

Original Research Article

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Effects of Nano Fertilizer on Vegetative Growth of Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

A field experiment was conducted on tomato (cv. Utkal Pallavi) during the winter season of 2018-19, in order to evaluate the performance of new commercial nano-based, water soluble, foliar fertilizer in relation to commonly adopted water soluble foliar fertilizer with regard to vegetative growth. The experiment was laid out in the randomized block design with 8 treatments and 3 replications. Results revealed that the treatment T₆ (Pramukh foliar spray @ 5g/l + RDF) was found to be the best with respect to the characters branches/plant, plant spread (E-W & N-S), width of leaf and leaf area. T₈ was maximum with respect to plant height, number of leaves/plant and length of leaf. As regards plant girth, T₄ (Pramukh foliar spray @ 3g/l + RDF) was superior followed by T₈ (Control) and T₆ (Pramukh foliar spray @ 5g/l + RDF).

Keywords

Tomato, nano-fertilizer, vegetative growth, foliar application

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Introduction

Nano technology is a new scientific approach that includes the use of materials and equipments capable of using physical and chemical properties of a substance at molecular levels to explore the biological and material worlds in nanometer scale and use it in various carriers from medicine to agriculture. It is the science and technology of tiny things, that are less than 100 nm in size (1 nm = 10⁻⁹ m). Various applications of

nanotechnology are seen in the fields of agriculture, medicine, air and water pollution, solar cells, electronics etc.

Basically, in the field of agriculture, use of nano nutrients based fertilizers can mitigate the problems caused by inorganic fertilizers such as environmental pollution, leaching, increasing salinity and toxicity, plant damage etc. Nano nutrients based fertilizers are highly soluble, providing actual concentration and controlled release of nutrients due to higher

surface area with targeted activity and are also environmentally safe than the commercially used inorganic fertilizers.

Among different vegetable crops, tomato universally treated as “Protective Food” is being extensively grown as annual plant all over the world. It is rich in lycopene which is an important antioxidant. It is a very good appetizer and its soup is said to be a good remedy for patients suffering from constipation (Thamburaj and Singh, 2001). Khanm *et al.*, (2017) found that application of 400ppm nano ZnO particles on the tomato plant as seed priming or seed priming + foliar spray increased yield and growth. Priya *et al.*, (2015) observed that 20 and 30ppm of nano phosphorus increased the germination% up to 20.83% and also increased the root length (47%) and shoot length (33.66%) of cowpea.

Practically, no research work has been undertaken in Odisha with particular reference to application of nano fertilizers in

tomato. Hence, an experiment was conducted with the objective of analyzing the effects of nano-based commercial NPK fertilizer on vegetative growth of tomato.

Materials and Methods

The experiment was conducted in the experimental field under the Department of Horticulture, Institute of Agricultural Sciences, Siksha ‘O’ Anusandhan (Deemed to be University), Bhubaneswar, during the winter season of 2018-19.

Design layout - Randomized Block Design.

Number of treatments - 8 and number of replications - 3

Spacing - 50 cm x 30 cm

Textural class of the cultivated soil - Loamy sand

Details of Treatments

Sl. No.	Treatments
T ₁	Nano-Max NPK @ 3ml/l of water foliar spray + RDF
T ₂	Nano-Max NPK @ 4ml/l of water foliar spray + RDF
T ₃	Nano-Max NPK @ 5ml/l of water foliar spray + RDF
T ₄	Pramukh @ 3g/l of water foliar spray + RDF
T ₅	Pramukh @ 4g/l of water foliar spray + RDF
T ₆	Pramukh @ 5g/l of water foliar spray + RDF
T ₇	Nano-Max NPK @ 4ml/l foliar spray + Pramukh @ 4g/l of water foliar spray + RDF
T ₈	Control (Only RDF)

(RDF- Recommended Dose of Fertilizer@ 125 kg N : 60 kg P₂O₅ : 100 kg K₂O/ha)

Nano-max NPK

Nano-Max NPK is totally bio-available & bio-degradable & completely absorbable by plant. It promotes growth of green leaves, photosynthesis, carbohydrates, oil fats &

proteins in crop. It contains multiple Organic acids (protein lacto-gluconates) based chelated major nutrients (N, P, K) (min.4-4-4%) along with amino acids @ 6.00% (min.), Organic Carbon @ 10.00% & formulated with organic micro nutrients / trace elements -

vitamins and probiotic. It is manufactured by J.U. Agri Science Pvt. Ltd., Indore, Madhya Pradesh.

Pramukh

Multiplex Pramukh contains Nitrogen(N) : Phosphorous (P) : Potassium(K), in the ratio of 19:19:19. This product is available in powder form. It supplies major nutrients to the plants in easily available form quickly. It is manufactured by Agriplex Pvt. Ltd., Mahalakshmi Layout, Bengaluru, Karnataka.

Details of cultural operations

Sowing and transplanting

Seeds of tomato variety Utkal Pallavi were 1st treated with Bavistin @ 2g/kg of seed and were sown in the nursery bed on 23rd October, 2018. Mulching was done with paddy straw. Transplanting of seedlings was done on 19th November, 2018 and irrigated immediately.

Application of fertilizers

Farm yard manure @25t/ha was applied at land preparation before transplanting. Inorganic fertilizers like Urea (20%) + single super phosphate (full rate) + muriate of potash (20%) were applied as basal. The first top dressing of urea (40%) + muriate of potash (40%) were applied at 15 days after transplanting. The second top dressing with the remaining 40% urea and muriate of potash was done at 30 days after transplanting. Three sprays of all the treatments of Nano-Max NPK and Multiplex Pramukh fertilizers were applied at respective doses to different subplots at the time of 1st and 2nd topdressing and 15 days after 2nd topdressing.

Other cultural practices

All other cultural practices were adopted as

per recommended packages.

Sampling technique

Five plants from each plot were taken randomly excluding border plants and were tagged as sample plants for recording observations. Observations on plant height, no. of branches per plant, plant spread (East-West and North-South), no. of leaves per plant, leaf area, length and width of fully grown leaves and plant girth were recorded periodically.

Statistical analysis

Analysis of variance method as suggested by Panse and Sukhatme (1985) was used for statistical analysis for Randomized Block Design. Standard error of mean (SEm \pm) and critical difference (CD) at 5 percent level of significance were worked out for each character.

Results and Discussion

The field experiment was conducted during the winter season of 2018-19 to study the effects of commercial nano-based and other conventional water soluble fertilizers as foliar sprays (in different concentrations) on tomato variety Utkal Pallavi (BT-1). Observations were systematically recorded on vegetative growth parameters, results of which have been presented below and discussed simultaneously.

Plant height (cm)

A perusal of Table 1 showed that there were significant differences among the treatments in case of plant height, which ranged from 57.71cm to 64.48cm. However, T₈, T₆, T₄, T₅ and T₇ had similar values statistically. T₈ was significantly superior (64.48cm) to T₄, T₃ and T₂ treatments. T₆, T₄, T₅ and T₇ were at par. T₄, T₅, T₇, T₁, T₃ and T₂ had given the similar

results. Several researchers observed better effect of nano fertilizers on plant height (Dehkourdi and Mosavi *et al.*, (2013); Priya *et al.*, (2016); Anandaraj and Natarajan, (2017); Rathnayak *et al.*, (2018). The least value (57.71cm) was observed in case of the treatment T₂.

Branches per Plant

Significant differences were observed among the different treatments with respect to branches per plant (Table 1). The values ranged from 5.53 to 7.13. T₆ and T₈ were at par and T₆ was significantly superior (7.13) to T₃, T₇, T₅, T₂, T₄ and T₁. T₈, T₃ and T₇ gave the similar results statistically. T₃, T₇, T₅, T₂ and T₄ were at par. T₅, T₂, T₄ and T₁ also produced similar results. This confirms the findings of Manasa and Hebsur, (2016); El-Metwally *et al.*, (2018). The lowest value (5.53) was observed in case of T₁.

Plant spread (E-W) (cm)

It was evident from Table 1 that there were significant differences were obtained with regard to plant spread (E-W), which ranged from 53.63cm to 65.50 cm. T₆, T₈, T₅ and T₄ treatments were at par. T₇, T₃, T₂ and T₁ were significantly inferior to T₆ treatment (65.50cm). T₅, T₄, T₇ and T₃ showed similar results statistically. T₇, T₃, T₂ and T₁ were at par. Manasa and Hebsur (2016) also made similar observations. However, T₁ had the lowest value (53.63cm) in this respect.

Plant spread (N-S) (cm)

It was seen from Table 1 that significant differences existed with respect to plant spread (N-S), which ranged from 58.97cm to 67.43cm. T₆ produced the highest (67.43cm) plant spread which was at par with T₄, T₈ and T₅ in this regard. T₅, T₃ and T₇ were statistically similar. T₂ and T₁ were also at par. However, the smallest value (58.97cm)

was obtained in T₁.

No. of leaves per plant

Significant differences were observed regarding no. of leaves per plant, which ranged from 58.27 to 77.40 (Table 2). The treatments T₈, T₆, T₅, T₄ and T₇ were at par. T₈ (77.40) was superior to T₁, T₃ and T₂. However, T₆, T₅, T₄, T₇ and T₁ were similar statistically. This tallies with the observations of Manasa and Hebsur (2016) and Yassen *et al.*, (2017). T₁, T₃ and T₂ also at par in this respect. T₂ treatment had lowest (58.27) no. of leaves per plant.

Length of leaf (cm)

It was evident from Table 2 that there were significant differences in case of length of leaf, which ranged from 18.98cm to 23.87cm. T₈, T₆, T₄ and T₃ were at par and T₂, T₇, T₅ and T₁ were significantly inferior to T₈. T₄, T₃ and T₂ were similar while T₇ and T₅ treatments also at par statistically. However, the highest (23.87cm) leaf length was recorded in T₈ and the lowest (18.98cm) in T₁ treatment.

Width of leaf (cm)

Significant differences were seen with regard to width of leaf, which ranged between 17.11cm and 22.18cm (Table 2). T₆, T₄, T₈ and T₃ treatments were similar statistically and T₂, T₇, T₅ and T₁ were significantly inferior to T₆. T₃, T₂, T₇ and T₅ were at par. T₂, T₇, T₅ and T₁ were also similar. T₆ performed best (22.18cm) in this respect and the lowest width (17.11cm) was seen in case of T₁.

Leaf area (sq.cm)

It was observed from Table 2 that there were significant differences regarding leaf area of tomato plant, which ranged from 109.77

sq.cm to 141.71 sq.cm. The treatments T₆, T₈, T₄, T₅, T₇ and T₃ showed similar result and T₂ and T₁ were significantly inferior than T₆. T₂ and T₁ were at par statistically. However, T₆ produced the highest (141.71 sq.cm) leaf area and T₁ showed the least value (109.77 sq.cm) in this respect. The treatments T₆, T₇ and T₃ showed similar results. Several researchers (Hafeez *et al.*, (2015); Jhazab *et al.*, (2017); Jyothi and Hebsur, (2017); Singh and Kumar, (2017); Sushmitha *et al.*, (2018) also made similar observations regarding better effect of

nano-fertilizers on leaf area.

Plant girth (cm)

It was evident from Table 2 that there were no significant differences among the treatments as regards plant girth, which ranged between 4.92cm and 5.27cm. The highest value (5.27cm) was seen in case of T₄ followed by T₈ and T₆. The lowest value (4.92cm) was observed in case of T₂ treatment.

Table.1 Effects of nano-fertilizer on plant height, branches/plant, plant spread (E-W) and plant spread (N-S) of tomato

Treatments		Plant height (cm)	Branches per plant	Plant spread (E-W) (cm)	Plant spread (N-S) (cm)
T ₁	Nano-Max NPK (3ml/l) + RDF	58.61	5.53	53.63	58.97
T ₂	Nano-Max NPK (4ml/l) + RDF	57.71	5.87	55.64	59.51
T ₃	Nano- Max NPK (5ml/l) + RDF	58.36	6.40	57.47	61.03
T ₄	Pramukh (3g/l) + RDF	61.55	5.80	61.29	65.94
T ₅	Pramukh (4g/l) + RDF	61.17	5.87	61.82	64.49
T ₆	Pramukh (5g/l) + RDF	63.45	7.13	65.50	67.43
T ₇	Pramukh (4g/l) + Nano-Max NPK (4ml/l) + RDF	59.67	6.40	57.64	60.59
T ₈	Control (No spray + RDF)	64.48	6.67	65.15	65.57
SE(m)±		1.59	0.20	1.83	1.43
CD(0.05)		4.81	0.60	5.56	4.33
CV(%)		4.53	5.53	5.32	3.93

Table.2 Effects of nano-fertilizer on number of leaves/plant, length and width of leaf, leaf area and plant girth of tomato

Treatments		No. of Leaves per plant	Length of leaf (cm)	Width of leaf (cm)	Leaf area (sq.cm)	Plant girth (cm)
T ₁	Nano-Max NPK (3ml/l) + RDF	64.80	18.98	17.11	109.77	5.12
T ₂	Nano-Max NPK (4ml/l) + RDF	58.27	20.76	19.11	112.09	4.92
T ₃	Nano- Max NPK (5ml/l) + RDF	59.93	22.32	20.62	122.51	4.97
T ₄	Pramukh (3g/l) + RDF	68.53	23.25	21.92	129.41	5.27
T ₅	Pramukh (4g/l) + RDF	70.60	19.94	18.45	126.93	4.94
T ₆	Pramukh (5g/l) + RDF	73.00	23.61	22.18	141.71	5.15
T ₇	Pramukh (4g/l) + Nano-Max NPK (4ml/l) + RDF	67.47	20.05	18.68	124.47	4.98
T ₈	Control (No spray + RDF)	77.40	23.87	21.91	132.92	5.25
SE(m)±		4.07	0.87	0.89	7.68	0.17
CD(0.05)		12.35	2.65	2.71	23.28	NS
CV(%)		10.45	7.01	7.73	10.64	5.81

The treatment T₆ (Pramukh foliar spray@ 5g/l + RDF) was found to be the best with respect to the characters branches/plant, plant spread (E-W & N-S), width of leaf and leaf area. T₈ (Control) was the best with respect to plant height, number of leaves/plant and length of leaf. T₄ (Pramukh foliar spray @ 3g/l + RDF) was superior as regards plant girth followed by T₈ (Control) and T₆ (Pramukh foliar spray @ 5g/l + RDF).

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