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# Effect of nitrogen and sulphur supplementation through organic sources on growth, yield and yield parameters of tomato *(Solanum lycopersicn Mill.)*, in Bundelkhand Region

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## Abstract

*A field experiment was conducted at the organic farm Karguwanji in Bundelkhand University, Jhansi, U.P. during rabi season 2019-20 to study the effect of nitrogen and sulphur supplementation through organic sources on growth, yield and yield parameters of tomato* (Solanum lycopersicum Mill.), *in Bundelkhand Region. The experiment was laid out in randomized block design with nine treatments in three replications. The results revealed that plant height was significantly highest with 50 % VC + 50 % FYM + 30 kg ha$^{-1}$ S through gypsum under $T_8$ and lowest height was observed in $T_0$ control at all days of observation except 120 days after planting. The application of organic sources of nitrogen and sulphur had recorded significant taller plant, stem diameter and number of branches plant$^{-1}$ in tomato under the treatment $T_8$ applied with 50 % N VC + 50 % N FYM + 30 kg ha$^{-1}$ S through gypsum and lowest was recorded with control with use of recommended dose of fertilizers. In case of yield parameter, the applications of organic manures sources of nitrogen and Sulphur have very positive effect on yields of tomato crop. The investigation that was carried showed significantly highest number of fruits per plant, fruit diameter, average fruit weight, yield per plant and yield per hectare in tomato in the treatment $T_8$ and lowest was recorded with control without use of any organic sources of manures.*

**Keywords:** Nitrogen, sulphur, growth, yield, tomato

## Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most important vegetables belonging to family Solanaceae. The Solanaceae, commonly known as the nightshade family, also includes other notable cultivated plants such as tobacco, chilli, potato and eggplant. It is popularly known as *Wolf apple, Love of Apple or Vilayati baingan*. Tomato is a treasure of nutrients and vitamins and equally liked by both poor and rich. Hence, it is called as "Poor Man's Orange". Tomato is very attractive and tasty fruits with a bright red colour that makes it even more appetizing to the consumers. It is consumed in a variety of ways like fresh in salads and sandwiches, cooked or processed in ketchup, pickle, puree, sauces or dried powder. Tomato plays an important role in human nutrition by providing vitamins A and C, essential amino acids, folic acid and potassium. It also contains lycopene, a very potent antioxidant that may be an important contributor to the prevention

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of cancers (Agrawal and Rao, 2000). However, the major concerns are low productivity, diminishing return from farming as a whole and lack of awareness among the vegetable growers regarding scientific crop management and quality product (Chattopadhyay *et al.,* 2007).

The beneficial effects of FYM and Vermicompost on crop yield and soil productivity is the result of their usefulness as a store house of plant nutrients. These average sources of nutrients improve soil aeration, root development and increase microbial and biological activities in the rhizosphere. Vermicompost could promote early and vigorous growth of seedlings. Vermicompost has found to effectively enhance the root formation, elongation of stem and production of biomass, vegetables, ornamental plants Etc. (Edwards 1988).Vermicompost could be used as an excellent soil amendment for main fields and nursery beds and has been reported to be useful in raising nursery species plants.

Nitrogen play an important role in the plant metabolism and hence in determining growth. The inorganic nutrition of plants has, therefore, been dominated by the N, as it improves both quantity and quality of the produce. Under these situations understanding N interaction with other essential plant nutrients is fundamental importance in improving plant growth and development increasing N supply enhances growth, and consequently, increases the demand for other nutrients. Sulphur is an essential element for plants because it is an essential concentration of most plant proteins and their and their amino acid fragments, cystine methionine, and glutathione. The sulphur availability in the soil is directly proportional to the levels of loams, oxides and organic matter, being also influenced by the soil pH (Chao *et al.,* 1962). Both the total sulphur amount and the absorption capacity of $S\text{-}SO_4^{-2}$ are lower in soils with low loam content, and its retention is still diminished by the application of limestone and phosphate (Camtargo and Raij, 1989). The aim of this study was to evaluate the nitrogen and sulfur application on the productivity and development of tomato plants. Organic sulfur is associated principally with the proteins those cells of the plants are richest in sulfur which are also richest in proteins using radio sulfur it has been shown by radio autographs that in the root and stems of tomatoes the principal sulfur accumulation occurs in the inner and outer phloem and cambium areas whereas the pith and xylem areas are relatively low sulfur. Therefore, the present study was conducted to evaluate the effect of nitrogen and sulphur through organic sources on growth parameters and yield of tomato.

## Materials and Methods

The experiment was laid out in nursery area organic farm Karguwan ji, Bundelkhand University, Jhansi, Uttar Pradesh during 2019-20. Geologically, Jhansi is the district of Uttar Pradesh situated between the two rivers Pahuj and Betwa at an average elevation of 225 meters above mean sea level (MSL) at 78°342 113 E longitude and 25°262 553 N latitude. The soil had EC 0.57 $dSm^{-1}$, pH 6.96, organic carbon 3.9 g $kg^{-1}$, available N 109.91, P 17.31, K 170.10 kg $ha^{-1}$, sulplur 13.86 mg $kg^{-1}$ and zinc 0.50 mg $kg^{-1}$. The experiment was laid out in randomized block design (RBD) with eight treatments in three replication using tomato crop as test crop grown. The nine experimental treatments were comprised of different levels of of nitrogen and sulphur supplementation through organic sources application as follows: $T_0$: RDF 100:75:55 (Through chemical fertilizer) $T_1$:100% N from FYM $T_2$: 100% N from VC., $T_3$:100% N from FYM+20kg/ha sulphur through gypsum, $T_4$: 100% N from FYM+30kg/ha sulphur through gypsum.$T_5$:100% N From VC+20kg/ha sulphur through gypsum, $T_6$:100% N From VC+30 kg/ha From sulphur through gypsum, $T_7$:50% N From FYM+50%N From VC+20kg/ha sulphur through gypsum and $T_8$: 50% N From FYM+50% from VC+30kg/ha sulphur through gypsum. The seeds were sown on 10-10-2019 the rate of 500 g per hectare in the raised nursery beds (1 meter in width and 2 meter in length). Prior to sowing seed bed was properly solarized and pulverized. The sandy loan soil was selected for nursery raining seed were sown in lines 3 inches apart and properly covered with thatching material, irrigation was given regularly as and when required. Full dose of organic manures and fertilizers *e.g.* RDF (100:75:55) through di-ammonium phosphate (DAP), muriate of potash (MOP), farmyard manure, vermicompost and gypsum and half of urea were applied as basal dose mixed with soil in plot according to treatment. The rest half of nitrogen applied 3 split applications during various growth periods. Four weeks old seedlings were transplanted on the field. Nursery beds were properly prior to removal of seeding and care was taken to avoid root injury. Planting was done in evening. A light irrigation was given immediately after transplanting. First picking of matured fruits was done manually and thereafter continuous picking was done at an interval of 4 to5 days. The data on different morphological and yield parameters were studied.

## Results and Discussion

*Plant height*

The mean data of plant height was observed lowest 18.04 in $T_0$ and highest 25.34 cm in T8 at 30 days. However, at 120 days plant height ranged from 61.12 cm to 65.68 cm in $T_2$ and T8 respectively. Plant height reviled at 30, 60, 90, 120 Day after Planting were significantly influenced by organic sources of nitrogen and sulphur application during the crop session and in mean data (Table 1) amount the nitrogen application (through organic sources) and sulphur (through gypsum) recorded significantly taller plant as compared to control ($T_0$) during the growth period on the basis of mean data as regard to influence of different treatment plant height was found to deviate significantly at the stay of observation. Among the all treatments T8 recorded taller plant at 30 & 60 DAP, However $T_0$ found higher plant growth at 90 and 120 DAP. Similar resulted also reported that Kumaran et al. (1998), Naidu et al. (2002) and Angadi et al. (2017).

*Number of leaves plant$^{-1}$*

The mean data of plant leaves was observed, minimum leaves 11.45 in T0 and maximum 24.36 in T8 at 30 days. However, at 120 days plant leaves ranged from 83.33 to 105.13 in $T_0$ and respectively. Number of plant leaves rewarded at 30, 60, 90 and 120 day after planting (DAP) were significantly influenced by organic sources of nitrogen and sulphur application during the crop session. Application of N and sulphur recorded significantly higher number of plant leaves compared to control during the growth period on the basis of mean data. Among the all treatments $T_8$ recorded minimums plant leaves at 30 and 60 DAP, however $T_0$ found maximum plant leaves at 90 and 120 DAP (Table 2).

*Stem diameter*

The mean data of stem diameter presented in (Table 3) over all, stem diameter was observed highest in $T_8$ followed by $T_3$, $T_6$ and $T_7$ at 30 days. However, at 120 days after transplanting stem diameter was maximum under $T_8$ (1.72 cm) and lowest in $T_2$ (1.35 cm) respectively. Among the Nitrogen application (through organic sources) and sulphur (through gypsum) recorded significantly stem diameter as compared to control ($T_0$) during the plant width on the basis of mean data. Among the all treatment $T_8$ recoded best stem diameter plant at 30 and 60 DAP, however $T_2$ found in lowest stem diameter at 90 and 120 DAP. These results are in conformity with the findings of Doifode and Nandkar (2014).

Table 1: Effect of organic source of N and S application on plant height (cm)

| Treatments | 30DAS | 60DAS | 90DAS | 120DAS |
|---|---|---|---|---|
| $T_0$ (RDF) | 18.04 | 27.57 | 48.96 | 65.16 |
| $T_1$ (100 % FYM) | 19.63 | 31.38 | 54.56 | 63.63 |
| $T_2$ (100 % V.C) | 21.74 | 31.32 | 50.18 | 61.12 |
| $T_3$ (100 %FYM+20 kg/ha S) | 21.64 | 33.40 | 55.11 | 65.26 |
| $T_4$ (100% V.C+30 kg/ha S) | 23.15 | 35.81 | 52.43 | 65.03 |
| $T_5$ (100 % V.C+20kg/ha S) | 23.78 | 37.28 | 51.16 | 63.47 |
| $T_6$ (100 % V.C+30 kg/ha S) | 24.67 | 37.92 | 52.33 | 63.9 |
| $T_7$ (50 % V.C+50 % FYM+20kg/ha S) | 25.08 | 40.20 | 52.61 | 64.88 |
| $T_8$ (50 % V.C+50 %FYM+30 kg/ha S) | 25.34 | 41.28 | 53.62 | 65.68 |
| SEm(±) | 0.31 | 0.78 | 1.16 | 0.67 |
| CD @ 5% | 0.95 | 2.34 | 3.49 | 2.04 |

Table 2: Effect of organic source of N and S application on number of leaves plant$^{-1}$

| Treatment | 30DAS | 60DAS | 90DAS | 120DAS |
|---|---|---|---|---|
| $T_0$ (RDF) | 11.45 | 34.60 | 41.36 | 83.33 |
| $T_1$ (100 % FYM) | 13.39 | 45.97 | 42.43 | 93.47 |
| $T_2$ (100 % V.C) | 15.25 | 39.10 | 44.48 | 89.87 |
| $T_3$ (100 %FYM+20 kg/ha S) | 16.47 | 42.27 | 46.57 | 95.40 |
| $T_4$ (100% V.C+30 kg/ha S) | 17.08 | 44.00 | 52.01 | 89.20 |
| $T_5$ (100 % V.C+20kg/ha S) | 20.33 | 34.53 | 55.63 | 80.73 |
| $T_6$ (100 % V.C+30 kg/ha S) | 22.42 | 37.70 | 57.81 | 85.87 |
| $T_7$ (50 % V.C+50 % FYM+20kg/ha S) | 23.29 | 53.07 | 62.32 | 98.40 |
| $T_8$ (50 % V.C+50 %FYM+30 kg/ha S) | 24.36 | 53.80 | 67.85 | 105.13 |
| SEm(±) | 0.58 | 0.85 | 0.66 | 1.06 |
| CD @ 5% | 1.74 | 2.57 | 2.00 | 3.19 |

Table 3: Effect of organic source of N and S application on stem diameter

| Treatment | 30DAS | 60DAS | 90DAS | 120DAS |
|---|---|---|---|---|
| $T_0$ (RDF) | 1.08 | 1.08 | 1.60 | 1.65 |
| $T_1$ (100 % FYM) | 1.04 | 1.04 | 1.40 | 1.46 |
| $T_2$ (100 % V.C) | 1.06 | 1.06 | 1.28 | 1.35 |
| $T_3$ (100 %FYM+20 kg/ha S) | 1.17 | 1.17 | 1.58 | 1.69 |
| $T_4$ (100% V.C+30 kg/ha S) | 1.04 | 1.04 | 1.38 | 1.46 |
| $T_5$ (100 % V.C+20kg/ha S) | 1.07 | 1.07 | 1.38 | 1.46 |
| $T_6$ (100 % V.C+30 kg/ha S) | 1.14 | 1.14 | 1.39 | 1.45 |
| $T_7$ (50 % V.C+50 % FYM+20kg/ha S) | 1.12 | 1.12 | 1.57 | 1.52 |
| $T_8$ (50 % V.C+50 %FYM+30 kg/ha S) | 1.41 | 1.41 | 1.68 | 1.72 |
| SE m (±) | 0.11 | 0.13 | 0.86 | 0.08 |
| CD @ 5% | N/A | N/A | N/A | 0.24 |

*Number of branches*

Over all, mean data of branches was observed lower in $T_0$ (1.33) and highest in $T_8$ (4.76) at 30 days. However, at 120 days stem diameter ranged from 6.26 to 10.66 cm in $T_8$ and $T_0$ respectively (Table 4). Among the nitrogen application (through organic Sources) and sulphur (through gypsum) recorded significantly number of branches as compared to control. Among the all treatment $T_8$ recoded best number of branches plant$^{-1}$ at 30 and 60, 90 and 120 DAP. However, $T_3$ found in lowest number of branches 90 and 120 DAP and lowest in ($T_0$) DAP. These results are in conformity with the findings of Doifode and Nandkar (2014) and Singh et al. (2017).

*Fresh weight and dry weight*

The mean data of fresh weight was observed lower in $T_0$ (570.0 g) and higher (682.33 g) in $T_8$ were significantly influenced by organic source of nitrogen and sulphur application during the crop session. Among the nitrogen application (through organic sources) and sulphur (through gypsum) recorded significantly higher fresh weight as compared to control during the growth period on the basis of mean data. Fresh weight was also increased with 50% N from FYM + 50% N from vermicompost + 30 kg ha$^{-1}$ Sulphur through gypsum followed by (NPK 100:75:55) kg ha$^{-1}$ through fertilizer application as compared to RDF (Table 5). The mean data of dry weight (g) was observed lower in (106.67 g) $T_4$ and highest in $T_8$ (148.67 g) were

Table 4: Effect of organic sources of N and S application on number of branches plant$^{-1}$

| Treatment | 30DAS | 60DAS | 90DAS | 120DAS |
|---|---|---|---|---|
| $T_0$ (RDF) | 1.33 | 4.33 | 6.43 | 6.26 |
| $T_1$ (100 % FYM) | 1.46 | 4.33 | 7.36 | 6.66 |
| $T_2$ (100 % V.C) | 1.93 | 6.96 | 7.93 | 7.53 |
| $T_3$ (100 %FYM+20 kg/ha S) | 2.93 | 6.26 | 5.43 | 5.23 |
| $T_4$ (100% V.C+30 kg/ha S) | 3.5 | 7.16 | 7.3 | 7.13 |
| $T_5$ (100 %V.C+20kg/ha S) | 3.8 | 9.06 | 7.6 | 8.23 |
| $T_6$ (100 % V.C+30kg/ha S) | 4.43 | 6.26 | 7.23 | 9.1 |
| $T_7$ (50 % V.C+50% FYM+20kg/ha S) | 2.63 | 7.36 | 10.43 | 10.2 |
| $T_8$ (50 % V.C+50 % FYM+30kg/ha S) | 4.76 | 9.43 | 11.43 | 10.66 |
| SE m (±) | 1.21 | 1.88 | 2.07 | 1.42 |
| CD @ 5% | 0.40 | 0.62 | 0.68 | 0.47 |

Table 5: Effect of organic sources of N and S application on fresh weight, dry weight and fruit diameter of plant

| Treatment | Fresh weight (g) | Dry weight (g) | Fruit diameter (cm) |
|---|---|---|---|
| $T_0$ (RDF) | 570.00 | 137.33 | 4.31 |
| $T_1$ (100 % FYM) | 575.67 | 136.00 | 3.51 |
| $T_2$ (100 % V.C) | 596.67 | 120.33 | 3.67 |
| $T_3$ (100 %FYM+20 kg/ha S) | 604.67 | 121.67 | 3.37 |
| $T_4$ (100% V.C+30 kg/ha S) | 623.00 | 106.67 | 3.39 |
| $T_5$ (100 %V.C+20kg/ha S) | 643.00 | 112.00 | 3.88 |
| $T_6$ (100 % V.C+30kg/ha S) | 654.67 | 122.00 | 4.27 |
| $T_7$ (50 % V.C+50 % FYM+20 Kg/ha S) | 667.00 | 113.67 | 4.25 |
| $T_8$ (50 % V.C+50 % FYM+30 Kg/ha S) | 682.33 | 148.67 | 4.33 |
| SEm (±) | 39.56 | 5.45 | 0.21 |
| CD @ 5% | 13.08 | 1.80 | 0.62 |

significantly influenced by organic source of nitrogen and sulphur application. Dry weight accumulation was also increased with 50% N from FYM+50% N from vermicompost + 30 kg ha$^{-1}$ sulphur through gypsum followed by (NPK 100:75:55) kg ha$^{-1}$ through fertilizer application as compared to RDF(Table 5). The results are in conformity with the reports of Angadi et al. (2017) and Singh et al. (2017).

*Fruit Diameters*

Over all, fruit diameter was observed lower (3.37) in $T_3$ and highest in $T_8$ (4.33 cm) were significantly influenced by organic source of nitrogen and sulphur application during the crop session. Among the nitrogen application (through organic Sources) and sulphur (through gypsum) recorded significantly of higher fruit diameter as compared to control during the growth period (Table 5). Similar results were reported by Bhardwaj *et al.* (2000), and Chatterjee, *et al.* (2014).

*Fruit weight*

Over all, fruit weight was observed lower in $T_1$ (51.03 g) and highest in $T_8$ (92.87 g) were significantly influenced by organic source of nitrogen and sulphur application during the cropping session (Table 6). Among the nitrogen application (through organic sources) and sulphur (through gypsum) recorded significantly higher fruit weight as compared to control. Fruit weight (g) was also increased with 50% N from FYM+50% N from vermicompost + 30 kg ha$^{-1}$ sulphur through gypsum followed by (NPK 100:75:55) kg ha$^{-1}$ through

Table 6: Effect of organic source of N and S application on fruit weight (g), fruit yield plant$^{-1}$ (g), fruit yield plot$^{-1}$ (kg) and fruit yield qha$^{-1}$

| Treatment | Fruit weight (g) | Fruit yield plant$^{-1}$ (g) | Fruit yield plot$^{-1}$ (kg) | Fruit yield q ha$^{-1}$ |
|---|---|---|---|---|
| $T_0$ (RDF) | 72.87 | 476.41 | 7.15 | 167.79 |
| $T_1$ (100 % FYM) | 51.03 | 397.14 | 5.96 | 132.37 |
| $T_2$ (100 % V.C) | 62.03 | 332.33 | 4.99 | 110.76 |
| $T_3$ (100 %FYM+20 kg/ha S) | 55.53 | 412.67 | 6.19 | 137.54 |
| $T_4$ (100% V.C+30 kg/ha S) | 65.60 | 392.69 | 5.89 | 130.88 |
| $T_5$ (100 %V.C+20kg/ha S) | 83.90 | 347.81 | 5.22 | 116.14 |
| $T_6$ (100 % V.C+30kg/ha S) | 59.43 | 397.47 | 5.96 | 132.48 |
| $T_7$ (50 % V.C+50 % FYM+20 kg/ha S) | 61.20 | 335.08 | 5.03 | 111.68 |
| $T_8$ (50 % V.C+50 % FYM+30 kg/ha S) | 92.87 | 535.07 | 8.03 | 178.34 |
| SEm(±) | 23.00 | 3.45 | 0.05 | 2.99 |
| CD $_{(5\%)}$ | 7.61 | 1.14 | 0.02 | 9.04 |

fertilizer application as fresh weight compared to RDF. Similar results were reported by Bhardwaj et al. (2000), Sannigrahi and Barah (2000) and Chatterjee et al. (2014).

*Fruit yield plot$^{-1}$*

The fruit yield plot$^{-1}$ (kg) was observed lower in $T_2$ (4.99 kg) and highest in $T_8$ (8.03 kg) were significantly influenced by organic source of nitrogen and sulphur application during the cropping session (Table 6). Among the nitrogen application (through organic sources) and sulphur (through gypsum) recorded significantly of higher fruit yield plot$^{-1}$ as compared to control. It may be maximum fruit yield plot$^{-1}$ 8.03 (kg). The better performance of the tomato plants yields with organic sources of nitrogen and S supplementations support the results of Ogundare *et al*. (2015) and Adekiya and Agbede, (2009).

*Fruit yield plant$^{-1}$*

The fruits yield plant$^{-1}$ was observed lower in $T_2$ (332.33 g) and highest in $T_8$ (535.07 g) were significantly influenced by organic source of nitrogen and sulphur application during the cropping session (Table 6). The treatments ($T_8$) higher fruit yields plant$^{-1}$ as compared to RDF (Table 6). All the organic sources attained significant difference among them in relation to growth and yield parameters 535.07 (g). These results are in conformity with the reports of Mishra et al. (2018), Singh *et al.* (2017) and Angadi et al. (2017).

*Fruit yield*

The fruit yield (q/ha$^{-1}$) was lower observed under the treatment $T_2$ (110.76 q/ha$^{-1}$) highest in $T_8$ (178.34 q/ha$^{-1}$) in were significantly influenced by organic source of nitrogen and sulphur application during the crop session and in mean data. Among the Nitrogen application (through organic Sources) and sulphur (through Gypsum) recorded significantly of fruit yield (q/ha$^{-1}$) as compared to control (Table 6). The better performance of the tomato plants yields with organic sources of nitrogen and S supplementations support the results of Ogundare et al. (2015), Adekiya and Agbede, (2009) and Rajya *et al*. (2015).

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