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Effect of integrated nutrient management on growth and economic yield of tomato (*Solanum lycopersicum* L.) *cv*. Kashi Aman

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Abstract
An experiment entitled "Effect of integrated nutrient management on growth and economic yield of tomato (*Solanum lycopersicum* L.) *cv*. Kashi Aman." was carried out between September 2021 and March 2022 at the Experimental Unit, Department of Horticulture, Tilak Dhari Post Graduate College, Jaunpur. The seedlings were transplanted on October 20, 2021, with the spacing of 60 centimeters × 40 centimeters. The goal of the current study was to determine which source of nutrient produced the greatest growth and yield using a Randomized Block Design. The experiment was comprised of three replications and eleven treatments. At the time of harvest, T_2 (100% N.P.K.) produced superior results in terms of plant height (133.15 cm), number of branches plant^{-1} (25.72), number of leaves plant^{-1} (218.97), and leaf area plant^{-1} (6.10 cm^2), while T_6 (50% N.P.K. + VC + *Azotobacter* + PSB) produced the highest economic yield (6.53:1) and yield plant^{-1} (1.203 kg), while T_1 (control) took the longest time to first flowering (49.72 days), the quickest rate of blooming (74.76 days), and the highest number of flower clusters per plant (10.05 flower clusters) were all found in T_6 (50% N.P.K. + VC + *Azotobacter* + PSB).

Keywords: Biofertilizers, *Azotobacter*, vegetative development, organic manure

Introduction
The tomato (*Solanum lycopersicum* L.), which originated in Peru, Ecuador, Bolivia, and Mexico and was introduced to Europe by the Portuguese in the early 16th century, as well as to India at the end of the 18th and beginning of the 19th century, is one of the most significant crops in the solanaceae family and ranks first as the vegetable crops suitable for processing.
In reality, nitrogen is essential to plant nutrition and without it, there would be no possibility of plant life. To get a decent yield and better quality in vegetable crops, enough nitrogen is needed. Different nitrogen doses improve plant growth by raising the number of leaves, branches, and plant height, which raises yield.
India is the second-largest producer of tomatoes after China, with a total area under cultivation of 789 mha and a total output of 19759 metric ton. In terms of area (91.01 mha) and output (1312.07 mt), Madhya Pradesh is in second place (84.53 mha).
Tomatoes have a high market value both domestically and abroad. In the years 2017–18, India exported tomatoes to the U.A.E. (19960.65 mt), Nepal (18799.66 mt), Qatar (2670.57 mt), Maldives (1218.74 mt), and Oman (1800.89 mt) and earned profits of Rs. 6450.95 lacs, 2208.26 lacs, 1027.94 lacs, 583.08 lacs and 541.98 lacs respectively.

Materials and Methods
The trial was carried out at the Experimental Unit of the Department of Horticulture at the Tilak Dhari Post Graduate College in Jaunpur, Uttar Pradesh, India. Located in the eastern region of Uttar Pradesh, 83.230 meters above mean sea level, between 25^{0}44'0" North Latitude and 82^{0}41'0" East Longitude.
Winter temperatures (December–January) can drop as low as 5 °C, while summer temperatures (May–June) can soar as high as 45°C. Occasionally, during the winter, there may be snow and frost. The period from mid-July to the end of September sees the heaviest rains, after which it becomes less intense. About 850 to 1100 millimeters of rainfalls in each year.

On October 20, 2021, tomato seedlings with four to five fully open leaves were planted using Khurpi in ready plots at a spacing of 60×40cm. The depth at which seedlings were inserted into the receiving medium was chosen so that the shoot would stay visible but the roots would be completely buried. Around the stem's base, the earth was tightly packed and patted down. The seedlings were watered after planting.

The treatments *viz*. T_1 (control), T_2 (100% NPK), T_3 (75% NPK + VC + *Azotobacter* + PSB), T_4 (75% NPK + NC + *Azotobacter* + PSB), T_5 (75% NPK + PM + *Azotobacter* + PSB), T_6 (50% NPK + VC + *Azotobacter* + PSB), T_7 (50% NPK + NC + *Azotobacter* + PSB), T_8 (50% NPK + PM + *Azotobacter* + PSB), T_9 (25% NPK + VC + *Azotobacter* + PSB), T_{10} (25% NPK + NC + *Azotobacter* + PSB), T_{11} (25% NPK + PM + *Azotobacter* + PSB), In accordance with the treatments, fertilizers and bio-fertilizers were applied during transplanting and organic manures were applied during the last field preparation. Every traditional practice was carried out when necessary. The growth parameters were documented at the 25 DAT, 50 DAT, 75 DAT, 100 DAT, and harvesting stages, and the quality parameters were recorded at the harvesting stages.

Results and Discussion

This chapter presents the statistical analysis and presentation of the data on tomato vegetative growth and yield parameters. According to the information shown in the tables, each tomato's characteristics were explained.

Table 1: Effect of integrated nutrient management on growth and yield of tomato *cv*. Kashi Aman

Treatments	Plant height (cm)	Number of branches	Number of leaves	Leaf area (cm^2)	Yield $plant^{-1}$ (Kg)	Yield $plot^{-1}$ (Kg)
T_1	103.09	14.11	150.40	4.89	0.279	3.34
T_2	133.15	25.72	218.97	6.10	0.418	5.01
T_3	124.91	21.12	190.91	5.93	0.496	5.95
T_4	129.07	23.16	203.15	6.00	0.461	5.53
T_5	120.57	19.20	180.94	5.73	0.397	4.75
T_6	111.01	16.34	166.94	5.49	1.203	14.44
T_7	113.21	17.30	172.90	5.68	0.874	10.48
T_8	110.17	15.28	162.88	5.36	0.335	4.01
T_9	106.24	15.04	124.96	5.03	0.703	8.42
T_{10}	108.44	15.14	158.95	5.15	0.590	7.08
T_{11}	104.28	14.42	153.95	4.95	0.308	3.61
CD at 5%	0.577	0.917	0.450	0.051	0.029	0.333

Table 2: Effect of integrated nutrient management on growth and yield of tomato *cv*. Kashi Aman

Treatments	Yield $ha.^{-1}$ (ton)	B:C	Days to first flowering	Days to 100% flowering	Number of flower $cluster^{-1}$	Number of flower cluster $plant^{-1}$
T_1	15.49	2.02:1	49.72	74.76	3.52	4.04
T_2	23.20	3.24:1	42.96	67.70	3.98	5.06
T_3	27.54	4.27:1	39.58	64.65	4.18	5.82
T_4	25.61	2.70:1	41.27	66.34	4.08	5.32
T_5	22.01	2.96:1	44.65	69.90	3.88	4.79
T_6	66.84	6.53:1	32.53	57.59	6.45	10.05
T_7	48.54	4.79:1	34.51	59.65	5.27	8.73
T_8	18.56	2.30:1	46.34	70.08	3.61	4.49
T_9	39.00	2.68:1	36.20	60.69	4.47	7.59
T_{10}	32.77	2.33:1	37.90	62.37	4.27	7.00
T_{11}	17.04	1.99:1	48.03	72.37	3.10	4.24
CD at 5%	1.616	-	0.130	0.704	0.146	0.234

In terms of growth parameters, the height of the plant, the number of leaves, the number of branches, and the area of the leaves all increased with crop age. T_2 (100% N.P.K.) provided the highest plant height (133.15 cm), number of branches (25.72), the maximum leaves (218.97), and the largest leaf area (6.10 cm^2). Maximum plant height might result from better nutrient absorption, like nitrogen, which is crucial for boosting cell division and enhancing plant development. These findings concur with those of Arancon *et al.* (2004) [3]. Similar reports on tomatoes were published by Patil *et al.* (2009) [6] and Meena *et al.* (2010) [5].

The yield $plant^{-1}$ (1.203 kg), yield $plot^{-1}$ (14.44 kg), yield $ha.^{-1}$ (66.84 t), and B:C ratio is yield characteristics (6.53:1), Because of microbial activity, applying N.P.K. along with organic manure results in a better yield. Ahire (1998) [1] and Raina (20003) [3] provided comparable reports.

The highest number of flower cluster per plant, days taken to first flowering (32.57 days) days taken to 100% flowering (57.59 days), and number of flower $cluster^{-1}$ (6.45 flowers) were discovered in T_6 (50% N.P.K. + VC + *Azotobacter* + PSB). These findings are in conformity with those of Gowda *et al.* (2015) [4]. Pushpa *et al.* (2006) [7] and Singh noted a similar account. (2014) [9].

Conclusion

The present study revealed that the application of inorganic fertilizers, organic manures and bio-fertilizers solely or combined application had a great influence at all the growth stages of the crop. Significant differences were observed in all parameters like, plant height, number of branches $plant^{-1}$, Leaves $plant^{-1}$ and leaf area due to the combined application of inorganic fertilizers performed maximum growth. (50% N.P.K. + VC + *Azotobacter* + PSB) performed superior quality in tomato *cv*. Kashi Aman. The results thus indicate that the application of combination of inorganic, organic manures and bio-fertilizers is the best strategy which can be

applied for the enhancement of growth and production efficiency since it had a positive impact.

Tomato plants require hot and humid climate for better production. Jaunpur comes under tropical and subtropical region, very hot in summer and less cold in winter. Normally soil of Jaunpur is fertile but deficient in some nutrient and organic matter. So that organic manure and bio-fertilizers is best suitable combination for increase soil fertility.

Bio fertilizers combined with organic manures influences the plant growth by enhancing root biomass total root surface facilitates higher absorption of nutrients and increase in yield by reducing consumption of natural sources of energy. Bio-fertilization is of great importance in order to alleviate deterioration of natural and environmental pollution. There is an increasing need for the management of the traditional processes of nutrient management, to result in higher nutrient concentration in soil and also to reduce environmental pollution.

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