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Effect of different levels of N, P and K on growth, yield and quality of tomato (*Lycopersicon esculentum*, Var. Arka Shrestha) under Kanpur agro-climatic condition

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Abstract
A field experiment entitled "Effect of different levels of N, P and K on growth, yield and quality of tomato *(Lycopersicon esculentum*, Var. Arka Shrestha) under Kanpur agro-climatic condition" was conducted at Horticulture field of Rama University, Kanpur, U.P., India during Feb to June 2022 to evaluate the effect of NPK and their combination on vegetative growth as well yield of Arka shrestha variety of tomato.

The experiment was laid out in RCBD considering 8 treatments and 3 replications. The variety of Arka shrestha was selected and combination of NPK were T_1 = N_{180} kg/ha +P_{100} kg/ha +K_{60} kg/ha, T_2 = N_{140} kg/ha +P_{50} kg/ha +K_{40} kg/ha, T_3 = N_{210} kg/ha +P_{110} kg/ha +K_{75} kg/ha, T_4 = N160kg/ha +P70kg/ha +K50kg/ha, T_5 = N170kg/ha +P80kg/ha +K55kg/ha, T_6 = N_{190}kg/ha +P_{90} kg/ha +K_{65} kg/ha, T_7 =N_{200} kg/ha +P_{100} kg/ha +K_{70} kg/ha and T_8 = N_{210} kg/ha +P_{110} kg/ha +K_{75} kg/ha.

On the basis of this experiment, it may be concluded that the application of NPK combination (N-210 kg + P-110 kg + K-75 kg per ha) increase the vegetative growth as well yield of tomato. In treatment T_8 the vegetative parameters like plant height, no of leaves, and length of leaves and number of braches shows positive response to the increasing rate of NPK combination. It has also the positive impact on the yield attributes of arka shrestha variety of tomato under the climatic condition of Kanpur. Therefore, it can be concluded that the increasing rate on NPK may increase the vegetative growth yield attributes as well the quality of fruits.

Is recommended to the tomato growers for the application of NPK combination for arka shrestha variety of tomato under which it gives better growth and yield is (N-210 kg + P-110 kg +K-75 kg per ha) for higher production of tomato under Kanpur condition.

Keywords: Tomato, growth, yield and quality

Introduction

Tomato (*Lycopersicon esculentum*) belongs to family Solanaceae having chromosome number (2n=24), it is a self-pollinated crop. Tomato is one of most popular and nutritious fruit vegetable widely grown around the world and second ranked after potato. Tomato has its origin in Peru. From its centre of origin, the tomato first moved to Mexico for domestication and cultivation. The tomato is grown in both open field and greenhouse conditions for commercial and house use.

It is a good source of Fe and vitamin A, B, and C. A. Edible portion of Tomato contain. Energy 18 kcal, protein 0.95 g, fat 0.11g, carbohydrate 4.01 g sugars total 2.49 g, Ca 11mg, Fe 0.68 mg, Mg 9 mg, P 28 mg, K 218 mg, Na 11 mg, Zn 0. 14 mg, Vitamin C 22.8 mg Thiamine 0.036 mg, Riboflavin 0.022 mg, Vitamin B-6 0.079 mg, Vitamin E 0.56 mg, Fatty acids, total saturated 0.015 g Fatty acids, total polyunsaturated 0.044 g per 100 g. Consumption of tomato and its products can significantly reduce the risk of developing of colon, rectal, and stomach cancer. Recent studies suggest that tomatoes contain the antioxidant lycopene, the most common form of carotenoid, which markedly reduces the Risk of prostate cancer. *(*Hasan *et al.* 2014*)* [4]

Tomato is rightly known as an industrial crop because of its outstanding processing qualities. Therefore, high content of juive, TSS, pulp, acidity and ascorbic acid (varies from 16-65 mg/100g) are very important constituents for making tomato juice, puree, paste, ketchup etc.

Tomato is an important protective food because of its high nutritional value and medicinal properties and is said to be an excellent purifier of blood (Aykroyd, 1963) and its soup is said to be an excellent remedy for patients suffering from constipation.

The ripened tomato fruits have anticancer properties of mouth, stimulates torpid liver and also useful in chronic dyspepsia (Nadkarni, 1976) [9].

It is grown over an area of 3.9 million hectares worldwide with an annual production of 120 million metric tons. India with annual production of 21 metric tons is the sixth largest producer of tomato in the world (FAOSTAT, 2021) [2]. The estimated world production of tomato is about 127.92 million tones and area of about 47.19 lakh ha. China ranks first with production of 33.64 million tons leaving USA to second place. The area and production of tomato in India was about 852 lakh ha and 21 metric tons respectively in 2021. The leading tomato growing states are UP, Karnataka, Maharashtra, Haryana, Punjab and Bihar. It is grown all-round the year throughout India mainly in Uttar Pradesh, Madhya Pradesh, Orissa, Karnataka, Bihar, Punjab, West Bengal and Andhra Pradesh (Kabir *et al*., 2001) [6].

Material and Method

The experiment was carried out in a Randomized Block Design (RBD) from Feb 2022 to June 2022 at the Horticulture Farm of Rama University, Mandhana Kanpur, India. The test crop was Tomato (Arka shrestha).

The experiment was considering 8 treatments and 3 replications. The variety of Arka shrestha was selected and combination of NPK were T_1 = N_{180} kg/ha +P_{100} kg/ha +K_{60} kg/ha, T_2 = N_{140} kg/ha +P_{50} kg/ha +K_{40} kg/ha, T_3 = N_{210} kg/ha +P_{110} kg/ha +K_{75} kg/ha, T_4 = N160kg/ha +P70kg/ha +K50kg/ha, T_5 = N170kg/ha +P80kg/ha +K55kg/ha, T_6 = N_{190}kg/ha +P_{90} kg/ha +K_{65} kg/ha, T_7 =N_{200} kg/ha +P_{100} kg/ha +K_{70} kg/ha and T_8 = N_{210} kg/ha +P_{110} kg/ha +K_{75} kg/ha. NPK fertilizers combination was made. The experimental field of 130 m^2 and total length of the field is 15.5m and width is 5.0m. The experiment was laid out in factorial RBD considering different levels of NPK as factors. They were evaluated under RBD design with 3 replications and 8 treatments. There were 24 plots and the size of the plot is 2.40×1.20 m. In each plot 4 saplings were planted. The space between rows is 60×60 cm and plant to plant is 45×45 cm. the main irrigation channel is 1 m and field border is also 1m.

The collected data were entered in Excel and analyzed statistically by F-test to examine the treatment effects and the mean differences were judged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Result and Discussion

1. Effect of NPK and their combination on growth attributes of tomato

Results presented in table 1, indicates the significant differences the different levels of NPK. The plant height was recorded maximum (55.67 cm) was recorded under the treatment T_8 (N_{210} kg/ha +P_{110} kg/ha +K_{75} kg/ha), followed by T_6 (N_{190} kg/ha + P_{90} kg/ha + K_{65} kg/ha) and T_7 (N_{200} kg/ha + P_{100} kg/ha + K_{70} kg/ha) whereas other growth parameters also positive influence by use different levels of NPK. It is concluded the increasing rate of NPK levels may also increase the growth attributes of plant. Bombang *et al*. 2011, was also observed the growth attributes of tomato significantly increased by use of different levels of NPK. plant height.

Maximum no of leaves was (61.33), the maximum no of branches was recorded under the treatment T_8 (17.13) followed by T_7 (13.98) and T_6 (13.67) and maximum no of branches was recorded under T_1 (13.62). Minimum was found in T_2 (8.48). The maximum length of leaves was recorded under the treatment T_8 (21.38 cm) followed by T_7 (17.88 cm) and T_6 (17.25 cm) and maximum length of leaves was recorded under T_1 (20.42 cm).

Table 1: Effects of NPK on the growth attributes of tomato

Treatment	Plant height (cm)			No of leaves			Length of leaves (cm)			No of branches		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1	29.5	37.24	52.6	18.7	36.4	55.67	5.48	10.01	20.42	2.73	8.61	13.62
T_2	25.7	33.46	47.4	17.1	34.3	54.57	4.01	8.68	16.26	1.21	5.38	8.48
T_3	26.1	34.13	48	17.3	34.7	54.05	4.19	8.85	16.56	1.3	6.99	8.92
T_4	26.3	35.65	48.5	18.3	35.7	55.67	4.85	9.01	16.87	1.54	7.14	9.56
T_5	27.2	37.28	49.2	17.7	37.3	56.67	5.17	9.66	17.21	1.67	8.43	9.46
T_6	28.3	39.58	51.8	19.5	35.7	57.33	5.73	10.24	17.28	2.01	10.8	13..67
T_7	30.6	41.68	53.7	22.9	37.7	60.67	6.77	10.95	17.86	3.69	10.8	13.98
T_8	32.2	43.23	55.7	23.8	39.7	61.33	7.2	11.58	21.38	3.78	13.4	17.13
S. E. (M)	0.18	0.681	0.7	2.82	1.58	1.971	0.06	0.076	0.1	0.072	0.16	0.125
C. D.	1.48	2.547	2.61	0.86	0.86	0.666	0.23	0.285	0.377	0.271	0.61	0.471

2. Effect of NPK and their combination on yield attributes of tomato

The maximum no of flowers were recorded under the treatment T_8 (82.33) followed by T_7 (80.67) and T_6 (79.13) and minimum was found in T_2 (75.15). According to V.M Prasad, 2014 [4] the highest no fruit was 60.60 under the treatment having 50 % of RDF nitrogen.

The maximum no of fruits per plant at was recorded under the treatment T_8 (35.84) followed by T_7 (33.96) and T_6 (32.54) and minimum no of fruits was found in T_2 (61.79)

The maximum fruit weight at 90 DAT was recorded under the treatment T_8 (101.4 gm) followed by T_7 (95.26 gm) and T_6 (93.19 gm) and minimum was found in T_2 (86.14 gm). Hasan *et al*. 2014 [4] also observed that use of NPK influence the fruit of tomato.

The maximum yield per plant at 90 DAT was recorded under the treatment T_8 (7.63 kg) followed by T7 (6.83 kg) and T_6 (6.65 kg) and minimum was found in T_2 (5.32 kg).

The maximum yield at 90 DAT was recorded under the treatment T_8 (159.7 Q/Ha) followed by T_7 (157.2 Q/Ha) and T_6 (155.4 Q/Ha) and whereas minimum total yield was found in T_2 (148.89 Q/ha). (Egharevba *et al*., 2009) [7] revealed that the application of NPK fertilizers increase the productivity of tomato in high density plantation.

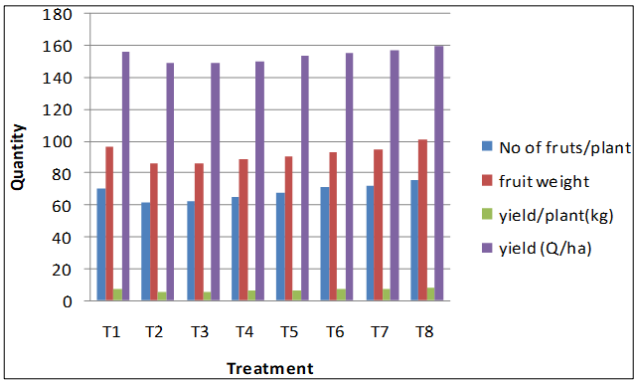

Fig 1: effect of different levels of NPK on yield attributes of tomato.

3. Effect of NPK and their combination on chemical properties of tomato

The data obtained on vitamin C content in the fruit of tomato due to the influence of inorganic fertilizers NPK present in table 2, that use of NPK increase the vitamin C content in tomato significantly. T_8 has the maximum (11.4 mg/100) followed by T_7 (10.48 mg/100), T_6 (9.05 mg/100), T_5 (8.62 mg/100). The lowest vitamin C was found in T_2 (7.52 mg/100).

T_8 has the maximum (0.82 0brix) followed by T_7 (0.78 0brix), T_6 (0.73 0brix), T5 (0.67 0brix). The lowest TSS was found in T_2 (0.62 0brix). According to Kumar *et al*. 2013 [8], the total soluble solid was also influenced by use of NPK.

T_8 has the maximum (11.4 mg/100) followed by T_7 (10.48 mg/100), T_6 (9.05 mg/100), T_5 (8.62 mg/100). The lowest ascorbic acid was found in T_2 (7.52 mg/100). Rahim *et al*. 2010 [9], observed 10.95 mg/100g ascorbic acid with use of 50 % more NPK than RDF. T8 has the maximum (11.4 mg/100) followed by T_7 (10.48 mg/100), T_6 (9.05 mg/100), T_5 (8.62 mg/100). The lowest vitamin C was found in T_2 (7.52 mg/100).

T_8 has the maximum (0.82 %) followed by T_7 (0.78), T_6 (0.73), T_5 (0.67 %). The lowest acidity was found in T_2 (0.7 %). Saha *et al*. 2010 [9], also observed 0.47% acidity with use of 50 %more NPK than RDF

Table 3: effect of different levels of NPK on quality of tomato fruits.

Treatment	TSS (^{0}brix)	Ascorbic acid (mg/100)	Vitamin-C (mg/100)	Acidity (%)
T_1	0.7	9.6	9.6	0.7
T_2	0.62	7.52	7.52	0.63
T_3	0.65	7.54	7.54	0.65
T_4	0.63	8.02	8.02	0.62
T_5	0.67	8.62	8.62	0.67
T_6	0.73	9.05	9.05	0.73
T_7	0.78	10.48	10.48	0.78
T_8	0.82	11.4	11.4	0.82
S. E. *(M)*	0.11	0.136	0.125	0.016
C. D.	0.414	0.508	0.47	0.062

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