Effect of Nitrogen Fertilizer Levels on Watermelon Growth and Yield in Banadir Region, Somalia

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ABSTRACT

This study evaluated the effects of different nitrogen fertilizer rates on watermelon growth and yield at the Gaheyr Campus of Somali National University. The experiment was arranged in a randomized complete block design with four nitrogen treatments (0, 100, 150, and 200 kg N ha^{-1}) and five replications. Growth measurements included plant height, number of leaves, leaf area, stem girth, number of flowers, and number of branches. Yield measurements included fruits per plant, fruit length, reported fruit diameter, fruit weight, yield per plant, reported yield per plot, and reported yield per hectare. Data were analyzed using Statistix 8.0, and treatment means were compared using Fisher's least significant difference test at $P \leq 0.05$ when the overall treatment effect was significant. Nitrogen rate significantly affected plant height, leaf area, stem girth, flower number, branch number, and fruit length. Leaf number was not significant at the 5% level ($P = 0.0586$). Fruits per plant, reported fruit diameter, fruit weight, yield per plant, and reported yield per plot were also nonsignificant. The results indicate that nitrogen enhanced vegetative growth more consistently than yield under the conditions of this trial.

Keywords: Citrullus lanatus; nitrogen rate; randomized complete block design; vegetative growth; fruit yield; Somalia

INTRODUCTION

Watermelon (Citrullus lanatus) is an economically important cucurbit cultivated in tropical and subtropical regions. Archaeological and historical evidence indicates that watermelon was domesticated in northeastern Africa more than 4,000 years ago (Paris, 2015). The crop contributes to food supply, hydration, and farm income, but its productivity is often constrained by unsuitable varieties, poor crop management, inefficient irrigation, and inappropriate fertilizer use (Sabo et al., 2013).

Nitrogen is essential for chlorophyll formation, photosynthesis, canopy development, and plant growth (Leghari et al., 2016). Adequate nitrogen can increase vine growth, leaf area, flower production, fruit development, and yield. Excessive nitrogen, however, may favor vegetative growth over reproductive development and can reduce nitrogen-use efficiency. Consequently, nitrogen recommendations should be evaluated under local soil, climate, and irrigation conditions. Information on nitrogen management for watermelon in Somalia remains limited. Farmers commonly rely on generalized fertilizer recommendations that may not reflect local soils or production conditions. This study therefore evaluated the effects of four nitrogen fertilizer rates on watermelon growth and yield at Somali National University and examined whether increasing nitrogen beyond a particular rate produced a measurable yield response.

MATERIALS AND METHODS

Experimental Site and Period

The field experiment was conducted at the Gaheyr Campus of Somali National University, Mogadishu,

Somalia, from 23 November 2024 to March 2025. The experimental site is located at approximately 2.039° N and 45.290° E, at an elevation of about 61 m above mean sea level.

The site is hot, windy, and cloudy, with an average annual temperature of approximately 29.0 °C and average annual rainfall of about 466 mm.

Soil Information

The experiment was conducted in loamy sand soil characteristic of the coastal lowlands of the Banadir region of southern Somalia. Laboratory analysis indicated low inherent fertility, with very low organic matter (0.009%) and total nitrogen (0.0015%). Available phosphorus was very low (P_2O_5: 4 ppm, $NaHCO_3$ extract), and exchangeable potassium was low (K_2O: 0.25 meq 100 g^{-1}). Soil pH was 7.6, indicating a slightly alkaline environment. These properties indicate a low native nutrient supply and should be considered when interpreting crop response to applied nitrogen

Experimental Design and Treatments

The experiment used a randomized complete block design with four nitrogen treatments: 0, 100, 150, and 200 kg N ha^{-1}. Each treatment was replicated five times, giving 20 plots. The total site measured 250 m^2 (25 m × 10 m), whereas the laid-out experimental field measured 240 m^2 (24 m × 10 m). Each plot measured 6 m^2 (6 m × 1 m), plots were separated by 0.4 m, and blocks were separated by 1.0 m. Treatments were randomized within each block.

All plots received the same basal applications of diammonium phosphate (DAP) and chicken manure. The treatment labeled 0 kg N ha^{-1} therefore received nutrients from these basal inputs and should be interpreted as the zero added-treatment rate rather than an absolute nitrogen-free control.

Nutrient Inputs and Fertilizer Application

The nitrogen treatments were specified as 0, 100, 150, and 200 kg N ha^{-1}. During land preparation, all plots received DAP at 100 g $plot^{-1}$ and chicken manure (Fartiplus) at 0.9 kg $plot^{-1}$. The nutrient composition of the manure and the fertilizer grade of the DAP were not reported.

Land Preparation, Sowing, and Crop Management

The field was cleared, hoed, and leveled before planting. DAP and chicken manure were incorporated to a depth of approximately 20 cm, and watermelon seeds were sown directly on 23 November 2024.

Irrigation Management

A drip-irrigation system was used, and irrigation was adjusted according to weather conditions and crop water needs.

Sampling and Measurements

Two plants were randomly selected from each plot for repeated measurements of most growth and yield variables. Plant height was measured from the soil surface to the apical growing point, and the numbers of leaves, branches, and flowers were counted. Leaf area was recorded in square centimetres.At harvest yield per plot,fruit length was measured from the neck to the base of the fruit.

Statistical Analysis

Plot means were analyzed by analysis of variance appropriate for a randomized complete block design. When the treatment effect was significant, means were separated using Fisher's least significant difference test at $P \leq 0.05$. Analyses were performed using Statistix 8.0. Mean-separation letters are reported only for traits with a significant overall treatment effect.

RESULTS AND DISCUSSION

Vegetative Growth

Nitrogen rate significantly affected plant height (P = 0.0035). Plants receiving 200 kg N ha^{-1} were tallest (153.0 cm), whereas control plants were shortest (70.4 cm). This response is consistent with the role of nitrogen in canopy development and with previous watermelon fertilizer studies (Kacha et al., 2017).

The effect on leaf number was not significant at the 5% level (P = 0.0586), although the mean increased from 54.5 leaves in the control to 114.8 leaves at 200 kg N ha^{-1}. Leaf area was significantly affected (P = 0.0111), with the highest mean at 200 kg N ha^{-1} (104.9 cm^2). Stem girth also differed among treatments (P = 0.0496), although the pattern was not strictly linear.

Flower number increased significantly with nitrogen rate (P = 0.0048), reaching 11.2 flowers at 200 kg N ha^{-1}. The coefficient of variation for flower number was 44.11%, indicating substantial plot-to-plot variability. Branch number was strongly affected by nitrogen (P < 0.0001), increasing from 3.2 in the control to 5.1 at 200 kg N ha^{-1}.

Supplemental N (kg ha^{-1})	Plant height (cm)	Leaves (no.)	Leaf area (cm^2)	Stem girth (cm)	Flowers (no.)	Branches (no.)
0	70.40 b	54.50	62.90 c	3.50 ab	3.70 b	3.20 c
100	89.40 b	67.80	50.10 bc	3.30 b	4.20 b	3.80 b
150	103.50 b	89.20	91.80 ab	3.40 b	6.60 b	4.70 a
200	153.00 a	114.80	104.90 a	3.80 a	11.20 a	5.10 a

Table 1. Effects of nitrogen fertilizer rate on vegetative growth. Within a column, means followed by the same letter are not significantly different by Fisher's LSD test at P ≤ 0.05. Letters are omitted for leaf number because the overall treatment effect was nonsignificant (P = 0.0586).

Yield Performance

Fruits per plant were not significantly affected by nitrogen rate (P = 0.2375). Means ranged from 1.0 fruit per plant in the control to 1.5 fruits per plant at 200 kg N ha^{-1}. Fruit length was significantly affected (P = 0.0350); the longest fruits were recorded at 150 and 200 kg N ha^{-1}. Previous field research has likewise reported nitrogen responses in watermelon fruit development, although responses vary with environment and management (Goreta et al., 2005; Maluki et al., 2016).

Reported fruit diameter (P = 0.0571), fruit weight (P = 0.1668), yield per plant (P = 0.2766), and reported yield per plot (P = 0.1666) were not significantly affected at P ≤ 0.05. Although the treatment means increased numerically, the experiment did not provide sufficient statistical evidence that these differences were caused by nitrogen rate.

The source records label the fruit-size measurement as diameter, but values of 29.2–51.7 cm are unusually large for diameter relative to the reported fruit weights and may instead represent circumference; the original measurement sheets should be checked. The reported plot-yield values also closely duplicate the fruit-weight values, and the hectare-yield conversions are not fully consistent with the reported yield-per-plant data. These variables should therefore be interpreted cautiously until the source records are reconciled.

Supplemental N (kg ha^{-1})	Fruits plant^{-1}	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Yield plant^{-1} (g)	Reported yield plot^{-1} (g)	Reported yield (kg ha^{-1})
0	1.00	17.50 b	29.20	630.5	438.5	630.0	2,923.0
100	1.40	21.60 ab	40.20	802.5	500.0	802.5	3,333.35
150	1.40	29.50 a	49.40	1,294.0	665.0	1,294.0	4,433.33
200	1.50	29.20 a	51.70	1,791.0	1,008.0	1,791.0	6,666.7

Table 2. Effects of nitrogen fertilizer rate on yield traits. Within the fruit-length column, means followed by the same letter are not significantly different according to Fisher's LSD test at $P \leq 0.05$. Mean-separation letters are omitted for traits with nonsignificant overall treatment effects. Conclusion

Nitrogen fertilizer improved several vegetative traits of watermelon under the conditions of this experiment. Plant height, leaf area, stem girth, flower number, branch number, and fruit length differed significantly among treatments, and the highest values for most growth traits occurred at 200 kg N ha^{-1}. Leaf number, fruits per plant, reported fruit diameter, fruit weight, yield per plant, and reported yield per plot were not significantly affected at the 5% level.

The results indicate that nitrogen promoted vegetative growth but did not establish a statistically significant yield benefit or an economically optimal rate. Recommending 200 kg N ha^{-1} would be premature because all plots received basal DAP and manure, animal and disease damage reduced the reliability of yield measurements, and several field records require confirmation. Future multiseason and multilocation trials should document soil fertility, fertilizer source and timing, plant population, irrigation volume, crop losses, marketable yield, and economic returns before a recommendation is issued for watermelon growers in Somalia.hors declare that they have no competing interests.

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