^{-1}		Yield plot^{-1}		Yield ha^{-1}	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T_1-RDF (NPK 250 kg + 25 t FYM ha^{-1})	70.53	66.22	33.03	31.15	2.33	2.06	35.92	29.58	33.26	27.39
T_2- P as OPV-1 (658 kg ha^{-1}) in RDF	83.20	77.95	33.55	32.38	2.79	2.52	45.15	33.81	41.80	31.31
T_3- P as OPV-2 (658 kg ha^{-1}) in RDF	86.73	77.73	39.76	31.08	2.58	2.48	40.62	34.63	37.61	32.06
T_4- P as OPV-3 (658 kg ha^{-1}) in RDF	87.70	78.43	35.95	38.11	3.15	2.99	52.04	43.71	48.18	40.48
T_5-RDF + 750 kg OSV-1 ha^{-1}	85.03	70.03	38.98	44.50	3.31	3.11	55.28	46.62	51.18	43.16
T_6-RDF + 750 kg OSV-2 ha^{-1}	88.13	72.75	41.83	42.43	3.69	3.09	62.73	45.73	58.08	42.35
T_7-RDF + 750 kg OSV-3 ha^{-1}	87.67	77.83	35.01	39.20	3.07	3.05	50.39	47.69	46.65	44.15
T_8-RDF + 750 kg OSV-4 ha^{-1}	92.30	78.95	40.47	43.16	3.73	3.40	63.66	52.66	58.94	48.76
T_9-RDF + 750 kg OSV-5 ha^{-1}	94.24	79.85	41.44	43.97	3.90	3.47	66.08	53.74	61.19	49.76
T_{10}-N as UVM-1(381 kg ha^{-1}) in RDF	83.33	69.97	36.42	42.30	3.03	2.96	49.70	43.18	46.01	39.99
T_{11}- N as OUV-3 (372 kg ha^{-1}) in RDF	87.73	75.75	39.32	41.14	3.45	3.12	55.98	46.32	51.83	42.89
T_{12}- N as OUV-9 (338 kg ha^{-1}) in RDF	92.43	78.78	40.58	44.32	3.74	3.44	63.23	51.89	58.55	48.05
T_{13}-Absolute control	43.97	37.15	29.76	27.16	1.36	1.30	16.29	14.63	15.08	13.55
S. Em ±	**1.00**	**0.69**	**0.69**	**0.61**	**0.06**	**0.02**	**1.25**	**1.23**	**1.15**	**1.14**
CD @ 5%	**2.92**	**2.02**	**2.02**	**1.77**	**0.16**	**0.07**	**3.64**	**3.60**	**3.37**	**3.33**
CV %	**4.62**	**1.60**	**3.27**	**3.61**	**3.09**	**1.52**	**4.27**	**5.10**	**4.27**	**5.10**

pollen fertility in melon plants with the application of silica, resulting in more yield realization. The content organic matter is beneficial to maintain water nutrient relationships in soil which makes easy availability of nutrients to plants (Lal *et al*., 1999). Organic matter (OM contains 70% of OC) improves both the chemical and physical properties of soil, moisture holding capacity, diversity and activity of soil organisms and nutrients availability, which could increase the growth and yield (Anonymous, 2005).

Among the different treatment combination soil application of silicon (60 kg ha^{-1}) and organic carbon (60 kg ha^{-1}) along with normal recommended dose of fertilizers for hybrids recommended by UAS Bangalore package of practice of 250 kg ha^{-1} each N P K is found to be highly beneficial to increase in growth attributes like the maximum plant height, higher number of branches which in turn increased the maximum number of fruits, fruit yield per plant, fruit yield per plot and estimated fruit yield per hectare of tomato.

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