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Effect of NPK Fertilizers on Growth and Quality of Tomato (*Solanum lycopersicum* L.) Under Heavy Clay Soils of Patiala

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Abstract

Study was conducted at Khalsa College Farm during the year 2019. The experiment was laid out in Randomized Block Design and replicated four times. The treatment comprised T_1: control, T_2: 50% NPK, T_3: 75% NPK, T_4: 100% NPK, T_5: 125% NPK and T_6: 150 % NPK. Among different treatments, T_6: 150% NPK was found to be superior for growth characters like plant height (73.56 cm), plant spread (93.36 cm), leaf length (7.02 cm) and number of branches plant^{-1} (17.60) which was followed by T_5: 150% NPK. Maximum quality characters like TSS (6.63°Brix) ascorbic acid (26.45 mg 100 g^{-1}) and shelf life (12.85 days) were examined under T_5: 125% NPK which was followed by T_4: 100% NPK and T_6: 150% NPK. It is clear from the present study that more doses of fertilizers play positive effect on growth and quality of tomato.

Keywords: Fertilizers, growth, quality

1. Introduction

Tomato (*Solanum lycopersicum* L.) is one of the admired and most consumed vegetable in the world and ranks 2nd after potato in terms of area but 1st as a processing crop. Tomato crop is highly richest source of vitamin C 15 – 30 mg 100 g^{-1} and vitamin A 1667 IU 100 g^{-1} (Dhaliwal et al., 2003). The nutrients applied to crop has played very important role in tomato crop yield and quality. Nitrogen, Phosphorus and potassium are the well-known nutrients elements of tomato crop. The fertilizers applied to crops are very costly and especially in Punjab soils are very deficient of nutrients. The application of fertilizers to crop is very important for obtaining good yield. The application of nitrogen to tomato crop which is helpful for more cell division and cell elongation that would leads to more vegetative growth of plants. Similarly, the phosphorus is helpful root development and better utilization of nutrients by roots. Pollen grain formation is also influenced by phosphorus application. Potassium plays a significant role in the plant energy status for storage of assimilates and plant tissue water relationship and also it improves fruit quality (Sajid et al., 2013). For above mention particulars, the present study was designed to assess the "Effect of NPK fertilizers on growth and quality of Tomato (*Solanum lycopersicum* L.) crop under heavy clay soils of Punjab.

2. Materials and Methods

The field experiment was conducted at an experimental farm of G.S.S.D.G.S. Khalsa College Patiala at Campus for Advanced Research and Studies, Dhablan, Patiala during March-August 2019 located 31°-38´ N latitude and 74°-52´ E longitude with an elevation of 236 m MSL and represents the sub-tropical climate and humid zone of Punjab region in order to work effect of npk fertilizers on tomato crop. The soil of an experimental plot was clay loam in texture with pH 7.3, organic carbon (0.52%), available nitrogen (262.62 kg ha^{-1}), available phosphorus (22.32 kg ha^{-1}) and potassium (130.00 kg ha^{-1}). The experiment was laid in a randomized block design with four replications having 6 treatments comprising different doses of inorganic fertilizers viz. control (T_1), 50% NPK (T_2), 75% NPK (T_3), 100% NPK (T_4), 125% NPK (T_5), 150% NPK (T_6). Recommended doses of fertilizers (NPK 50:60:60 kg ha^{-1}). The source of nitrogen is urea, phosphorus is single super phosphate and potash source is MOP. The tomato (Hybrid Shiva) seedlings were transplanted at 75×45 cm^2 spacing on 23rd March 2019. After three month the fruits were picked and quality parameters were determined. TSS was determined by hand Refractrometer (ERMA, Made in Japan) with the scale of 0–32°Brix at ambient temperature. Juice was extracted from selected fruits. Drop of juice was placed on plate of Erma Hand Refractrometer and the reading was recorded and expressed in °Brix. Ascorbic acid was determined as per the methods suggested by Ranganna (1986) using 2,6-dichlorophenol indophenols dye to a colourless form by ascorbic acid in alkaline solution and

expressed as mg 100 g^{-1} of sample.

The economics of different cultural practices, input and returns for tomato variety Shiva under each treatment combination was worked out to find out the most effective and economical treatment. The data were analyzed as per the standard procedure for Analysis of Variance (ANOVA). The difference in the treatment mean was tested by using critical difference (CD) at 5% level of probability.

3. Results and Discussion

The data pertaining to fruit growth and quality of tomato fruit is presented in Table 1 and 2.

Table 1: Effect of NPK fertilizers on growth characteristics of tomato

Treatment	Plant height (cm)	Plant spread (cm)	No. of branches $plant^{-1}$	Leaf length (cm)	Leaf Breadth (cm)
T_1: Control	60.84	83.09	7.48	5.60	3.98
T_2: 50% NPK	64.23	86.27	10.16	5.82	4.10
T_3: 75% NPK	66.57	88.32	12.22	6.36	4.18
T_4: 100% NPK	69.37	90.24	15.06	6.57	4.38
T_5: 125% NPK	71.49	91.29	16.79	6.68	4.46
T_6: 150% NPK	73.56	93.36	17.60	7.02	4.59
CD (p=0.05)	1.71	2.19	1.72	0.42	0.19

*Recommended doses of fertilizers (NPK 50:60:60 kg ha^{-1})

Table 2: Effect of NPK fertilizers on quality characteristics of tomato

Treatment	TSS (Brix°)	Juici-ness (%)	Titratable Acidity (%)	Ascorbic Acid (mg 100 g^{-1})	Shelf life (days)
T_1: Control	5.59	19.43	0.89	22.24	7.85
T_2: 50% NPK	5.98	21.18	0.92	23.56	9.76
T_3: 75% NPK	6.07	24.66	1.03	24.05	10.80
T_4: 100% NPK	6.51	31.26	1.05	25.65	11.82
T_5: 125% NPK	6.63	30.85	1.03	26.45	12.85
T_6: 150% NPK	6.38	30.33	1.06	26.05	11.11
CD (p=0.05)	0.30	1.80	0.02	0.41	1.14

*Recommended doses of fertilizers (NPK 50:60:60 kg ha^{-1})

3.1. Growth characters

After 90 days of transplanting, chemical fertilizer treatment significantly improved plant height. The treatment T_6: 150% NPK exhibited highest plant height (73.56 cm) which was followed by T_5: 125% NPK (71.49 cm). Whereas, lowest plant height (60.84 cm) was recorded under control (T_1). The highest plant height was due to high doses of fertilizers promote growth especially nitrogen which is essential for cell division and cell enlargement. Phosphorus being a part of nucleoprotein and help in photosynthesis and cell division. These results are in agreement with the findings of Gill et al. (2018), Dhiman et al. (2018), Sultana et al. (2015) and Biswas et al. (2015).

Maximum plant spread was recorded with T_6: 150% NPK (93.36 cm) which was followed by T_5: 125% NPK (91.29 cm). Minimum plant spread was reported with T_1: Control (83.09 cm). Plant spread of tomato mainly depends on shoot length and number of leaves $plant^{-1}$. Inorganic fertilizers contain essential nutrients that associated with high photosynthesis activities that promote vegetative growth. More applied doses of fertilizers increased vegetative growth that means a greater number of leaves, branches $plant^{-1}$ and it gives more plant spread. The current findings are in accordance with Kanneh et al. (2017), Islam (2018) and Naik et al. (2002) who also reported that more doses of nitrogen, phosphorus and potassium plays a vital role in plant spread.

The maximum number of branches $plant^{-1}$ (17.60) was noticed with T_6 i.e.,150% NPK which was followed by T_5 i.e., 125% NPK (16.79). Minimum number of branches were recorded under T_1 i.e., Control (7.48). The number of branches $plant^{-1}$ is essential for getting maximum productivity. But sometimes, too many branches causing problem for fruit maturation because sun rays do not reach properly to fruit, but too a smaller number of branches will have negative effect on yield. So optimum number of branches has greater influence on flowering, fruit setting and yield of tomato (Haque et al., 2007). The highest level of fertilizers at initial growth phase could have encouraged a greater number of auxillary branches. Similar findings were also reported by Narayan et al. (2011) and Soumya et al. (2009).

Highest leaf length (7.02 cm) was found in 150% NPK (T_6) which was statistically at par with 125% NPK (T_5) (6.68 cm). The lowest leaf length (5.60 cm) was observed in treatment T_1 i.e., control as compare to other treatments. Maximum leaf breadth (4.59 cm) was noticed in T_6 i.e., 150% RDF. Tomato plant in all other fertilizers treatment showed significant increase in leaf breadth at compared to control. Minimum leaf breadth (3.98 cm) was reported in T_1 i.e., control which was significantly lowered from rest of treatments. The maximum leaf length and breadth is due to the reason that nitrogen expands tissue cells and it increases the leaf epidermal cells. Also, potassium activates the ATP enzyme which plays role in cell division and increase in leaf size. The present study result in line with a study conducted by Islam et al. (2018) and Akhtar et al. (2010).

3.2. Quality character

One of the quality characteristics of tomato is total soluble solids (TSS). Total soluble solid content is of considerable economics importance for the processing tomato industry. A small increase in TSS value can considerably boost the

product yield and decline the cost of dehydration of puree into sauce and paste. The maximum TSS content of tomato juice (6.63°Brix) was examined in the treatment i.e., 125% RDF which is statistically at par with 100% NPK (6.51°Brix) and 150% NPK (6.38°Brix). The lowest content (5.59°Brix) of TSS was found in control where no fertilizers are applied.

The results showed that total soluble solid content was significantly higher at high level of nitrogen, phosphorus and potassium but if NPK dose increases more concentration then the TSS of fruit started declining. An increase in potassium application raises sugar level of tomato fruit which in turn, may increase the TSS content of fruit. Plant grown at high nitrogen, phosphorus and potassium level will result high soluble solid content. The results are to some extent in agreement with Bilalis et al. (2018), Gill et al. (2018), Sanju et al. (2010), Balibera et al. (2006) and Zekri and Obreza (2003).

The highest shelf life (12.85 days) was recorded in T_5 i.e.,125% NPK which was statistically at par with T_4 i.e., 100% NPK (11.82 days). The lowest days for shelf life (7.85 days) was observed in T_1 i.e., control. Freshness of tomato is also related to consumer's preference according to size and color of fruit. Being a climacteric fruit, ripening of tomato fruit thus associated with release of ethylene gas. The water content and ethylene content play an important role in shelf life of tomato. More doses of fertilizers might have reduced the rate of respiration and transpiration resulting in reduced ethylene production during storage of tomato fruits, which ultimately increasing the shelf life. The present results are in close conformity with the findings of Rajya et al. (2015) and Chatterjee et al. (2013) who also stated that more doses of fertilizers also played a role in shelf life of tomato.

Increase in quality characters due to the availability of nutrient in excess amount to plants like ascorbic acid content highest under 125% NPK (26.45 mg 100 g^{-1}). Also, other attributes like titrate able acidity and juice percentage also observed under higher doses of fertilizers. Similar results were also obtained by Singh et al. (2010).

4. Conclusion

From current study we concluded that maximum doses of fertilizers showed best result for growth of tomato plant whereas, the quality of fruits started declining with more use of fertilizers. Therefore, treatment T_5: 125% NPK gave better quality of tomato fruits which was followed by 100% NPK. So, it is clear that recommended 100% NPK showed good result pertaining to quality of tomato.

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