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Effect of Different Level of Nitrogen Fertilizer on Growth Yield and Yield Component of Tomato (*Lycopersicon esculentum* Mill.) at West Showa Zone, Oromia, Ethiopia

Nemomsa Beyene and Tesfaye Amare

Ambo University, College of Agriculture and Veterinary Sciences,
Department of Plant Sciences, P.O. Box: 19 Ambo, Ethiopia.

Abstract: The field experiment was conducted in West showa zone, Toke kutaye district of Ormia region, Ethiopia with the objective to determine the optimum nitrogen fertilizer rate on different growth parameters, yield and yield component of tomato crop. To attain the objective, four level of nitrogen fertilizer Viz., 0, 50, 100 and 150 kg/ha were used as treatments. The experiment was laid out in randomized complete block design (RCBD) with three replications. Data on plant height, primary branches per plant, number of leaves per plants, number of cluster per plant, number of fruits per cluster and fruit yield were collected from five plants of the middle rows of each plot and subjected to statistical analysis software (SAS) version 9.3 and LSD at 5% was used for mean comparison. The statistical analysis showed that, there was the significant ($P<0.05$) difference among treatments for all parameters except for number of fruit per cluster. For growth variables, 150 kg/ha revealed the highest value but there was no significant ($P<0.05$) difference between 100 and 150 kg/ha of nitrogen except for the height of the plant. The treatment 150 kg/ha nitrogen fertilizer provided 22.41, 35.57 and 25.40% over the control treatment in height, number of leaves and primary branches, respectively. The treatment 150kg/ha nitrogen fertilizer increased the number of cluster per plant and yield of tomato fruit per hectare by 34.50 and 70.79% over the control treatment, respectively. However, there was no significant difference in both number of cluster per plant and yield per hectare between 150 and 100kg N/ha.

Key words: Tomato · Nitrogen Fertilizer · Yield Components · Yield

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) belongs to the family Solanacea, genus *Lycopersicon*, sub family *Solanoideae* and tribe *Solaneae* [1]. It is widely cultivated in tropical, subtropical and temperate climates and ranks third next to potato and sweet potato in terms of world vegetable production [2] with estimated annual area coverage and total production of 164 metric million tones which was harvested from 4.73 million hectares [3].

Among vegetable crops, tomato is the most important edible and nutritious worldwide [2]. Tomato plays an important role in human nutrition by providing essential amino acids, vitamins, minerals, sugars and dietary fibers [4]. The authors also reported that the fruit contains vitamin B and C, iron and phosphorus and its vitamin C content is particularly high and it is an important source of antioxidant such as lycopene. Tomato is almost always used as an essential ingredient in the diet of the people and in almost every household and usually used for preparing foods like soups, sauces, stews, salads and others, in cooked or processed form in large quantities as compared to other vegetables [5].

In Ethiopia, the highest share of commercial vegetable is taken by tomato [6]. Edossa *et al.* [7] indicated that the climatic and soil condition of Ethiopia allow cultivation of wide range of fruit and vegetable crops including tomato. The crop is produced at altitude range of 700 up to 2200 meter above sea level and with about 700 to over 1400 mm annual rain fall on different soils and different weather conditions in Ethiopia [8]. The average yield of tomato in Ethiopia is extremely low, 8 tone/ha compared to the world average yields which is 34 tone/ha [9]. Tomato production in Ethiopia reduced

Corresponding Author: Nemomsa Beyene, Ambo University, College of Agriculture and Veterinary Sciences, Department of Plant Sciences, P.O. Box: 19 Ambo, Ethiopia.

from 6298.63 ha area coverage and 283648.27 quintal yield in 2016/17 to 5235.19 ha and 277, 745.38 quintals yield in 2017/18 cropping season [10].

The major yield reducing factors of tomato in Ethiopia are low soil fertility, erratic rainfall distribution, lack of high yielding cultivars, low soil moisture content, disease and insect pest and lack of optimum recommended fertilizer application rate [11]. Sanchez *et al.* [12] reported that, low fertilizer utilization and soil nutrient depletion is the major reason for low agricultural productivity in African country particularly in Ethiopia. Among these factors, application of optimum nitrogen fertilizer rate is one of the main determinant factors which significantly affect growth and yield of tomato in Ethiopia [13].

Tomato crop is highly responsive to nitrogen fertilizer application where nitrogen availability may be limited and time of the application is critical [14]. Hokam *et al.* [15] reported that nitrogen promotes vegetative growth and fruit yield, favors fruit development (when applied at later growing stage) and application of proper amount of the fertilizer has a dramatic effect on tomato growth and development. So far, fertilizer rates for tomato crop was determined only at Melkasa Research Center which cannot represent agro-ecologically for other tomato growing regions of the country and especially no such study was done for tomato under vertisol condition [16]. Therefore, it is prudent to test different rate of nitrogen fertilizer at different topographic area. Hence, the objective of this study was to determine the optimum nitrogen fertilizer level for growth, yield and yield components of Roma VF tomato variety at gudar area and for the areas of the similar soil type.

MATERIALS AND METHODS

Description of the Study Area: The study was conducted in Oromiya region, West Showa zone, Toke kutaye district in 2019 under irrigation. The site is located at distance of 137 km to west of Addis Ababa (capital city) at 8°58' North latitude and 37"46' East longitude with an elevation 2101 meters above sea level. The annual range of temperature of the area is 15-40°C, with rain fall which ranges from 1257-2000mm. The soil type of the area is *vertisol* with pH value of 5.5-6.5.

Treatments and Experimental Design: Roma VF tomato variety was used for the study. The seedling was prepared a head on a well prepared seed bed. The experiment was consisted of four nitrogen fertilizer rate (0, 50, 100, 150 kg/ha). The experiment was arranged in randomized complete block design (RCBD) with three replications. Each plot had 3.2 meter width and 2 meter length. The spacing between the blocks and plots were 1.5 m and 1m, respectively. Four rows per plot with 0.8 m and 0.4 m between the row and the plant, respectively, was used. Each row contained five plants. The treatments were assigned to the plots randomly.

Experimental Procedure, Data Collection and Data Analysis: The seedlings were transplanted to the experimental field accordingly. At transplanting, 50% N from the total of each treatment was added to the experimental plot and remaining 50% of N was added on 45 days of transplanting. Five plants from the middle two rows of each plot were randomly taken and tagged for

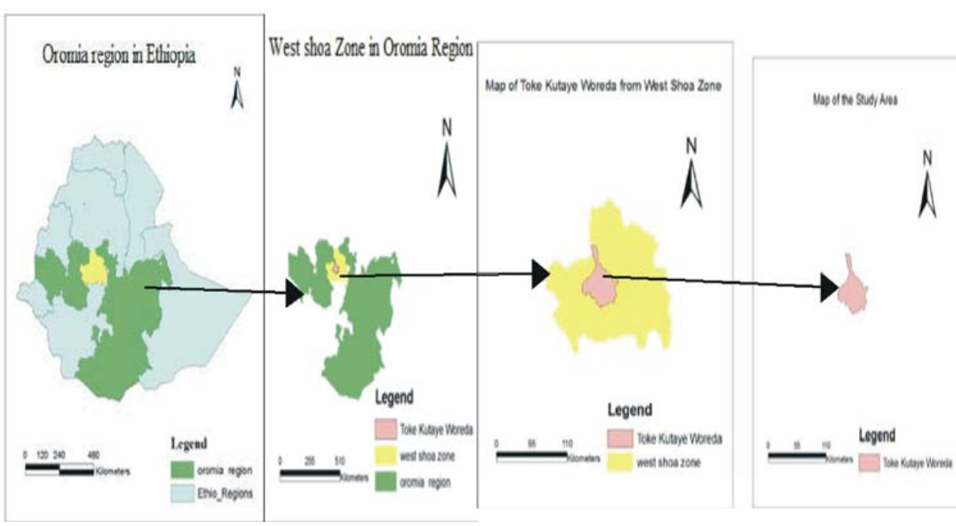

Fig. 1: Map of the study area. *Source*: Woreda Administrative office

data collection. Plant height, number of leaf per plant, number of primary branches, number of cluster per plant, number of fruit per cluster and fruit yield per hectare data were collected.

The collected data were subjected to SAS software version 9.3 for Analysis of Variance (ANOVA) and means comparisons for the significantly different variables were made among treatments using Least Significant Differences (LSD) test at 0.05 levels of significance.

RESULTS AND DISCUSSION

Effect of Nitrogen Fertilizer on Growth of Tomato: The statistical analysis showed that there was significant ($P<0.05$) difference among treatments in affecting the height of the plant. The longest (61.26 cm) and the shortest (47.53 cm) plant was recorded from the plot treated by 150 and 0kg N/ha, respectively, (Table 1). The height of tomato plant was increased with the rate nitrogen fertilizer. However, there was no significant difference between 0 and 50 kg N/ha in influencing the height of tomato. This result was in agreement with the result obtained by Biswas *et al.* [17] who revealed that the tallest plant was obtained by applying 150 kg N/ha. This study also in line with the study conducted by Najafvand *et al.* [18] who reported that as the amount of nitrogen fertilizer increase the height of tomato also increase. Applying 150 Kg N/ha increases plant height by 22.41, 19.03 and 9.5% compared to the control (0 kgN/ha), 50 and 100 kg/ha, respectively. while, 100 kg/ha increased plant height by 14.25% compared to the control which was in line with the study conducted by Gezu *et al.* [19] who revealed 13.6% in plant height increment compared to the control (no fertilizer application) by application of 99 kg N/ha. The increase in plant height could be due to the readily available nitrogen which promotes vegetative growth and development. Nitrogen nutrient is responsible for photosynthesis, formation of chlorophyll and nucleic acids, its absence or deficiency causes stunted growth [20], hence this nutrient responsible for accumulation of greater biomass. These results was in in line with the results obtained by Akbar [21] who found that plant height in tomato increased with increase in nitrogen rate.

The study revealed that there was significant ($P<0.05$) difference between 0 kg N/ha and 100 kg N/ha, 0 kg/ha and 150 kg/ha, 50 kg/ha and 100 kg/ha and 50 kg/ha and 150 kg/ha of nitrogen fertilizer in influencing the number of leaves per plant. The study revealed that, as the rate of nitrogen fertilizer increase, the number of leaves per plant also increases. The highest leaf number per plant was recorded from the plot treated with 150 kg N/ha. Biswas *et al.* [17] also reported the heights number of leaves per plant of tomato from the plot treated by 150kg N/ha. However, application of 150kg N/ha was not significantly different from 100kg N/ha on influencing number of leaves per plants and also using 50kg N/ha also not different from using 0 kg N/ha on number of leaves per plant. Many authors reported that supplementary application of nitrogen fertilizer increase number of leaves per plant [21]. This result also in agreement with the result of Balemi [13] who reported that as nitrogen fertilizer level increases the number of tomato leaf increased.

Number of primary branches per plant was significantly ($P<0.05$) affected by rate of nitrogen fertilizer. The number of primary branch at 150 and 100kg N/ha was 5.0 and 4.93, respectively, which was reduced to 4.08 and 3.73 when 50 and 0 kg N/ha applied, respectively. Application of 150 kg/ha did not make significant difference in number of primary branch compared to 100 kg/ha but significantly different from 50 and 0 kg/ha. Iqbal *et al*. [22] also reported that, application of 90 kg N/ha resulted in 4.33 number of primary branches which in par with using 100 kg/ha in this study. Application of 100 kg N/ha increased the number of branch by 24.34% compared to application of 0 kg nitrogen fertilizer. The number of branch per plant increased with increasing nitrogen application up to optimum level. Degefa *et al.* [19] also reported that, as the rate of nitrogen increases from 0-99 kg/ha, the number branches in tomato increase and 99 kg/ha nitrogen application increased number of branches by 28.9% compared to the nil nitrogen fertilizer.

Effect of Nitrogen on Yield Component of Tomato: Application of nitrogen fertilizer resulted in significant ($P<0.05$) change on number of cluster per plant of tomato. The highest number of cluster per plant was recorded from the plot received 150 kg N/ha (20.40) followed by 100 kg N/ha (19.26) which was significantly different from the plot treated by 50 and 0 kg/ha (Table 2). However, there was no significant different between the plots treated by 100 and 150 kg/ha in number of cluster per plant. In this study, as the nitrogen fertilizer level increased, the number of clusters per plant also increased however, the successive rates of fertilizer were not significantly different in affecting number of cluster per plant of tomato. The most probable reason could be tomato cluster formation do not give significant response

Table 1: Effect of nitrogen fertilizer rate on plant height, leaf number, branch number of tomato

Treatment N kg/ha	Plant height (cm)	Number of leaves per plant	Number of primary branch
0	47.53[c]	27.53[b]	3.73[c]
50	49.60[c]	31.20[b]	4.08[c]
100	55.43[b]	38.60[a]	4.93[ab]
150	61.26[a]	42.73[a]	5.0[a]
Mean	53.46	35.01	4.44
LSD (5%)	5.49	5.38	0.83
CV (%)	5.12	7.69	10.417

Means within the same column followed by the same letter(s) are not significantly different from each other and different letter(s) indicated significantly different at 5% level of significance.

Table 2: Effect of different rate of nitrogen fertilizer on number of clusters per plant, number of fruits per clusters and yield in tone per hectare of tomato

Treatment N kg/ha	Number of cluster/plant	Number of fruit/cluster	Yield t/ha
0	13.36[c]	4.5333[a]	8.393[c]
50	14.20[bc]	4.53[a]	18.073[b]
100	19.26[ab]	4.80[a]	28.233[a]
150	20.40[a]	5.06[a]	28.737[a]
Mean	16.88	4.73	20.867
LSD (5%)	5.72	0.81	2.1941
CV (%)	16.81	8.59	5.27

Means within the same column followed by the same letter(s) are not significantly different from each other and different letter(s) indicated significantly different at 5% level of significance

for to narrow rate of fertilizer. This result was in line with the result obtained by Iqbal *et al.* [22]. Biswas *et al.* [17] also reported highest number of cluster per plant of tomato from the plot treated by 150 kg N/ha.

The analysis of the result demonstrated that the various doses of nitrogen fertilizer showed non-significant on number of fruits per cluster of tomato even if the mean values were different from each other. This result was disagreed with the result revealed by Biswas *et al.* [17] who reported significant difference among nitrogen fertilizer levels in number of fruits per cluster but on different cultivar (BARI Tomato-9). This could be different variety of tomato responds to level of nitrogen fertilizer differently regarding number of fruits per cluster.

Effect of Nitrogen on Yield of Tomato: The result of analysis showed that, there was significance ($P<0.05$) difference among treatments in influencing yield of tomato. The highest yield was obtained from the plot treated by 150 kg N/ha (28.737 t/ha) which was not significantly different from the plot treated by 100 kg N/ha (28.233 t/ha). The lowest yield (8.393 t/ha) was recorded from the plot treated by nil nitrogen fertilizer. There was significant differences between 0 kg and 100 kg N/ha and between 50 and 100 kg N/ha in influencing the yield of tomato. This result revealed that the gradual increase in yield of tomato with the rate of nitrogen fertilizer up to optimum level. This result was in line with the finding of Biswas *et al.* [17] who reported that the highest fruit yield from the plot treated with 150 kg N/ha. Application of 150 and 100 kg N/ha increased yield of tomato by 70.79 and 70.27%, respectively, compared to the control treatment. Application of 50 kg N/ha had 9.68 t/ha yield advantage over the nil (control) fertilizer application. The result of this study was in line with result of Warner *et al.* [23] who reported that, as the rate of nitrogen fertilizer increases, the yield of tomato increase. Biswas *et al.* [17] also reported the highest fruit yield of tomato when the crop treated by 108.6 kg N /ha at the eastern part of Ethiopian country.

CONCLUSION

The rate 100 and 150 kg /ha provided 28.233 and 28.737 t/ha yield, respectively, in which. Then, However, there was no significant difference between the two treatments. Hence, the rate 100 kg/ha nitrogen fertilizer can be recommended for optimum yield of tomato (Roma VF variety) in the study area and areas with similar soil type.

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