

**Effect of Different Levels of Nitrogen and Filter  
mud on Tomato Vegetative Growth Yield and  
Yield Components**

**ABSTRACT**

**Aim:** This study aimed to evaluate the effect of different levels of nitrogen and filter mud cake applications on vegetative growth and yield on tomato cultivar "Castle Rock".

**Place and Duration of Study:** Field experiments were conducted during two successive winter seasons 2015/2016 and 2016/2017 at the experimental farm, Faculty of Agriculture and Natural Resources, University of Bakht Al Ruda, Ed Duiem, Sudan.

**Methodology:** Treatments included three Nitrogen levels (0, 43 and 86 kg N/ ha) and three filter mud levels (0, 2 and 4 ton/ ha). Urea (46%N) was used as source of nitrogen and applied after fifteen days from sowing. Filter mud Cake was applied one month before sowing. The treatments were arranged in a randomized complete block design with three replications.

**Results:** Results showed significant differences among N treatments in tomato vegetative growth, yield and yield components in the two seasons. The 86 kg N/ ha showed the highest vegetative growth yield and yield components compared to control. The filter mud application at both rates showed significant increase in the most vegetative growth parameters, yield and yield components compared to the control in the two seasons. The combination of N and filter mud resulted in significant increase in vegetative growth and yield components, the highest values were obtained by application of 86 kg/ha combined with 4 ton filter mud /ha.

**Conclusion:** Considering the present study it can be concluded that the application of 86 kg/ha combined with 4 ton filter mud /ha is the best level in terms of maximum vegetative growth, yield and yield components of Castle Rock tomato cultivar.

**Keywords:** Filter mud; nitrogen; fertilization; tomato; growth, yield; Sudan.

**1. INTRODUCTION**

Tomato (*Lycopersicon esculentum* Mill.) belongs to the family Solanaceae and is one of the most widely consumed and popular vegetables in the world. Its popularity comes from the fact that it can be eaten fresh or in multiple of processed forms. Recently, the consumption of tomatoes has been associated with prevention of several diseases [1; 2]. The tomato total world production is 161.7 million metric tons [3]. In Sudan the annual production of tomato is 423,350 tons. The main production areas are Gezira, south Blue Nile, Kassala, and Khartoum State [4]. Farmers are interested in tomato production more than any other vegetable for its multiple harvests, which result in high profit per unit area [5].

Industrial by-products in agriculture becomes use to enhanced the productivity of agricultural land and save the environment from its degradation through their disposal in the nearby area of the industries [6]. One of these important organic wastes is filter mud which is a by-product of sugar cane industry containing oxides of Si, Ca, P, Mg and K [7]. Recently, the high cost of fertilizers and concerns about environmental hazard have promoted incentives for studying the recycling of the large quantities of organic residues produced as by- products of the sugar industry. It is produced in large volumes (30-40kg/t of crushed cane) [8].

The usefulness of organic sources to meet the nutrient requisite of crop is not as assured as mineral fertilizers, but the joint employ of chemical fertilizers along with different organic sources is capable of enhancing soil quality and higher crop productivity on long- term basis [9]. Highest productivity of crops in sustainable way with no deteriorating the soil and other natural resources could be accomplished only by applying proper combination of various organic manures and inorganic fertilizers [10]. Therefore, this research conducted to study the effect of different levels of filters mud and Nitrogen on the vegetative growth, yield and yield components of tomato (Castle Rock) under field conditions.

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## 2. MATERIALS AND METHODS

Field experiments were conducted during the two successive winter seasons of 2015/16 and 2016/17 on the research farm of the Faculty of Agriculture and Natural Resources, University of Bakht ALRashid, Ed-Duiem, Sudan ( 32° 20' - East longitude, 13° 39' N latitude) . Soil of the experimental site is heavy clay. The physicochemical properties of the soil in the experimental site including was shown in Table 1. The area allotted for the experiment was disc ploughed, harrowed, leveled and made into a metal part. The experimental units were equipped with a distance of 2 m for length and 1 m for the width. The tomato seeds (Castle Rock) were sown manually in two sows of ridge in 3 – 2 cm deep holes. Spacing between holes was 50 cm. Seed rate was 5 seeds / hole. The seed were sown on 17 of November and 25 of November for the first and second seasons, respectively. Irrigation started directly after sowing, and continued for every 7- 10 days interval. All cultural practices were done as recommended. Three Nitrogen levels (0, 43 and 86 kg N/ha) applied at 15 days after sowing and three levels of filter mud cake (0, 2, and 4 t/ha) applied one month before sowing giving a total of 9 treatments. Urea (46%N) was used as source of nitrogen. Treatments were arranged in a randomized complete block design (RCBD) with three replications.

Four plants were randomly selected from each plot for growth parameters and yield components measurement and the following parameters were measured: number of leaves/plant, number of primary branches/plant, plant height (cm), stem girth (cm), fruit diameter (cm), fruit length (cm), fruit weight (gm), fruits weight per plant and total yield (t/ha).

Data were subjected to analysis of variance using M-Stat. C computer program. Means separation were done according to Duncan's Multiple Range Test (DMRT).

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**Table 1. Physicochemical characteristics of the soil in the experimental site**

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| <b>Soil characteristic</b> | <b>Values</b> |
|----------------------------|---------------|
| PH                         | 8.3           |
| Organic matter %           | 0.45          |
| Total N%                   | 0.016         |
| Available(P) mg/kg         | 10            |
| CEC cmol/kg                | 56            |
| K+ cmol/kg                 | 0.55          |
| CaCO <sub>3</sub> %        | 6.2           |

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### **3. RESULTS AND DISCUSSION**

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#### **3.1. Vegetative growth**

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86 The main effects of different nitrogen levels on vegetative growth parameters of  
87 tomato at 50% flowering during season 2015/2016 and 2016/2017 are shown in Table 2.  
88 Treatments showed significant differences in plant height and number of leaves in the two  
89 seasons. Application of 187 N kg/ha showed the highest values in all parameters at the two  
90 seasons. These results are in agreement with those reported by Elizabeth and John [11] and  
91 Oyindola and Jinadu [12] who reported that tomato responded significantly to applied N rates.  
92 Along the same lines, Tswanya and Olaniyi [13], who found that as increase of N rates  
93 resulted in an increase in plant height and number of leaves. These findings confirmed the  
94 importance and contribution of N to the growth of the vegetative in tomato crop.

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96 The main effects of different filter mud levels on tomato vegetative growth parameters at 50%  
97 flowering during seasons 2015/16 and 2016/17 are presented in Table 3. Filter mud  
98 application showed significant differences in plant height, number of primary branches and  
99 number of leaves during 2015/2016 and plant height, primary branches and number of leaves  
100 during season 2016/17. The highest values in all parameters were obtained with application  
101 of 410 (1) filters mad during the two seasons. These findings are in line with the findings of  
102 Abdellim [14] who reported that filter mud application had beneficial effects on the  
103 performance of tomatoes. These findings are also, in line with finding obtained by Kumar and  
104 Chopra [15] that worked in eggplant and reported positive correlation between vegetative  
105 growth and different treatments of the filter mud.

The growth response of tomato to filter mud in this trial could be attributed to increased organic matter, nitrogen, and possibly other nutrients released from the incorporated filter mud. Soil amendment by filter mud is also thought to help in plant establishment by providing a suitable rooting environment by the improvement in soil structure, aeration, water retention and nutrient availability.

The interaction effects of different nitrogen and filter mud levels on tomato vegetative growth parameters at 50% flowering during seasons 2015/2016 and 2016/2017 are shown in Table 4. There were significant differences in plant height and number of leaves in the two seasons. The highest values of these parameters were obtained with application of 187 kg N /ha and 4 ton filter mud / ha. In this study, application of N and filter mud fertilizer enhances growth of tomato. Tomato growth increases as expressed by the increases observed in plant height and number of leaves. The higher response of tomato to the growth might be due to the availability of essential elements from inorganic fertilizer. This observation is in agreement with that of Isah *et. al.*, [16] who reported that application of green manure and NPK fertilizer increased the vegetative growth of tomato. These findings are in line with the findings of

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**Table 2: The main effects of different nitrogen levels on vegetative growth parameters of tomato at 50% flowering during season 2015/2016 and 2016/2017**

| Nitrogen<br>( kg/ha) | Season 2015/2016        |                              |                 |                       | Season 2016/2017        |                              |                 |                       |
|----------------------|-------------------------|------------------------------|-----------------|-----------------------|-------------------------|------------------------------|-----------------|-----------------------|
|                      | Plant<br>height<br>(cm) | No of<br>primary<br>branches | No of<br>leaves | Stem<br>girth<br>(cm) | Plant<br>height<br>(cm) | No of<br>primary<br>branches | No of<br>leaves | Stem<br>girth<br>(cm) |
| 0                    | 34.59 b                 | 7                            | 71 c            | 3.61                  | 34.71b                  | 7                            | 75c             | 3.78 a                |
| 43                   | 38.21 a                 | 7                            | 78 b            | 3.67                  | 38.99 a                 | 7                            | 81b             | 3.83a                 |
| 86                   | 39.46 a                 | 8                            | 91 a            | 3.70                  | 40.86 a                 | 8                            | 90a             | 4.11a                 |
| CV (%)               | 12.21                   | 10.80                        | 13.72           | 9.42                  | 7.06                    | 16.42                        | 20.27           | 15.58                 |
| <b>Sig.</b>          | *                       | NS                           | **              | NS                    | **                      | NS                           | *               | NS                    |

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Means within columns followed by the same letter (s) are not significantly different ( $P < 0.05$ )

\*, \*\*, NS indicate significance at  $P \leq 0.05$ , 0.01 and not significant, respectively.

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**Table 3:** The main effects of different filter mud levels on tomato vegetative growth parameters at 50% flowering during seasons 2015/2016 and 2016/2017.

| Filter mud<br>( ton/ha) | Season 2015/2016        |                              |                 |                       | Season 2016/2017        |                              |                 |                       |
|-------------------------|-------------------------|------------------------------|-----------------|-----------------------|-------------------------|------------------------------|-----------------|-----------------------|
|                         | Plant<br>height<br>(cm) | No of<br>primary<br>branches | No of<br>leaves | Stem<br>girth<br>(cm) | Plant<br>height<br>(cm) | No of<br>primary<br>branches | No of<br>leaves | Stem<br>girth<br>(cm) |
| 0                       | 33.6c                   | 6 c                          | 66 c            | 3.3                   | 34.7b                   | 7                            | 75c             | 3.4                   |
| 2                       | 37.4b                   | 7 b                          | 77b             | 3.5                   | 39.0 a                  | 7                            | 81b             | 3.9                   |
| 4                       | 41.2 a                  | 8 a                          | 97 a            | 4.1                   | 40.7 a                  | 8                            | 90a             | 4.4                   |
| CV (%)                  | 12.21                   | 10.80                        | 13.72           | 9.42                  | 7.06                    | 16.42                        | 20.27           | 15.58                 |
| <b>Sig.</b>             | **                      | *                            | **              | NS                    | **                      | NS                           | **              | NS                    |

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**Table 54: Interaction effects of different nitrogen and filter mud levels on tomato vegetative growth parameters at 50% flowering during seasons 2015/2016 and 2016/2017**

| Treatment        |                   | Season 2015/2016  |                        |              |                 | Season 2016/2017  |                        |              |                 |
|------------------|-------------------|-------------------|------------------------|--------------|-----------------|-------------------|------------------------|--------------|-----------------|
| Nitrogen (Kg/ha) | Filter mud (t/ha) | Plant height (cm) | No of primary branches | No of leaves | Stem girth (cm) | Plant height (cm) | No of primary branches | No of leaves | Stem girth (cm) |
| 0                | 0                 | 29.5e             | 6                      | 61f          | 3               | 29.8e             | 7                      | 60d          | 3               |
|                  | 2                 | 35.7cd            | 7                      | 79d          | 4               | 37.5cd            | 7                      | 78c          | 4               |
|                  | 4                 | 38.6bc            | 9                      | 97b          | 4               | 43.5a             | 9                      | 87b          | 4               |
| 43               | 0                 | 36.8bcd           | 7                      | 76d          | 3               | 35.9d             | 7                      | 75c          | 3               |
|                  | 2                 | 38.5bc            | 8                      | 61f          | 3               | 35.7 d            | 7.                     | 87b          | 4               |
| 86               | 4                 | 39.3b             | 9                      | 86c          | 4               | 38.7bc            | 7                      | 107a         | 5               |
|                  | 0                 | 34.6d             | 6                      | 90 c         | 3               | 36.4cd            | 8                      | 59d          | 3               |
|                  | 2                 | 38.0bc            | 7                      | 67e          | 4               | 40.5b             | 6                      | 75c          | 3               |
|                  | 4                 | 45.8a             | 8                      | 107a         | 4               | 45.7a             | 9                      | 109a         | 4               |
| CV (%)           |                   | 12.21             | 10.80                  | 13.72        | 9.42            | 7.06              | 16.42                  | 20.27        | 15.58           |
| Sig.             |                   | *                 | NS                     | *            | NS              | *                 | NS                     | *            | NS              |

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Tonon et al., [17] who found that combined application of organic and inorganic fertilizers on tomato varieties significantly improved plant growth. Along the same lines, Nawaz et al., [16] who found that application of sugarcane processing by-product compost supplements with organic fertilizer markedly increased the growth parameters of sugarcane.

### 3.2. Yield and yield components:

The main effects of different nitrogen levels on yield and yield components on tomato during seasons 2015/2016 and 2016/2017 are shown in Table 5.

According to Anderson et al., [19], tomato yields are highly responsive to the application of nitrogen. Nutrient requirement of the tomato is an important factor if large quantities of high quality fruits are to be produced effectively and efficiently annually. Nitrogen fertilizer levels increase total marketable yields [20].

In the current study application of N showed significant differences on number of days from flowering to maturity, fruit weight, fruit weight/plant and total yield in the two seasons. These parameters increased with increasing rate of urea. The highest values of all the parameters were observed in plots treated with 187 Kg/ha N compared to control treatment. These findings are in agreement with those reported by Ogundare et al., [21] who found that fruit weight, number of fruits and fruit yield increased with increasing rate of urea in tomato. Along the same lines, Samaila et al., [22] reported that the highest mean of fruit weight and fruit yield were obtained at 90 kg N ha<sup>-1</sup>. These results are also, in conformity with those obtained by Olaye et al., [23] who reported that Roma variety recorded a relatively better fruit yield under nitrogen treatment.

The main effects of different filter mud levels on yield and yield components on tomato during seasons 2015/2016 and 2016/2017 are shown in Table 6. Application of different levels of filter mud revealed significant differences in fruit length, fruit weight, fruit weight/ plant and total yield in the two seasons. Application of 4 ton/ha revealed the highest values in all these parameters at the two seasons. These results are in line with the findings of Abdelhalim [14] who worked on tomato and found that the application of filter mud resulted in a significantly increased marketable yield. Also, Ibrahim and Fadni [24] found that application of organic manure significantly increased tomato yield, Hassan et al., [25] worked on dill and found that application of filter mud increased fruit yield /plant and total yield. Similarly, Kumar and Chopra [15] worked on eggplant and found the crop yield/plant was positively correlated with sugarcane press mud treatments.

Interaction effects of different nitrogen and filter mud levels on yield and yield components on tomato during seasons 2015/2016 and 2016/2017 are shown in Table 7.

Application of N and filter mud combination showed significant differences in number of days from flowering to maturity, fruit weight, fruit weight/ plant and total yield at the first season and fruit weight, fruit weight/ plant and total yield at the second season. The highest values of these parameters were obtained with application of 86 kg N/ ha in combination with 4 ton filter mud. Ayoola and Adeniyani [26] reported that nutrients from mineral fertilizers enhance the

**Table 9:** The main effects of different nitrogen levels on yield and yield components on tomato during seasons 2015/2016 and 2016/2017

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| Nitrogen (kg/ha) | Season 2015/2016  |                     |                  |                        |                      | Season 2016/2017  |                     |                  |                          |                      |
|------------------|-------------------|---------------------|------------------|------------------------|----------------------|-------------------|---------------------|------------------|--------------------------|----------------------|
|                  | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Fruit weight/plant (g) | Total yield (ton/ha) | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Fruit weight / plant (g) | Total yield (ton/ha) |
| 0                | 4.3               | 4.2                 | 39.86b           | 540.4c                 | 20.6 b               | 3.8               | 4.3                 | 37.72c           | 549.1c                   | 21.9c                |
| 43               | 4.4               | 4.2                 | 40.22b           | 585.7b                 | 22.5 a               | 4.3               | 4.1                 | 41.8 b           | 610.3b                   | 24.2b                |
| 86               | 4.2               | 4.0                 | 45.89a           | 596.9a                 | 22.8a                | 4.3               | 4.5                 | 42.7 a           | 628.6a                   | 25.2a                |
| C.V              | 7.81              | 6.82                | 9.32             | 7.94                   | 9.51                 | 7.39              | 11.19               | 13.00            | 7.94                     | <b>14.57</b>         |
| Sig.             | NS                | NS                  | *                | **                     | **                   | NS                | NS                  | *                | **                       | **                   |

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**Table 6: The main effects different of filter mud levels on yield and yield components on potato during seasons 2015/2016 and 2016/2017**

| Filter mud (t/ha) | Season 2015/2016  |                     |                  |                        |                    | Season 2016/2017  |                     |                  |                          |                    |
|-------------------|-------------------|---------------------|------------------|------------------------|--------------------|-------------------|---------------------|------------------|--------------------------|--------------------|
|                   | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Fruit weight/plant (g) | Total yield (t/ha) | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Fruit weight / plant (g) | Total yield (t/ha) |
| 0                 | 3.9c              | 4.23                | 40.61b           | 533.6 c                | 20.98b             | 3.9 b             | 3.82                | 37.72 b          | 549.1c                   | 21.36c             |
| 2                 | 4.4b              | 4.37                | 41.88a           | 595.2b                 | 20.95b             | 4.2 ab            | 4.01                | 42.78 a          | 610.3b                   | 24.05b             |
| 4                 | 4.6a              | 4.16                | 43.48a           | 659.2 a                | 23.97a             | 4.8 a             | 4.53                | 42.88a           | 628.6a                   | 25.94a             |
| C.V               | 7.81              | 11.19               | 9.32             | 12.24                  | 9.51               | 7.39              | 11.19               | 9.32             | 7.94                     | 14.57              |
| Sig.              | **                | NS                  | *                | **                     | *                  | **                | NS                  | **               | **                       | **                 |

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**Table 37: Interaction effects of different nitrogen and filter mud levels on yield and yield components on tomato during seasons 2015/2016 and 2016/2017**

| Treatment | Season 2015/2016 |                   |                   |                     |                  |                        | Season 2016/2017    |                   |                     |                  |                        |                     |
|-----------|------------------|-------------------|-------------------|---------------------|------------------|------------------------|---------------------|-------------------|---------------------|------------------|------------------------|---------------------|
|           | N(Kg/ha)         | Fliter mud (t/ha) | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Fruit weight/plant (g) | Total yield (t/ ha) | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (g) | Fruit weight/plant (g) | Total yield (t/ ha) |
| 0         | 0                |                   | 4.0               | 3.7                 | 38.1e            | 481.8d                 | 19.0 D              | 3.933a            | 3.900               | 32.83fe          | 481.3h                 | 19.267d             |
|           | 2                |                   | 4.1               | 4.0                 | 40.5df           | 560.9c                 | 22.0cd              | 4.167a            | 3.967               | 34.67f           | 554.3f                 | 22.183c             |
|           | 4                |                   | 4.8               | 4.7                 | 43.1c            | 579.7c                 | 22.0b               | 4.583a            | 4.967               | 38.67c           | 611.7d                 | 22.483c             |
| 43        | 0                |                   | 4.0               | 3.9                 | 40.6df           | 591.8c                 | 22.7b               | 4.200a            | 4.200               | 37.06c           | 587.7e                 | 22.530c             |
|           | 2                |                   | 4.4               | 4.0                 | 44.8bc           | 552.9c                 | 22.0b               | 4.167a            | 4.433               | 43.67b           | 611.3d                 | 23.213b             |
|           | 4                |                   | 4.8               | 4.5                 | 45b              | 611.3b                 | 23.2b               | 4.733a            | 4.933               | 47.90Ab          | 679.3b                 | 24.877a             |
| 86        | 0                |                   | 3.8               | 3.8                 | 37.6ef           | 535.4cd                | 21.2bc              | 3.867a            | 3.767               | 35.97df          | 531.7g                 | 21.270cd            |
|           | 2                |                   | 4.5               | 3.9                 | 41.2d            | 617.4b                 | 22.3b               | 4.200a            | 4.067               | 43.03 b          | 620.0c                 | 24.487a             |
|           | 4                |                   | 4.1               | 4.3                 | 46.7a            | 637.4a                 | 24.4a               | 4.400a            | 4.467               | 48.33 A          | 686.7a                 | 24.857a             |
| C.V       |                  |                   | 7.81              | 6.82                | 13               | 12.24                  | 9.51                | 7.39              | 13.00               | 11.19            | 7.94                   | 8.71                |
| Sig.      |                  |                   | NS                | NS                  | *                | *                      | *                   | NS                | NS                  | **               | *                      | *                   |

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establishment of crops, while those from mineralization of organic manure promoted yield when both fertilizers were combined. These results are in line with the findings of Islam *et. al.*, [26] who worked on tomato and found that application of combination of organic and inorganic fertilizers showed significant increased in tomato yield. Also, Arif *et. al.*, [28] reported that combined application of organic manures and inorganic fertilizers improve the growth and yield of rice.

#### 4. Conclusion

Results of this study showed that vegetative growth and yield and yield components were significantly increased with application of different nitrogen and filter mud levels. Application of 86 kg N/ha combined with 4 ton filter mud /ha is the best level in terms of maximum vegetative growth, yield and yield components of Castle Rock tomato cultivar.

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