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EFFECT OF MINERAL FERTILIZATION ON CERTAIN AGROMORPHOLOGICAL PARAMETERS OF THE RIBBED TOMATO VARIETY IN KORHOGO, NORTHERN CÔTE D'IVOIRE

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ABSTRACT

The tomato is one of the most important vegetable crops in Côte d'Ivoire due to its high nutritional value and economic importance. However, its production remains limited by low soil fertility. The objective of this study was to evaluate the effect of two NPK mineral fertilizer formulations on certain agromorphological parameters of the ribbed tomato variety. The experimental design was a randomized complete block design (Fischer blocks) consisting of nine plots distributed across three replicates and three treatments: a no-fertilizer control (T0), NPK 12-22-22 (T1), and NPK 15-15-15 (T2). The variables measured were plant height, number of branches, stem collar diameter, number of fruits, fruit mass, and yield. The results revealed a significant effect of the NPK treatments on all parameters studied. NPK 15-15-15 promoted vertical growth in the tomato plants, resulting in a maximum height of 83.85 ± 8.42 cm. Conversely, plants treated with NPK 12-22-22 produced a number of fruits (9.20 ± 0.86), fruit mass (73.61 ± 4.11 g), and yield (1.63 ± 0.09 t/ha) that were significantly higher than those of plants treated with NPK 15-15-15.

The 12-22-22 NPK formulation resulted in good production of the ribbed tomato. It is therefore the recommended formulation for successfully growing the ribbed tomato variety in Korhogo.

Keywords: Mineral fertilization; Growth; Production; Tomato; Korhogo

1 INTRODUCTION

Market gardening is a significant economic activity that contributes to food security and poverty reduction for rural households in Africa [1]. It is a key component of urban and peri-urban agriculture, contributing significantly to the economic development of cities [2]. Vegetable crops encompass a diverse range of plant species, including the tomato (*Solanum lycopersicum*).

The tomato is one of the most essential vegetables worldwide [3]. Global tomato production reaches approximately 160 million tonnes [4]. Tomatoes are primarily cultivated for their fruit, which is rich in vitamins, minerals, carotenoids, and

antioxidants, making them a food with diverse nutritional and therapeutic applications [5]. In Côte d'Ivoire, the tomato is among the most widely grown and consumed vegetables, alongside okra, eggplant, and chili pepper [6]. Although grown in all of the country's agro-ecological zones [7], annual national tomato production is estimated at 48,804 tonnes [8].

Despite its importance for food security and farmers' well-being, tomato production faces several biophysical and socio-economic constraints. Biophysical challenges include declining agricultural soil fertility [9]. In northern Côte d'Ivoire, the issue of improving soil fertility remains a pressing concern [10]. The appropriate and more intensive use of chemical fertilizers is recognized as necessary to rapidly increase agricultural yields [11]. However, a study conducted by [12] showed that market gardeners in the city of Korhogo used either NPK 15-15-15 or NPK 17-17-17 for tomato cultivation, whereas good agricultural practice guidelines recommend NPK 12-22-22 [13]. The objective of this study is to evaluate the effect of two NPK mineral fertilizer formulations on certain agromorphological parameters of the ribbed tomato variety.

2 MATERIALS

2.1 Study area

The experiment was conducted from February to April 2026 in the Kassirimé neighborhood of Korhogo, in the Poro region of northern Côte d'Ivoire. Korhogo lies between 9°29′ and 9°53′ N latitude and 5°36′ and 6°49′ W longitude. The region is characterized by a Sudanian climate, with a dry season extending from November to April and a rainy season from May to October. The mean annual rainfall is approximately 1,200 mm, and the average annual temperature is 27 °C [14].

2.2 Plant material

The plant material used in this experiment was the ribbed tomato variety. This variety was chosen because it is widely grown by market gardeners in Korhogo.

2.3 Fertilizing materials

The fertilizing material consisted of two NPK mineral fertilizer formulations: 15-15-15 and 12-22-22.

3 METHODS

3.1 Establishment of the nursery

Nursery beds measuring 5 m^2 were set up according to the experimental treatments. Each NPK formulation was assigned a bed, and a third bed served as the control, making a total of three nursery beds. Prior to sowing, 100 g of NPK was applied to the beds designated for the treatments. After sowing in rows, the beds were covered with straw. Ten days after emergence, 20 g of urea was applied to the beds that had received NPK to promote seedling growth. Nursery maintenance consisted of regular watering and manual weeding of the beds.

3.2 Plot preparation

The experimental plot was cleared and tilled by hand. The soil was disinfected by applying an insecticide at a rate of 9 g per bed and a combined fungicide-bactericide at a rate of 2 g per bed. After tilling, 5 m^2 beds (5 m x 1 m) were prepared. Finally, a basal application of mineral fertilizer was carried out on the beds assigned to treatment T2 (NPK 12-22-22) and treatment T3 (NPK 15-15-15) at a rate of 90 g per bed. This fertilizer application took place three days before transplanting. Transplanting was performed 25 days after sowing.

3.3 Experimental design

The experimental design consisted of Fischer blocks with three replicates specifically three randomized blocks with a single factor. The distance between blocks was 1 meter. Each block contained three elementary plots, with each plot corresponding to a treatment.

Each individual plot measured 5 meters in length by 1 meter in width and contained 25 plants. Each block comprised a total of 75 plants. The treatments were as follows:

- T1: No fertilizer
- T2: NPK 12-22-22
- T3: NPK 15-15-15

3.4 Crop maintenance

Throughout the growing period, the beds were watered daily. Regular weeding was carried out to improve soil aeration and facilitate water infiltration. Maintenance also included manual hoeing around the planting holes to eliminate weeds, which can serve as hosts for insect pests. Two and five weeks after transplanting, 10 g/m^2 of urea and 20 g/m^2 of potassium sulfate were applied to the tomato plants as maintenance fertilizer on plots T2 and T3. Insecticide treatment was administered every two weeks following transplanting until the appearance of the first fruits.

3.5 Observations and measurements

Observations began two weeks after the tomato plants were transplanted. Data collection took place once every two weeks. The observations and measurements focused on specific growth and production parameters. They were carried out on the nine central plants of the experimental plot.

3.5.1 Growth parameters

The growth parameters studied were plant height, root collar diameter, and the number of branches. Plant height was measured from the root collar to the terminal bud using a tape measure. The number of branches was determined by counting. Root collar diameter was measured using a caliper.

3.5.2 Production parameters

The production parameters studied were the number of fruits, the mass of harvested fruit, and the yield. The number of fruits was determined by counting. Fruit mass was determined using a scale, and yield was calculated using the following formula [15]:

$$R = \frac{m}{n} X \frac{N}{1000}$$

Where R = yield in t/ha; m = fruit mass in kg; n = number of plants in the net plot; N = number of plants/ha.

3.5.3 Statistical analyses

The data were subjected to Analysis of Variance using SPSS software (version 27.0.1). For each agronomic parameter, the means of the different varieties were compared using Tukey's test whenever the treatment effect was significant (P-value < 0.05).

4 RESULTS

4.1 Effect of mineral fertilization on growth

Table 1 shows the effect of mineral fertilizers on certain growth parameters. Regarding plant height, NPK 15-15-15 (T3) stimulated significant vertical growth in tomato plants (83.85 ± 8.42 cm). In contrast, NPK 12-22-22 (T2) resulted in a tomato plant height of 75.64 ± 1.74 cm, a height statistically different from that observed with NPK 15-15-15. However, both NPK formulations 15-15-15 and 12-22-22 stimulated statistically identical levels of branching and collar diameter in the tomato plants. Specifically, T2 produced 9.50 ± 1.52 branches and a collar diameter of 1.63 ± 0.01 cm, while T3 produced 8.73 ± 0.64 branches and a collar diameter of 1.68 ± 0.13 cm.

Table 1: Effect of mineral fertilizers on some growth parameters

Treatments	Height (cm)	Number of branches	Root collar diameter (cm)
T1: No fertilizer	62.44 ± 2.86^a	6.33 ± 0.83^a	1.09 ± 0.07^a
T2: NPK 12-22-22	75.64 ± 1.74^b	9.50 ± 1.52^b	1.63 ± 0.01^b
T3: NPK 15-15-15	83.85 ± 8.42^c	8.73 ± 0.64^b	1.68 ± 0.13^b
Average	73.97 ± 4.34	8.18 ± 0.99	1.46 ± 0.07
P-value	0.001	0.001	0.001
S	HS	HS	HS

Within the same column, means followed by the same letter are not significantly different at the 0.05 level; S = Significant; HS = Highly Significant.

4.2 Effect of mineral fertilization on production

Analysis of variance revealed a significant difference in the effect of mineral fertilizers on tomato production (Table 2). Specifically, NPK 12-22-22 and NPK 15-15-15 yielded statistically different values regarding the production parameters studied. The highest yield was obtained with NPK 12-22-22, at 1.63 ± 0.09 t/ha. However, there were no significant differences between the yields obtained with NPK 15-15-15 (1.09 ± 0.02) and the unfertilized control (0.81 ± 0.03).

Table 2: Effect of mineral fertilizers on certain production parameters

Treatments	Number of fruits	Fruit mass (g)	Yield (t/ha)
T1: No fertilizer	3.93 ± 0.33[a]	36.36 ± 1.51[a]	0.81 ± 0.03[a]
T2: NPK 12-22-22	9.20 ± 0.86[b]	73.61 ± 4.11[b]	1.63 ± 0.09[b]
T3:NPK 15-15-15	6.62 ± 0.18[c]	49.01 ± 1.29[a]	1.09 ± 0.02[a]
Average	6.58 ± 0.45	52.99 ± 2.73	1.17 ± 0.05
P-value	0.001	0.001	0.001
S	HS	HS	HS

Within the same column, means followed by the same letter are not significantly different at the 0.05 level; S = Significant; HS = Highly Significant.

5 DISCUSSION

The aim of this study is to evaluate the effect of two NPK mineral fertilizer formulations on certain agromorphological parameters of the ribbed tomato variety. Analysis of the results revealed variations in some of the parameters studied across the different treatments. Overall, mineral fertilization promoted good growth and higher yields compared to the unfertilized control.

Regarding growth parameters, particularly plant height, the analysis of variance revealed a significant difference between the treatments. NPK 15-15-15 induced greater vertical growth in the plants compared to those treated with NPK 12-22-22. This effect is likely attributable to the high nitrogen content of NPK 15-15-15, which is amply sufficient to stimulate vertical growth in tomato plants. According to [16], nitrogen is the primary growth factor for green plants. Indeed, nitrogen is a constituent element of chlorophyll and thus a decisive factor in plant growth and yield determination [17]. These results align with those of [18], who demonstrated that excess nitrogen stimulates vigorous shoot growth, thereby promoting an increase in the shoot-to-root ratio and plant height.

However, there was no significant difference in the number of branches or the collar diameter between the two NPK formulations. This suggests that the mineral content of both NPK formulations was sufficient to support branching and vigor in the tomato plants.

Regarding production parameters, NPK 12-22-22 stimulated a significantly higher yield than NPK 15-15-15. This can be attributed to the high potassium and phosphorus content, which promotes flower and fruit development [19] as well as increased yield [20]. According to [21], the tomato is a demanding crop that requires significant amounts of nitrogen, phosphoric acid, and potassium for optimal yield. This result aligns with the findings of [22], who observed the highest production performance in tomato plants treated with NPK 12-22-22. Furthermore, this result confirms the findings of [13], which recommends NPK 12-22-22 as a fertilizer for tomato cultivation.

6 CONCLUSION

Analysis of the results reveals that the growth and production of the ribbed tomato variety could be influenced by the NPK fertilizer formulation. NPK 15-15-15 promoted vertical growth, resulting in a plant height of 83.85 ± 8.42 cm. However, plants treated with NPK 12-22-22 produced a number of fruits (9.20 ± 0.86), fruit mass (73.61 ± 4.11 g), and yield (1.63 ± 0.09 t/ha) that were significantly higher than those of plants treated with NPK 15-15-15. The NPK 12-22-22 formulation resulted in superior production of the ribbed tomato compared to the 15-15-15 formulation and the unfertilized control. Therefore, NPK 12-22-22 is the recommended formulation for achieving good production of the ribbed variety.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The authors declare no conflict of interest.

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