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Effect of different levels of fertigation on the qualitative parameters of tomato (*Solanum lycopersicum* L.) grown under Polyhouse condition

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Abstract
A field experiment was conducted to study the effect of fertigation on the qualitative parameters of tomato (*Solanum lycopersicum* L.). The experiment was laid out with five replications and six treatments along with control in naturally ventilated Polyhouse with combinations of different doses of nitrogen, phosphorous and potassium. The different fertigation levels 100% RDF, 90% RDF, 80% RDF, 70% RDF and 60% RDF were tested during the course of experiment. Ascorbic acid (32.67 mg), Titratable acidity 0.47 (%) and TSS (5.10 ^{0}Brix) were increased with the application of 100% RDF. The maximum nitrogen content (199.97 kg), phosphorus content (24.78 kg) and potassium content (140.84 kg) were recorded in application of 100% RDF.

Keywords: Tomato, Fertigation, RDF, plant

Introduction
Tomato (*Solanum lycopersicum* L.) is most important vegetable crop grown throughout the world because of its wider adaptability, high yielding potential and stability for variety of uses in fresh as well as processed food industries. The red pigment (*Lycopene*) in tomato is now being considered as the world's most powerful natural antioxidant (Shankar *et al.,* 2013) [1]. Tomato is an important vegetable crop grown around the world and belongs to the family Solanaceae. It is considered an important source of vitamin A, C and minerals (Ughade *et al.*, 2016) [2]. Tomato has chromosome number of 2n=24. Tomato is grown annual or short lived perennial herbaceous plant. It has taproot Tomato can be grown in both winter and summer season in Punjab but, the extreme low and high temperature of semi-arid region of Punjab suffer with low fruit set and inferior fruit quality. Tomato grown under field conditions is exposed to abiotic and biotic stresses which affects productivity and quality of crop. Protected cultivation has the potential to reduce biotic and abiotic stresses. In northern India particularly at semi-arid region the summer season is from April to July and the rainy season is from July to October (Arumugam, 2010) [3].

Therefore, in the present scenario of perpetual demand for vegetables and drastically shrinking land holdings, protected cultivation of tomato vegetable crops suitable for domestic as well as export purposes is the best alternative for using land and other resources more efficiently (Sanwal *et al*., 2004) [4].

Another important component of protected cultivation, which influences productivity and quality of tomato fruit by application of fertilizers with the irrigation water called fertigation. Fertigation is the process of application of soluble fertilizer along with irrigation. Fertigation under drip irrigation is being used commonly for the application of Nitrogenous fertilizers in all fruits and vegetables. The practice of fertigation on a commercial scale probably started only in the mid of 20th century. Currently, fertigation is being practiced worldwide with Israel being the leading country. In India, commercial fertigation was started in early nineties and is yet to gain momentum. Fertigation optimizes the use of water and fertilizer enabling to harness high crop yield, simultaneously ensuring a healthy soil and environment.

In fertigation, nutrient use efficiency could be as high as 90 per cent compared to 40 to 60 per cent in conventional methods. The amount of fertilizer loss through leaching as low as 10 per cent in fertigation however, it is 50 per cent in the traditional system (Imamsaheb *et al*., 2011) [5].

Small applications of soluble nutrients saves labour, reduces compaction in the field, thereby enhancing productivity. Fertilizer requirement can be reduced by 15 to 25 per cent with fertigation through drip without affecting the yield. Controlled watering through drip and efficient nutrient management through fertigation, not only improves the production but quality as well due to better control over soil and water borne diseases (Gupta *et al*., 2014) [6]. Fertigation provides a variety of benefits to the users like high crop productivity and quality, resource use efficiency, environmental safety, flexibility in field operations, effective weed management and successful crop cultivation on fields with undulating topography (Godara *et al*., 2013) [7].

Materials and Methods

The present investigation was carried out at the Polyhouse located in the college campus, Mata Gujri College, Sri Fatehgarh Sahib, Punjab during *Rabi* season, 2016-17. The experimental material comprised of F_1 hybrid of tomato named Varuna NTH-2802 produced by Nuziveedu Seeds Pvt. Limited, Telangana. Observations were recorded on five competitive plants in each plot followed by observations on fruit quality parameters were recorded at various stages of crop growth and harvests on randomly selected five labelled plants in each plot and average was calculated. In Qualitative Parameters the ascorbic acid content in tomato under different treatments was determined by using 2-6 dichlorophenol indo phenol (dye) visual titration method as described by Ranganna (1986). Weigh 40 mg (0.04%) sodium 2-6 dichlorophenol indo phenol. Add 150 ml hot distilled water, then add 42 ml sodium bicarbonate. Cool the contents by adding 200 ml of water and keep in refrigerator. The five fully matured fruits are selected from each treatments and juice was extracted from fruits. The mean ten readings were averaged for in divided treatments. The ascorbic acid was determined by using following formula.

$$\text{Ascorbic acid (mg)} = \frac{\text{Dry factor} \times \text{Titre reading} \times \text{Volume made}}{\text{Weight of fruit taken} \times \text{Volume taken for estimation}} \times 100$$

Titratable acidity (%) Take 5-10 g sample. To this add a little amount of water and mix thoroughly. Now titrate the sample solution against 0.1 N NaOH using phenolphthalein as an indicator. Appearance of light pink colour denotes the end point. The value was expressed in percentage of titratable acidity in juice (AOAC, 1975). TSS (° Brix) the randomly selected tomato fruits crushed and the liquid extract obtained was used to record total soluble solid (° Brix) with the help of ERMA hand refractometer scale of 0-32 ° Brix ranges.

Result and Discussion

The analysis of variance revealed significant differences among the treatments for all the qualitative parameters. The results so obtained are presented as follows.

Ascorbic Acid (mg)

Significant differences were observed after analyzing (Table 1). The data among all the treatments on ascorbic acid. The maximum performance of different treatments showed that maximum ascorbic acid content (32.67 mg) was recorded in T_6 (100% RDF of NPK). This treatment (T_6) was statistically at par with T_5 (90% RDF of NPK) having value of 31.03 mg ascorbic acid whereas, minimum ascorbic acid content (14.74 mg) was recorded in T_1 (control).

Total Soluble Solids (° Brix)

Data recorded on total soluble solids (TSS) have been shown in (Table 1). An examination of the data showed that TSS was affected by all the treatments as values obtained were significant. Maximum TSS (5.10 ° Brix) was obtained in T_6 (100% RDF of NPK). This treatment (T_6) was statistically at par with T_5 (90% RDF of NPK) with the value of (5.06 ° Brix) total soluble solid. However, minimum total soluble solid (3.32 ° Brix) was recorded in T_1 (control).

Titratable Acidity (%)

The data pertaining to titratable acidity have been presented in Table 1. A perusal of the data revealed that there was significant effect of various treatments on titratable acidity. Maximum titratable acidity (0.47%) was obtained in T_6 (100% RDF of NPK). This treatment (T_6) was statistically at par with T_5 (90% RDF of NPK), T_4 (80% RDF of NPK) and T_3 (70% RDF of NPK) with the value of 0.46, 0.45 and 0.45 per cent titratable acidity, respectively. However, minimum titratable acidity (0.36%) was recorded in T_1 (control).

Table 1: Effect of different levels of fertigation on plant qualitative characteristics of F_1 hybrid tomato Varuna NTH-2802.

Treatment	Ascorbic acid (mg)	TSS (° Brix)	Titratable Acidity (%)
T_1: Control	14.74	3.32	0.36
T_2:60% RDF of NPK	22.22	4.16	0.41
T_3:70% RDF of NPK	24.60	4.86	0.45
T_4:80% RDF of NPK	28.54	4.89	0.45
T_5: 90% RDF of NPK	31.03	5.06	0.46
T_6:100% RDF of NPK	32.67	5.10	0.47
SE(m)±	0.57	0.16	1.23
$CD_{0.05}$	1.70	0.49	3.65
CV	5.03	8.38	2.41

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