*International Journal of Environment and Climate Change*

***Volume 13, Issue 9, Page 3154-3162, 2023; Article no.IJECC.104661***
***ISSN: 2581-8627***
*(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)*

# Effect of Traditional Fertilizer, Nano-Fertilizer and Micronutrient on Growth, Yield and Quality of Tomato (*Solanum lycopersicum* L.)

**Kumar Roushan [a++*], Deepanshu [b#] and Devi Singh [c]**

*[a] Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P., India.*
*[b] Department of Horticulture, NAI, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P., India.*
*[c] NAI, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj -211007, U.P., India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/IJECC/2023/v13i92584

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/104661

***Received: 01/06/2023***
***Accepted: 03/08/2023***
***Published: 08/08/2023***

***Original Research Article***

## ABSTRACT

A trial was conducted at the Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during 2022. This study investigates the "Effect of traditional fertilizer, nano fertilizer and micronutrient on growth, yield and quality of Tomato (Solanum lycopersicum L.)." The purpose of the study is to evaluate the plants in terms of various parameters such as plant height, survival percentage, days to first flowering, days to 50% flowering, number of flower clusters per plant,

[++] *M.Sc. Horticulture (Vegetable Science);*
[#] *Assistant Professor;*
[†] *Associate Professor of Horticulture;*
**Corresponding author: E-mail: kumar8271630444@gmail.com;*

number of fruit set per cluster, number of fruits per plant, fruit weight, fruit yield per plant, fruit yield per hectare, total soluble solids (TSS), ascorbic acid, and benefit-cost ratio. The study's findings show that applying more NPK, ZnSO4, and Nano Zinc to the soil dramatically increased tomato growth and yield. The plants treated with 100% NPK + 25% ZnSO4 by the conventional approach + 75% spray through Nano zinc had the maximum fruit yield (135.57 t/ha), fruit weight (88.407 g), TSS (5.36 Brix), and ascorbic acid content (26.4 mg/100g). Additionally, it was discovered that the treated plants' benefit-cost ratio was larger than the control's. Overall, the study indicates that increasing the growth, yield, and quality of tomatoes can be accomplished by applying 100% NPK + 25% ZnSO4 by traditional technique + 75% spray via Nano zinc.

*Keywords: Tomato; NPK; ZnSo4; nano zinc.*

## 1. INTRODUCTION

The tomato, also known by its scientific names *Solanum lycopersicum* L. and *Lycopersicon esculentum* Mill., is one of the most well-liked and widely farmed vegetable crops in the world and is often regarded as a "protective food." After the potato and sweet potato, it ranks highly among vegetables and is a great source of vitamins, vegetable protein, and minerals. In India and England, tomatoes are known as "love of apples" and "poor man's apple" (orange). Tomatoes are used in a variety of items, including soup, salads, pickles, ketchup, puree, sauces, tomato paste, and tomato juice. The tomato fruit's pulp and juice are palatable, a mild aperient, a stomach secretion promoter, and a blood purifier. Horticultural crop tomatoes are members of the Solanaceae family and have chromosomal number 2n=2X=24 [1]. It originated from South America [2]. The tomato's high rate of productivity places a great deal of strain on the soil's capacity to retain nutrients. In order to meet the nutritional needs of the corps, it is necessary to apply nutrients liberally; but, in the wake of the energy crisis, the detrimental effects on soil health and continuously rising prices of chemical fertilizer become a concern for the farmers. Therefore, there is an urgent need to apply fertilizers in increasing amounts to meet crop needs as well as to nourish the health and fertility status of soil. However, fertilizers should be administered in the proper amounts to lessen soil imparity [3,4]. Nitrogen is a component of the chlorophyll molecule, which gives plants their green color, and is used in photosynthesis to provide food for the plant. A plant that lacks N will be stunted and have paler-looking leaves. Because nutrients move around the plant, elder leaves are the first to display deficiencies. In severe situations of N deficiency, the flowers turn a darker shade of yellow, and the remaining fruits are smaller, which reduces the yield. Leafage that is toxic owing to overfertilization is dark green. More flower clusters are present, although bud abortion is rising. Additionally, it prevents the growth of flowers, prevents fruit from setting and forming, and makes people more vulnerable to illness and pest invasion [5]. " Phosphorus is an essential element of the building blocks of life, the RNA, as well as being required for many additional biochemical and physiological processes including energy transfer, protein metabolism and other functions. Deficiency symptoms include a decrease in leaf expansion and leaf area and number. One of the most visible symptoms is the color of the leaves going to a dark green and then turning purplish, usually starting with the older leaves. On the otherhand phosphorus excess is associated with micronutrients (zinc, copper, and iron) deficiency" [5].

"Next to nitrogen, potassium is the mineral nutrient required in the largest amount by plants. The potassium requirement for optimal plant growth is in the range 2-5% of the plant dry weight. Potassium (K) fertilization is essential, for all kind of crops especially long term vegetable crops like tomato" [6]. "Micro-nutrients, Plants are able sufficiently to accumulate most trace elements. Some plants are sensitive indicators of the chemical environment in which they grow [6], and some plants have barrier mechanisms that exclude or limit the uptake of a particular element or ion species, e.g., alder twigs commonly accumulate molybdenum but not arsenic, whereas the reverse is true of spruce bark" [6]. Zinc is required in a large number of enzymes and plays an essential role in DNA transcription. A typical symptom of zinc deficiency is the stunted growth of leaves, commonly known as "little leaf" and is caused by the oxidative degradation of the growth hormone auxin.

Nano fertilizers, the role of nano urea and nano zinc in the growth, yield, and quality of tomatoes has garnered significant attention in recent years due to their potential to improve nutrient uptake efficiency and enhance crop performance. Nano-scale materials, such as nano urea and nano zinc, possess unique physicochemical properties that make them promising alternatives to conventional fertilizers and micronutrient sources. The unique properties of nano urea, including its controlled release, improved solubility, and increased surface area, offer several advantages over conventional urea. Nano zinc offers unique advantages in terms of improved solubility, increased bioavailability, and efficient delivery to plants. These properties make it a promising source of Zn for enhancing the growth, yield, and quality of tomatoes.

These benefits help tomato plants utilise nitrogen more effectively, increase nutrient availability, and decrease nutrient loss from leaching and volatilization. This study intends to evaluate the efficacy of these substitute fertilizers in contrast to conventional NPK, offering insightful information about sustainable nutrient management techniques. Two recent advancements in agricultural science, nano urea and nano zinc, show great promise for enhancing crop productivity. A urea formulation known as nano urea has been shown to improve nutrient uptake effectiveness, reduce nitrogen losses, and reduce environmental pollution. Similar potential exists for nano zinc to improve photosynthesis, plant development, and nutrient uptake. Examining how nano urea and nano zinc affect tomato growth, yield, and quality can teach us a lot about how to use nanotechnology in agriculture. Consumers place a great value on the quality of tomatoes, which includes characteristics like flavour, color, texture, nutritional content, and shelf life. The quality of tomato fruits may be significantly impacted by the use of various fertilizer formulations, such as nano urea, nano zinc, and zinc sulphate. This study can help tomato growers produce high-quality tomatoes that satisfy consumer demand by examining the influence of these fertilizers on criteria that determine tomato quality.

## 2. MATERIALS AND METHODOLOGY

The information is presented in this chapter under the appropriate headings and subheadings. It pertains to the materials used and the procedures used in the investigation titled "Effect of Traditional Fertilizer, Nano Fertilizer, and Micronutrient on Growth, Yield, and Quality of Tomato (*Solanum lycopersicum* L.)" during 2022. From June 2022 to November 2022, field experiments were conducted at the Horticultural Research Field of the Naini Agricultural Institute of the Sam Higginbottom University of Agriculture Technology and Sciences in Prayagraj, India (25.43° N latitude, 81.84° E longitude), to examine the effects of traditional fertilizer, nano fertilizer, and micronutrient on tomato growth, yield, and quality. The area has loam and sandy loam as the soil types. The Prayagraj district has a subtropical climate, with typical maximum temperatures of 43°C to 47°C, which can reach 48°C during the hottest months of the year.

## 3. RESULTS AND DISCUSSION

**Effect of traditional fertilizer, nano fertilizer and micronutrient on growth, yield and quality of tomato on growth parameter:** All the growth parameter such as plant height (cm) 30,60,90 and 1$^{st}$ harvest after transplanting, survival percentage were variably by affected by application of traditional fertilizer, nano fertilizer and micronutrient on growth parameters. The experiment result revealed that all growth parameters were significantly improved by using traditional fertilizer, nano fertilizer and micronutrient The maximum Plant height (56.18 cm) at 30 DAT was observed with T7, The maximum plant height (83.60 cm) at 60 DAT was observed with T7 and the maximum plant height (100.25 cm) at 90 DAT was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc. The foliar application of fertilizers might have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which might have promoted the maximum vegetative growth while the minimum plant growth was due to non-availability of nutrients. Similar findings were reported by Sivaiah et al. [7]; Meena et al. [8]; Kumar et al. (2016); Singh et al. [9] and Swetha et al. (2018) in tomato.

Survival percentage of plant significantly varied among different treatment combinations. The maximum survival percentage (99.48%) were observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc.

**Effect of traditional fertilizer, nano fertilizer and micronutrient on growth, yield and quality of tomato on Earliness parameter:** All earliness parameters are Days to first flowering, Days to 50% flowering were variably by affected by application of traditional fertilizer, nano fertilizer and micronutrient on earliness parameters were significantly improved by using traditional fertilizer, nano fertilizer and micronutrient, Days to 1st Flowering of plant significantly varied among different treatment combinations. The minimum days to 1st flowering (27.33) were observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc. The reduced dose of chemical fertilizers supplemented with organic manures also reduce exploitation of micronutrients. Integration of organic fertilizers and biofertilizers favoured vigorous growth and synthesized more cytokinins in plants, which might have helped to the translocation of cytokinins as well as more quantity of available phosphorus through the xylem vessels and their accumulation in the axillary buds that would have favoured the plant to enter into reproductive phase (Dange et al., 2002). Similar results have also been reported by Singh and Tiwari [10], Dixit et al. (2018) and Singh et al., (2018). Days to 50% flowering of plant significantly varied among different treatment combinations. The maximum days to 50% flowering (40.33) were observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc, while the remaining treatments are moderate in their growth habitat. Similar results have also been reported by Singh and Tiwari (2013), Dixit et al. (2018) and Singh et al., (2018).

Effect of traditional fertilizer, nano fertilizer and micronutrient on growth, yield and quality of tomato on Qualitative parameters, TSS and ascorbic acid were variably by affected by application of traditional fertilizer, nano fertilizer and micronutrient on qualitative parameters were significantly improved by using traditional fertilizer, nano fertilizer and micronutrient, Total soluble solids significantly varied among different treatment combinations. The maximum total soluble solids (5.36) were observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc Similar findings were also reported by Ali et al. (2015); Kumar et al. (2017); Satyamurthy et al. (2017); Pandiyan et al. (2018); Singh et al. (2018) and Shnain et al. (2021) in tomato.

Ascorbic acid significantly varied among different treatment combinations. The maximum ascorbic acid (26.4) was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc.

**Effect of traditional fertilizer, nano fertilizer and micronutrient on growth, yield and quality of tomato on yield parameter:** Were variably by affected by application of traditional fertilizer, nano fertilizer and micronutrient on yield parameters were significantly improved by using traditional fertilizer, nano fertilizer and micronutrient are No. of Flower cluster per plant, Fruit set per cluster, Individual fruit weight, Polar diameter, Equatorial diameter, No. of fruits per plant, fruit yield per plant, Fruit yield per hectare. The experiment result revealed that all yield parameters were significantly improved by using traditional fertilizer, nano fertilizer and micronutrient.

Number of clusters per plant of plant significantly varied among different treatment combinations. The maximum number of clusters per plant (8.46) were observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc, These results are in close conformity with the findings of Basavarajeshwari et al. (2008); Saravaiya et al. (2014); Kumar et al. (2016); Reddy et al. (2018) and Shnain et al. (2021). Number of fruit set per cluster of plant significantly varied among different treatment combinations. The maximum number of fruit set per cluster (8.00) were observed with with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc due to increased number of flowers which might have formed into fruits due to adequate availability of major and minor nutrients during its growth and development. Similar findings were reported by Kazemi et al. (2013); Sivaiah et al. (2013); Pandiyan et al. (2018); Swetha et al. (2018) in tomato.

Fruit weight of plant significantly varied among different treatment combinations. The maximum fruit weight (88.40) was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc. Nutrients play an important role in improving productivity and quality of Tomato. Added dose of nitrogen,

**Table 1. Effect of traditional fertilizer, nano fertilizer and micronutrient on growth parameter and qualitative parameters**

| Notation | Treatments | Plant height | Survival percentage | Tss | Ascorbic acid |
|---|---|---|---|---|---|
| T0 | CONTROL | 88.78 | 93.12 | 3.256 | 15.325 |
| T1 | 100 % NPK traditional fertilizer + 100 % ZnSO4 as basal | 90.587 | 94.29 | 3.367 | 17.067 |
| T2 | 75 % N through traditional method + 100 % PK + 100 % Zn + 25% spray through Nano urea | 96.893 | 96.777 | 4.333 | 21.5 |
| T3 | 50% N through traditional method+ 100%PK+ 100% ZnSO4+ 50% spray through Nano urea | 96.037 | 96.37 | 4.197 | 20.667 |
| T4 | 25%N through traditional method+ 100%PK+ 100% ZnSO4+ 75% spray through Nano urea | 95.597 | 95.997 | 3.867 | 20.033 |
| T5 | 100 % NPK + 75 % ZnSO4 through traditional method + 25% spray through Nano zinc | 97.917 | 97.03 | 4.433 | 22.867 |
| T6 | 100 % NPK + 50 % ZnSO4 through traditional method + 50% spray through Nano zi | 98.88 | 98.403 | 4.483 | 23.433 |
| | 100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc | | | | |
| T7 | 100% N +Nano urea+ 100% PK+ 100% ZnSO4 as basal | 100.253 | 99.483 | 5.367 | 26.3 |
| T8 | 100% N +Nano urea+ 100% PK+ 100% ZnSO4 as basal | 95.157 | 95.377 | 3.583 | 19.033 |
| T9 | 100% Nano zinc+ 100% NPK through traditional method | 95.363 | 95.58 | 3.6 | 20 |
| T10 | 100% Nano urea + 100% Nano zn + 100% PK as basal | 92.327 | 95.0673 | 3.533 | 18.4 |
| | **F-Test** | **S** | **S** | **S** | **S** |
| | CD 0.05 | 3.829 | | 0.571 | 1.413 |
| | SE(d) | 1.808 | | 0.27 | 0.667 |
| | C.V. | 2.309 | | 8.105 | 3.903 |

**Table 2. Effect of traditional fertilizer, nano fertilizer and micronutrient on yield parameters**

| Notation | Treatments | No. of flower cluster/plant | Fruit set/cluster | Fruit weight | Polar diameter | Equatorial diameter | No. of fruit/plant | Fruit yield /plant | Fruit yield /hectare |
|---|---|---|---|---|---|---|---|---|---|
| T0 | CONTROL | 4.12 | 3.911 | 78.76 | 60.432 | 64.123 | 30.12 | 2.51 | 98.21 |
| T1 | 100 % NPK traditional fertilizer + 100 % ZnSO4 as basal | 5.467 | 5.133 | 80.143 | 61.547 | 65.363 | 34.56 | 2.76 | 102.57 |
| T2 | 75 % N through traditional method + 100 % PK + 100 % Zn + 25% spray through Nano urea | 7.373 | 7.433 | 83.557 | 65.597 | 68.553 | 54.8 | 4.58 | 169.63 |
| T3 | 50% N through traditional method+ 100%PK+ 100% ZnSO4+ 50% spray through Nano urea | 7.267 | 7.2 | 82.473 | 65.403 | 68.023 | 52.31 | 4.317 | 159.877 |
| T4 | 25%N through traditional method+ 100%PK+ 100% ZnSO4+ 75% spray through Nano urea | 6.6 | 7 | 81.547 | 63.82 | 66.887 | 46.2 | 3.767 | 139.507 |
| T5 | 100 % NPK + 75 % ZnSO4 through traditional method + 25% spray through Nano zinc | 7.5 | 7.533 | 84.813 | 65.737 | 68.657 | 56.52 | 4.793 | 177.533 |
| T6 | 100 % NPK + 50 % ZnSO4 through traditional method + 50% spray through Nano zi | 8 | 7.567 | 88.14 | 67.213 | 70.203 | 60.54 | 5.333 | 197.53 |
| | 100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc | | | | | | | | |
| T7 | 100% N +Nano urea+ 100% PK+ 100% ZnSO4 as basal | 8.467 | 8 | 88.407 | 69.517 | 71.33 | 67.74 | 5.99 | 221.853 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| T8 | 100% N +Nano urea+ 100% PK+ 100% ZnSO4 as basal | 6.3 | 6.8 | 80.147 | 63.4 | 68.023 | 42.81 | 3.433 | 127.163 |
| T9 | 100% Nano zinc+ 100% NPK through traditional method | 6.5 | 7 | 80.44 | 63.62 | 66.083 | 45.49 | 3.66 | 135.557 |
| T10 | 100% Nano urea + 100% Nano zn + 100% PK as basal | 5.827 | 6.163 | 80.143 | 62.107 | 66.017 | 35.92 | 2.883 | 106.79 |
| | **F-Test** | **S** | **S** | **s** | **S** | **s** | **s** | **s** | **s** |
| | CD 0.05 | 0.215 | 0.389 | 1.396 | 2.813 | 1.618 | 3.17 | 0.26 | 9.61 |
| | SE(d) | 0.072 | 0.13 | 0.466 | 1.329 | 0.764 | 1.49 | 0.123 | 4.54 |
| | C.V. | 1.793 | 3.226 | 0.973 | 2.512 | 1.384 | 3.74 | 3.661 | 3.661 |

phosphorus and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of Ali et al. (2015); Haleema et al. (2017); Satyamurthy et al. (2017); Pandiyan et al. (2018); Singh et al. (2018) and Shnain et al. (2021) as reported in tomato.

Polar diameter significantly varied among different treatment combinations. The maximum fruit girth (69.51) was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc.

Equatorial diameter significantly varied among different treatment combinations. The maximum fruit girth (71.33) was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc.

Number of fruits per plant of plant significantly varied among different treatment combinations. The maximum number of fruits per plant (67.74) were observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc Maximum number of fruits per plant increase of T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc might be due to increased number of flowers which might have formed into fruits due to adequate availability of major and minor nutrients during its growth and development. Similar findings were reported by Sathyamurthy et al. (2017); Reddy et al. (2018); Singh et al. (2018) in tomato.

Fruit weight of plant significantly varied among different treatment combinations. The maximum fruit weight (88.40) was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc Nutrients play an important role in improving productivity and quality of Tomato. Added dose of nitrogen, phosphorus and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of Ali et al. (2015); Haleema et al. (2017); Satyamurthy et al. (2017); Pandiyan et al. (2018); Singh et al. (2018) and Shnain et al. (2021) as reported in tomato.

Fruit yield per plant significantly varied among different treatment combinations. The maximum fruit yield (5.99) was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc. Nutrients play an important role in improving productivity and quality of Tomato. Added dose of nitrogen, phosphorus and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of Sivaiah et al. (2013); Ali et al. (2015); Haleema et al. (2017); Satyamurthy et al. (2017); Pandiyan et al. (2018); Singh et al. (2018) and Shnain et al. (2021) as reported in tomato.

Fruit yield per hectare significantly varied among different treatment combinations. The maximum fruit yield per hectare (221.85) was observed with T7 {100 % NPK + 25 % ZnSO4 through traditional method + 75% spray through Nano zinc. Nutrients play an important role in improving productivity and quality of Tomato. Added dose of nitrogen, phosphorus and other essential nutrients increased the vigor of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of Kazemi (2013); Saravaiya et al. (2014); Ali et al. (2015); Haleema et al. (2017); Satyamurthy et al. (2017); Pandiyan et al. (2018); Singh et al. (2018) and Shnain et al. (2021) as reported in tomato.

## 4. CONCLUSION

From the above experiment finding it may be concluded that the treatment $T_7$(100 % NPK + 25 % $ZnSO_4$ through traditional method + 75% spray through Nano zinc) was found to be best in the terms of growth viz,. plant height, survival percentage, days to first flowering, days to 50% flowering, days to first harvesting, number of flower cluster per plant, fruit set per plant, number of fruits per plant and in terms of yield viz,. average fruit weight, Yield per plant, Yield per Hectare and in terms of quality viz,. Ascorbic Acid content and TSS of fruit and in terms of economic viz,. Net return and B:C ratio.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Harish MS, Gowda R. Effect of nanoscale zinc oxide on plant growth, seed yield and quality in groundnut. Mysore Journal of Agricultural Sciences. 2017;513:637-643.

2. Sathyamurthy VA, Shanmugasundaram T, Rajasree V, Arumugam T. Effect of foliar application of micronutrients on growth, yield and economics of tomato (*Lycopersicon esculentum* Mill.). Madras Agricultural Journal. 2017;104(4-6): 188-193.
3. Janmejya Panda, Alok Nandi, Siba Prasad Mishra, Asit kumar Pal and Nitish kumar Jena 2020. Effects of nano fertilizer on yield, yield attributes and economics in tomato (*Solanum lycopersicum* L.) International Journal of Current Microbiology and Applied Sciences; 2017.
4. Datir RB, Patel PR, Shinde KB. Effect of foliar application of zinc and iron nanoparticles on growth of okra and chilli. Journal of Phytology. 2010;2(7):47-53.
5. Moghaddasi S, Khoshgoftarmanesh AH, Karimzadeh F, Chaney RL. Preparation of nano-particles from waste tire rubber and evaluation of their effectiveness as zinc source for cucumber in nutrient solution culture. Scientia Horticulturae. 2013;160:398-403.
6. Yassen A, Abdallah E, Gaballah M, Zaghloul S. Role of silicon dioxide nano fertilizer in mitigating salt stress on growth, yield and chemical composition of cucumber *Cucumis sativus* L. International Journal of Agricultural Research. 2017; 12:130-135.
7. Naga Sivaiah K, Swain SK, Sandeep Varma V, Raju B. Effect of foliar application of micronutrients on growth parameters in tomato (Lycopersicon esculentum mill.). Discourse J Agric Food Sci. 201;1(10):146-51.
8. Meena EC, Maji SJ, Meena K, Govind R, Kumawat KR, Meena SK, Sodh K. Improvement of Growth, Yield and Quality of Tomato (*Solanum lycopersicum* L.) cv. Azad T-6 with Foliar Application of Zinc and Boron. International Journal of Bio-resource and Stress Management. 2015;6(5):598-601.
9. Singh J, Dutta T, Kim KH, Rawat M, Samddar P, Kumar P. 'Green'synthesis of metals and their oxide nanoparticles: applications for environmental remediation. Journal of Nanobiotechnology. 2018;16(1): 1-24.
10. Singh RK, Tiwari MK, Singh R, Lee JK. From protein engineering to immobilization: promising strategies for the upgrade of industrial enzymes. International Journal of Molecular Sciences. 2013;14(1):1232-77.


---



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*https://www.sdiarticle5.com/review-history/104661*