



## Morphological Characterisation and Performance Evaluation of Local Eggplant Varieties in Southern Chad

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**ABSTRACT :** In recent years, climate change has had a negative impact on agricultural production, and Chad has been unable to meet its food needs. Aubergines, which are rarely grown and neglected, can be used as a food supplement. The aim of this study is to determine the morphological characteristics of local aubergine varieties and evaluate their performance. The trial was conducted using a split-plot design with four treatments, T1, T2, T3 and T4, corresponding respectively to white-fleshed aubergine, large green aubergine, white-green aubergine and small green aubergine, repeated four times. Treatment T4 (64.85 cm  $\pm$  4.35) recorded the highest plant height, followed by T2 (61.1 cm  $\pm$  11.2). Treatment T4 (143.8  $\pm$  22) recorded the highest number of leaves per plant, followed by T3 (110.25  $\pm$  7.95). Treatment T2 (19.6 cm  $\pm$  1.4) recorded the highest leaf length, followed by T1 (19.2 cm  $\pm$  1). Treatment T4 (461  $\pm$  122.5) obtained the highest number of fruits, followed by treatment T3 (207.75  $\pm$  28.875). Treatment T1 (3.39 cm  $\pm$  0.415) obtained the highest fruit length, followed by treatment T2 (3.26 cm  $\pm$  0.21). Short fruit lengths were observed in T4 (1.975 cm  $\pm$  0.095) and T3 (2.92 cm  $\pm$  0.14). Treatment T2 (5.3 cm  $\pm$  0.5) had the highest fruit diameter, followed by treatment T3 (4.895 cm  $\pm$  0.195). Treatment T4 (22.395 kg/12 m<sup>2</sup>  $\pm$  1.76) recorded the highest yield, followed by treatment T3 (15.18 kg/12 m<sup>2</sup>  $\pm$  7.75). Treatments T4 (Aub.v<sub>m</sub>) and T3 (Aub.v<sub>b</sub>) performed well. These two varieties can be made available to producers to combat food insecurity.

**KEYWORDS :** *Solanum aethiopicum*, local varieties, morphological characteristics, performance, Chad

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### 1. INTRODUCTION

The FAO (2019) estimated that 750 million people are severely food insecure, representing nearly one in ten people worldwide. In total, 2 billion people do not have regular access to safe, nutritious and sufficient food (FAO, 2020). Food security and poverty reduction have become major concerns for most countries around the world (WFP, 2023). In Chad, agricultural production is often deficient due, among other things, to climatic hazards and rudimentary means of production (Nadjam and Goalbaye, 2014; Issiné, 2023). Similarly, for several decades, agriculture has been affected by poor agricultural practices based on the High External Input Farming System (HEIFS), the use of synthetic chemical inputs that have proven to be potentially polluting for the environment (CORPEN, 2006) and shifting cultivation. African vegetables, which for a long time were considered secondary in terms of food security, are now gradually entering the diets of many households. African aubergines include several species, including *Solanum macrocarpon*, *S. anguivi* and *S. aethiopicum*. The latter, known as jaxatu in Senegal, is widespread in Africa in various varieties and has different vernacular names depending on the ethnic group and country (Seck, 1986). *Solanum macrocarpon* (or African eggplant) is a tropical perennial plant of the Solanaceae family, closely related to the eggplant (Oboh et al. 2005). This species, native to West Africa, is now widely distributed in Central and East Africa. It has also been introduced to the Caribbean, South America and parts of Southeast Asia, giving it growing socio-economic importance worldwide (Gbile et al., 1988). *Solanum macrocarpon* is widely cultivated for use as food, but also for certain medicinal purposes and even as an ornamental plant. *Solanum macrocarpon* (fruit, but also young leaves) is now consumed by humans and enjoyed in many parts of the world. The taste is bitter, but the food is rich in nutrients. In Chad, aubergines are a vegetable that is also eaten raw and is often found in household diets. The fruits are eaten raw or used in the preparation of sauces. However, aubergines are traditionally

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grown by producers who do not have a good understanding of technical procedures. Their profitability is undermined by the poor agronomic performance of certain local varieties. To this end, research should focus more on evaluating the performance of local eggplant varieties (genotypes) in Chad and developing appropriate cultivation techniques to increase productivity (Taffoua et al; 2008). So, what are the performance and morphological characteristics of local eggplant varieties in southern Chad? Morphological characterisation and performance evaluation of local eggplant varieties could increase production in Chad.

### 1.1. Objectives of the study

The overall objective of this study is to improve aubergine productivity in the Sudanese zone of Chad.

Specifically, this study aims to:

- Determine the morphological characteristics of local aubergine varieties in the Sudanese zone of Chad;
- Evaluate the performance of four local aubergine varieties.

## II. MATERIALS AND METHODS

### II.1. Geographical location

The experiment was conducted at the University of Sarh (Figure 1), Doyaba site (09°09'56.6"N, 18°21'54.4"E, altitude 360 m). Located approximately 7 km from the city of Sarh and on the Sarh-CST axis in Moyen-Chari, Chad, the University of Sarh is bordered to the north by the village of Doyaba, to the south by the village of Kemdéré, to the east by the Chari River and to the west by the village of Mossi-ara.

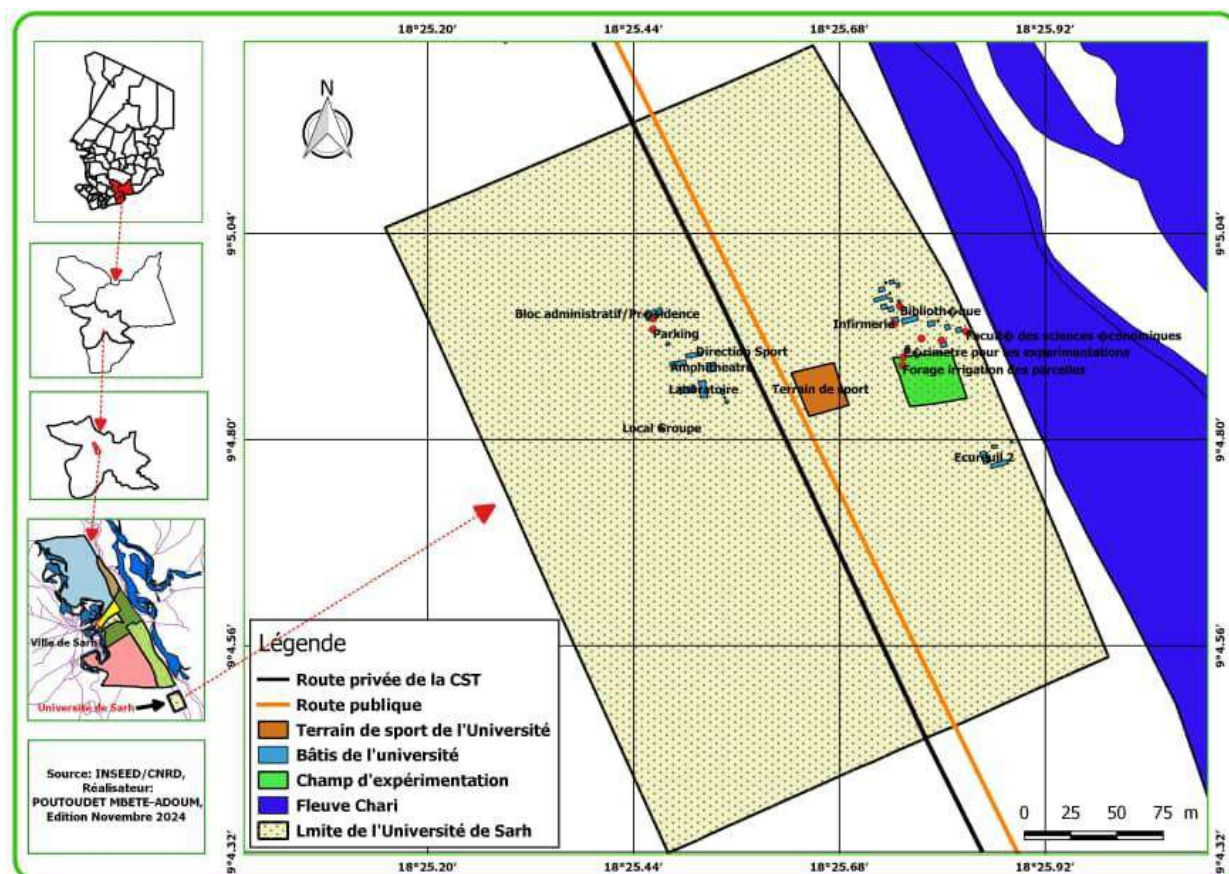


Figure 1 : Location of the experimental site

### II.2. Climatic characteristics of the study site

The site has a Sudano-Guinean tropical climate with a dry season marked by the harmattan (dry, hot wind) from November to March and a rainy season marked by the monsoon from April to October. Average rainfall is 1,167.0 mm/year and maximum and minimum temperatures are 33.9 °C and 19.6 °C respectively. The duration of sunshine is around 2,908.1 hours per year. The vegetation is characterised by light forests and wooded savannahs in the Sudanese part (DREM, 1998).

### II.3. Plant material

The plant material consists of four (4) varieties (genotypes) of local aubergines, including white-fruited aubergine (Aub.b); large green-fruited aubergine (Aub.vg); white-green-fruited aubergine (Aub.bv) and small green-fruited aubergine (Aub.vm). The level of intensification has been improved (ploughing, bed preparation, compost application, transplanting, weeding and hoeing).

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### II.4. Compost preparation

Compost is made from cow and goat dung and straw, which is cut into small pieces measuring approximately 5 cm. These materials are piled up and covered with a tarpaulin. They are turned every three days after being sprinkled with water. After 21 days of preparation, the compost is ready for use on the plots.

### II.5. Methods

#### II.5.1. Experimental design

The trial was conducted using a split-plot design with four treatments, T1, T2, T3 and T4, corresponding respectively to white-fleshed aubergine, large green aubergine, white-green aubergine and small green aubergine, repeated four times. Each treatment was grouped into a block of two elementary plots. Factor studied: the genetic potential of the varieties.

#### II.5.2. Cultivation methods

Nursery: four local varieties of aubergine were planted in rows and monitored regularly for 30 days. The experimental field was ploughed to a depth of 15-20 cm. The equivalent of 15 t/ha of compost was added during ploughing, i.e. 1.50 kg/m<sup>2</sup>. The field was then harrowed before being divided into small plots for transplanting. After emergence, once the plants had reached the 4- to 6-leaf stage, they were moved to the small plots. Transplanting was carried out after thorough watering of at least 30 mm in the morning. Transplanting was carried out with one seedling per hole. A spacing of 0.40 m between rows and 0.50 m between holes was maintained. The surface area of each plot was 10 m x 1.2 m = 12 m<sup>2</sup>, with two plots per block also representing one treatment (two plots per block = one treatment), i.e. an area of 12 m<sup>2</sup> x 2 x 4 = 96 m<sup>2</sup> for 4 blocks and 96 m<sup>2</sup> x 4 = 384 m<sup>2</sup> for 4 treatments repeated 4 times, i.e. the total area of the experiment. There are 32 elementary plots in total. The number of plants per elementary plot is 84, i.e. 84 x 2 = 168 plants per treatment and therefore 168 x 4 = 672 plants for 4 treatments. The total number of plants for the trial is 672 plants x 4 = 2688 plants. A space of 0.5 m between plots and blocks was chosen.

#### II.5.3. Phenological observations

Observations focused on agronomic parameters used to assess crop development. The dates of 25%, 50% and 100% emergence and flowering and the crop cycle were determined.

#### II.5.4. Calculated, measured or recorded parameters

The agronomic parameters measured were: plant height; number of leaves; leaf length; leaf width; number of fruits; yield; weight of 1,000 seeds. These agronomic data (collected 30 days, 60 days and 90 days after transplanting) were recorded in an Excel spreadsheet for processing and analysis at the end of the harvest.

#### II.5.5. Statistical analyses

The data were analysed using SPSS (Statistical Package for Social Sciences version 20.0) software. The means of the different parameters were separated using the Student-Newman-Keuls (SNK) multiple comparison test.

## III. RESULTS AND DISCUSSION

### 3.1. RESULTS

#### 3.1.1. Morphological characteristics of four local varieties of aubergine

**Table 1 : Morphological characteristics of local varieties of aubergines**

Varieties	Plant heights	Leaves	Diamètre des fruits	Fruit colours	Fruit length
T1 Aub.b	54,9 cm	Pubescent and lobed edges	4,61 cm	White	3,39 cm
T2 Aub.gv	61,1 cm	Pubescent and serrated	5,3 cm	Green	3,26 cm
T3 Aub.bv	54,8 cm	Pubescent and serrated	4,89 cm	White-green	2,92 cm
T4 Aub.vv	64,85 cm	Pubescent and serrated	3,39 cm	Green	1,975cm

#### 3.1.2. Results of measured parameters.

##### 3.1.2.1. Plant heights at 90 DAP

Plant heights at 90 DAP are shown in Figure 2. Treatment T4 (64.85 cm ± 4.35) recorded the highest plant height, followed by treatment T2 (61.1 cm ± 11.2). Low plant heights were observed in treatments T1 (54.9 cm ± 6.1) and T3 (54.8 cm ± 3.2). Statistical analysis revealed that there were significant differences between treatments in terms of plant height at 90 DAP at the 5% threshold (F= 6.30 ; P= 0.04).

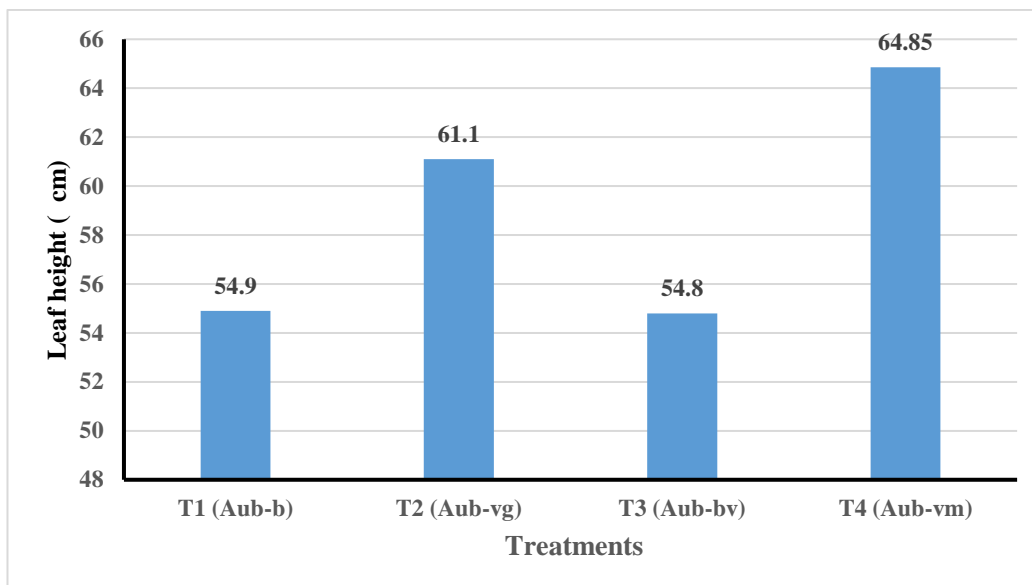


Figure 2 : Plant heights at 90 DAP

### 3.1.2.2. Number of leaves at 90 DAP

The number of leaves per plant at 90 DAP is shown in Figure 3. Treatment T4 ( $143.8 \pm 22$ ) recorded the highest number of leaves per plant, followed by treatment T3 ( $110.25 \pm 7.95$ ). Low numbers of leaves per plant were observed in treatments T1 ( $66.05 \pm 12.725$ ) and T2 ( $72.15 \pm 19.325$ ). Statistical analysis showed that there were highly significant differences between the treatment means in terms of the number of leaves per plant at 90 DAP at the 1% threshold ( $F= 12.56$  ;  $P < 0.01$ ).

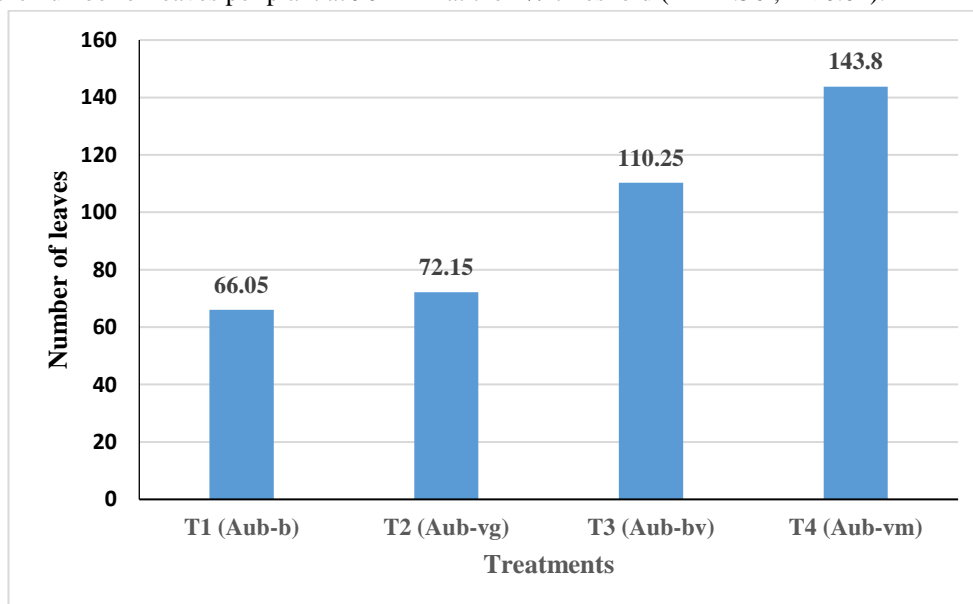


Figure 3 : Number of leaves at 90 DAP

### 3.1.2.3. Leaf length at 90 DAP

The leaf length measured during the trial is shown in Figure 4. Treatment T2 ( $19.6 \text{ cm} \pm 1.4$ ) had the longest leaves, followed by treatment T1 ( $19.2 \text{ cm} \pm 1.00$ ). Short leaf lengths were observed in treatments T4 ( $12.2 \text{ cm} \pm 0.75$ ) and T3 ( $14 \text{ cm} \pm 1.1$ ). Statistical analysis of the treatment means showed that there were significant differences in leaf length at 90 DAP at the 5% threshold ( $F= 9.38$  ;  $P < 0.005$ ).

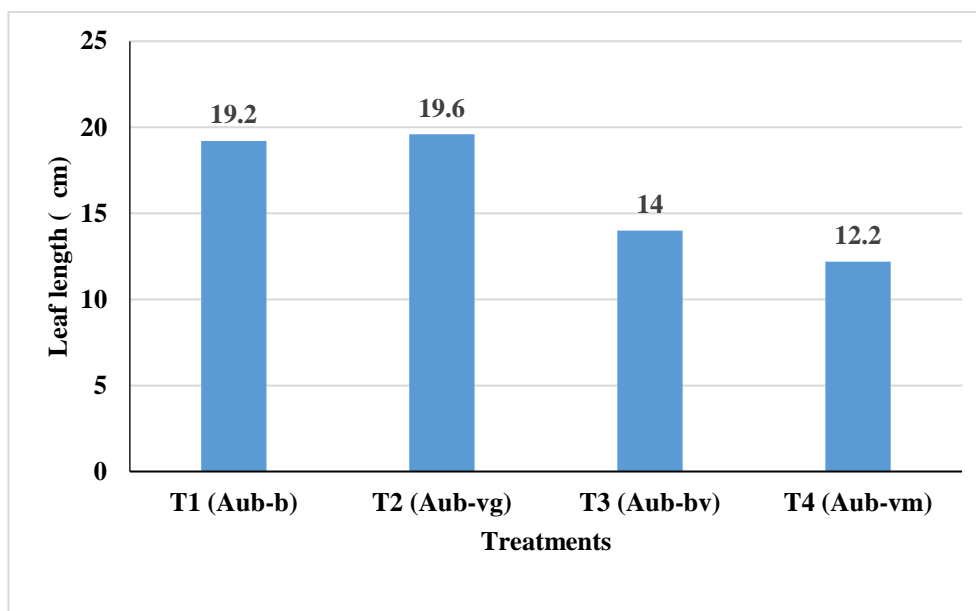


Figure 4 : Leaf length at 90 JAR

### 3.1.2.4. Leaf width at 90 JAR

The leaf width measured during the trial is shown in Figure 5. Treatment T2 (16.5 cm ± 1.25) had the highest leaf width, followed by treatment T1 (15.95 cm ± 1.35). Low leaf widths were observed in treatments T4 (10.25 cm ± 0.65) and T3 (11.8 cm ± 0.5). Statistical analysis of the treatment means showed that there was a significant difference in leaf width at 90 DAP at the 5% threshold (F= 8.51 ; P= 0.018).

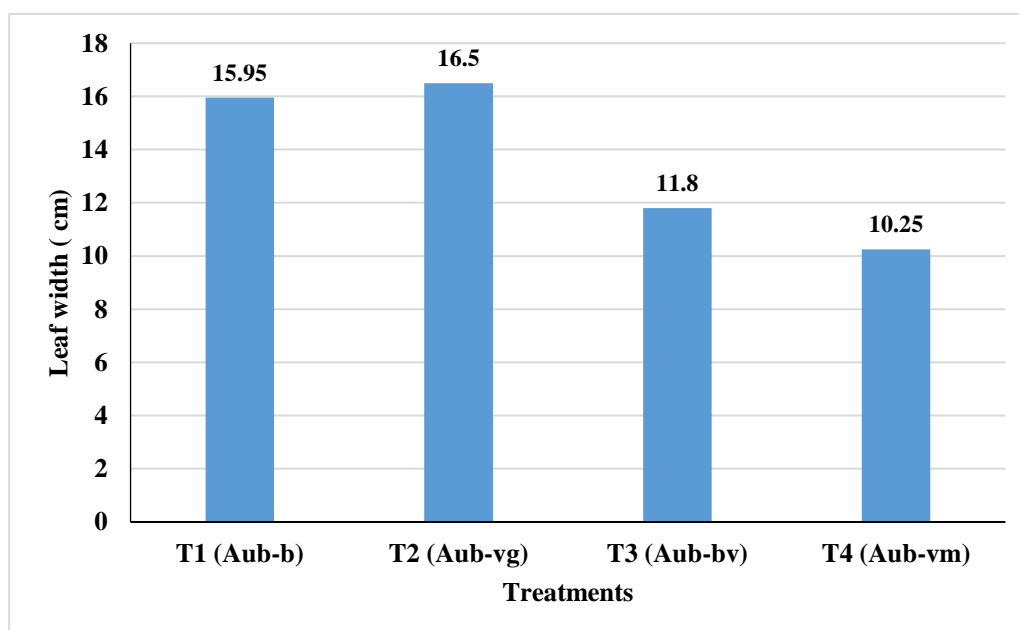


Figure 5 : Leaf width at 90 DAP

### 3.1.2.5. Fruit length at harvest

The fruit length measured at harvest is shown in Figure 6. Treatment T1 (3.39 cm ± 0.415) had the longest fruit length, followed by treatment T2 (3.26 cm ± 0.21). Short fruit lengths were observed in T4 (1.975 cm ± 0.095) and T3 (2.92 cm ± 0.14). Statistical analysis of the treatment means showed that there was a significant difference between fruit lengths at the 5% threshold (F= 7.34; P=0.006).

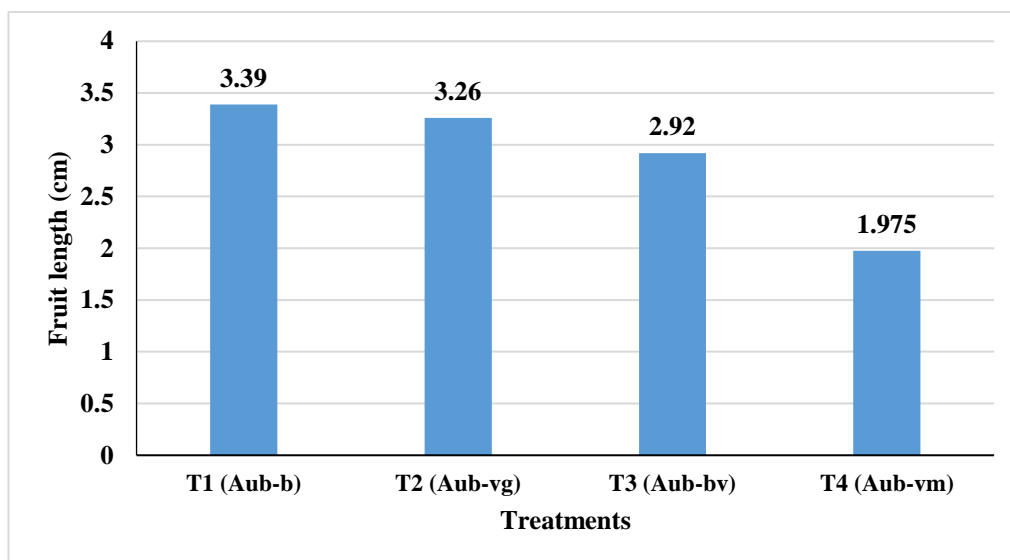


Figure 6 : Fruit length at harvest

### 3.1.2.6. Fruit diameter at harvest

The fruit diameter measured at harvest is shown in Figure 7. Treatment T2 (5.3 cm ± 0.5) had the highest fruit diameter, followed by treatment T3 (4.895 cm ± 0.195). Small fruit diameters were observed in treatments T4 (3.39 cm ± 0.19) and T1 (4.615 cm ± 0.4975). Statistical analysis of the treatment means showed that there was a significant difference between the widths of the harvested fruits at the 5% threshold (F= 7.1587; P= 0.008).

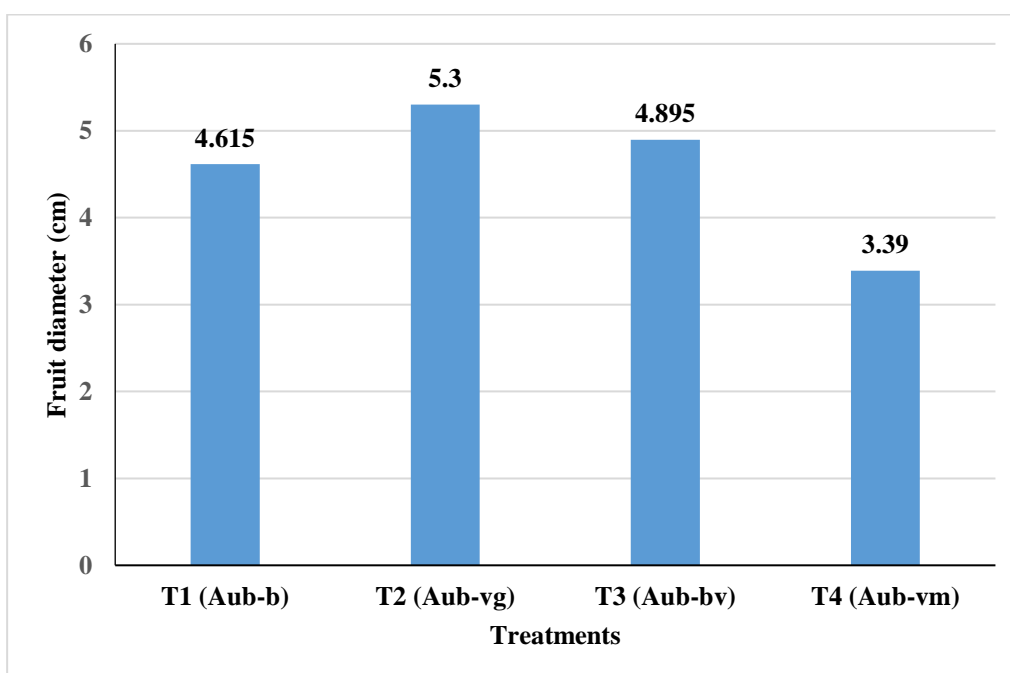


Figure 7 : Fruit diameter at harvest

### 3.1.2.7. Number of fruits harvested

The number of fruits harvested during the trial is shown in Figure 8. Treatment T4 (461 ± 122.5) obtained the highest number of fruits, followed by treatment T3 (207.75 ± 28.875). Low numbers of fruits were observed in treatments T1 (47.75 ± 8.75) and T2 (54.25 ± 7.25). Statistical analysis of the treatment means showed that they were highly significant between the number of fruits harvested at the 1% threshold (F= 22.25 ; P< 0.01).

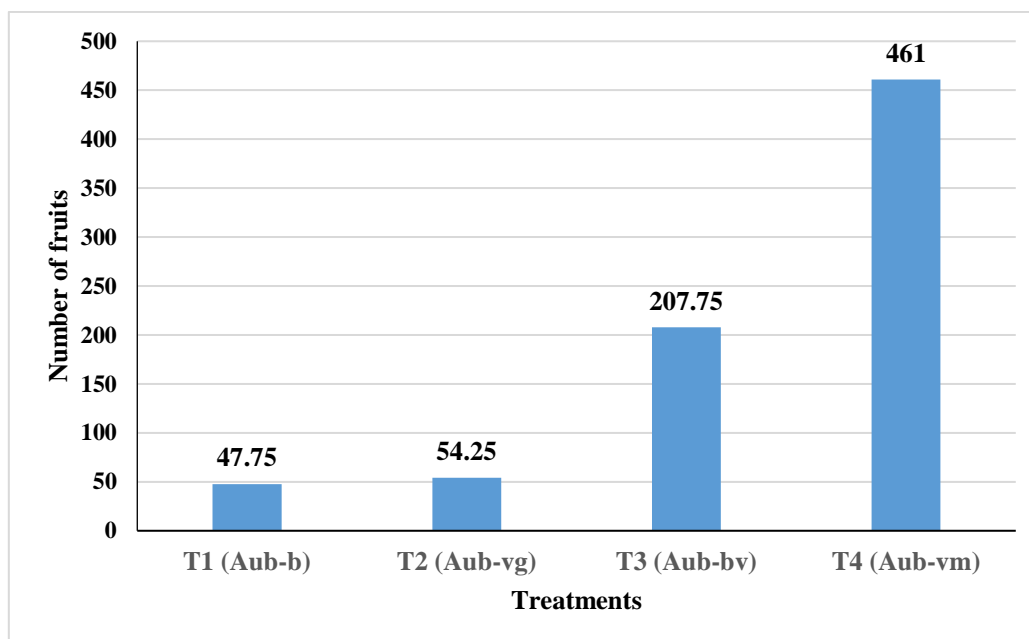


Figure 8 : Number of fruits harvested

**Yield in kilograms per 12 square metres**

The yields of four local varieties of aubergine are shown in Figure 9. Treatment T4 (22.395 kg/12m<sup>2</sup> ± 1.76) recorded the highest yield, followed by treatment T3 (15.18 kg/12m<sup>2</sup> ± 7.75). Low yields were observed in treatments T1 (7.361 kg/12m<sup>2</sup> ± 3.98) and T2 (8.94 kg/12m<sup>2</sup> ± 7.20). Statistical analysis of the treatment means revealed highly significant differences in yield at the 1% threshold (F= 14.789 ; P< 0.01).

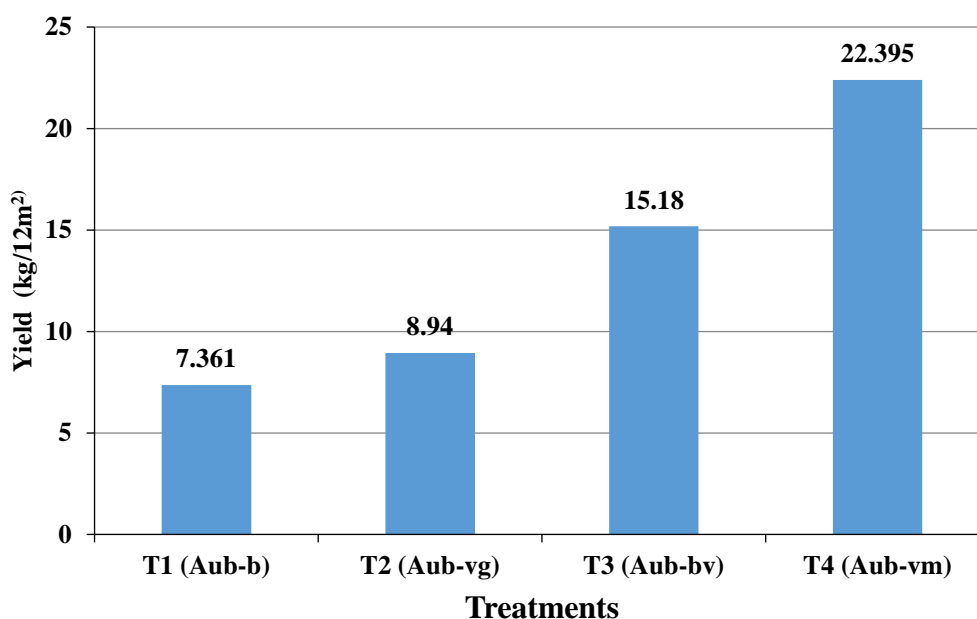


Figure 9 : Yield in kg/12 m<sup>2</sup>

**3.1.2.9. Weight of 1,000 seeds**

The weight of 1,000 seeds is shown in Figure 10. Treatment T2 (2.21 g ± 0.0475) recorded the highest weight of 1,000 seeds, followed by treatment T4 (1.82 g ± 0.0375). The lowest weights per 1,000 seeds were obtained in treatments T1 (1.62 g ± 0.015) and T3 (1.53 g ± 0.02). Statistical analysis of the treatment means revealed that there was no significant difference in terms of 1,000-seed weight at the 5% threshold (F= 3.0165; P= 0.36).

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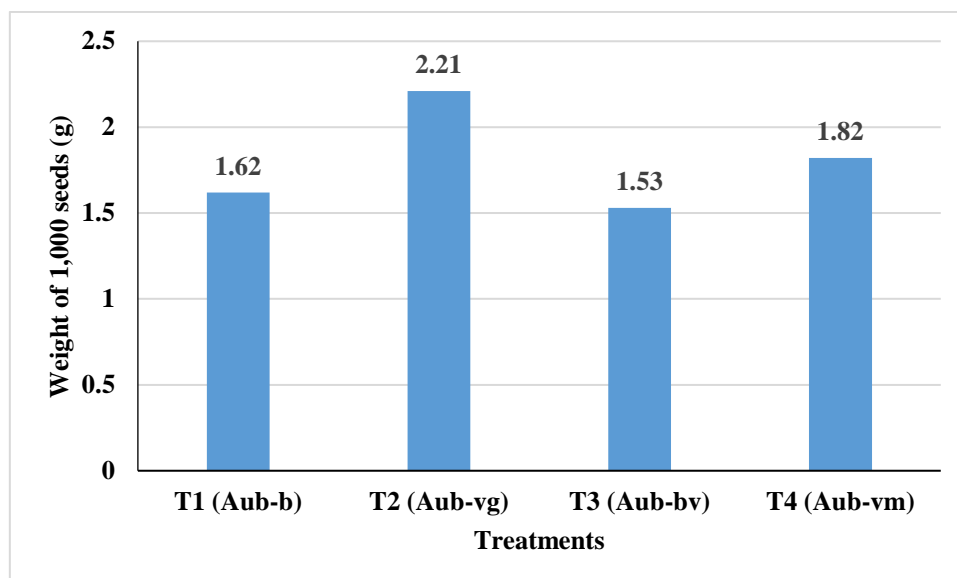


Figure 10 : Weight of 1,000 seeds

### 3.2. Discussion

Treatment T4 (64.85 cm) achieved the highest height of aubergine plants of all treatments with organic fertiliser application. These results for plant height are consistent with those of Fondio et al (2008). These authors recorded an average height of 63 cm for aubergine plants, which is similar to our results. However, the plant heights recorded for our four treatments are lower than those obtained by Mapuno (2008), which were 116.72 cm. Similarly, our results on plant heights are significantly lower than those of Kouadio et al. (2024) with the addition of organic fertiliser made from banana peel and poultry manure. However, the heights of the aubergine plants in our treatments are similar to those obtained by Bueso (2024) with the addition of organic fertiliser and treated with insecticide (Carbofuran). Treatment T4 (143.8) recorded the highest number of leaves, whereas the lowest number of leaves was observed in treatment T1 (66.05). Our results on leaf number are all lower than those obtained by Kouadio et al. (2024) with the addition of organic fertiliser made from banana peel and poultry manure.

In terms of leaf length, treatment T2 (19.6 cm) had the longest leaves, while treatment T4 (12.2 cm) had the shortest. The number of leaves (19.6 cm) obtained in treatment T2 corroborates well with the number of leaves (19.9 cm) recorded by Fondio et al. 2008. 4 (10.25 cm) recorded the lowest leaf width. Our results on leaf width are consistent with those obtained by Fondio et al. (2008). Treatment T2 is close to the leaf width (16.2 cm) reported by Fondio et al. (2008).

In terms of fruit length, our four treatments recorded fruit lengths ranging from 1.975 cm to 3.39 cm. Our results for fruit length are all lower than those obtained (4.02 cm to 4.23 cm) by Kouadio et al. 2024. In terms of fruit diameter, treatment T2 (5.3 cm) obtained the highest width, while the lowest width was observed in treatment T4 (3.39 cm). These fruit widths are higher than those obtained (2.05 cm to 2.20 cm) by Kouadio et al. 2024. The number of fruits (461) harvested in treatment T4 is higher than that obtained (32.2) by Mapuno (2008) and even higher than those obtained (255.08 to 375.51) by Kouadio et al. 2024. However, the number of fruits harvested is significantly lower than that obtained (1,416) by Fondio et al. 2008. The T4 yield (22.395 kg/12m<sup>2</sup>, or 18.662 t/ha) is higher than those obtained (17.2 t/ha) by Fondio et al., 2008 and (18 t/ha) obtained by Djidji et al. 2013 with an input of 10 kg/m<sup>2</sup> of organic manure and 20 g/m<sup>2</sup> of NPK fertiliser. However, our results are lower than those obtained (34.781 t/ha; 24.375 t/ha and 20.677 t/ha) by Rabo et al. 2021. But they are significantly higher than those obtained (5.42 t/ha; 8.26 t/ha and 8.75 t/ha) by Kouadio et al. (2024) and by Bueso et al. (2024) with the application of organic fertiliser to aubergine crops. The yield (15.18 kg/12m<sup>2</sup> or 12.650 t/ha) of treatment T3 is lower than that obtained (15.54 t/ha) by Mapuno (2008). The parameters observed or measured are varietal characteristics and may be influenced by the soil and climate conditions of the study area.

### CONCLUSION

Aubergine is a widely appreciated vegetable in Africa, including Chad. It is of great importance in the diet and economy of a country. The objectives of this study were to determine the morphological characteristics and evaluate the performance of local aubergine varieties in the Sudanese zone of Chad. Treatment T4 (64.85 cm) recorded the highest plant height, while treatment T3 (54.8 cm) recorded the lowest plant height. Treatment T4 (143.8) recorded the highest number of leaves per plant, followed by T3 (110.25). The leaf length observed in T4 (12.2 cm) was lower than that observed in treatment T3 (14 cm). Treatment T4 (461) had the highest number of fruits, followed by T3 (207.75). Treatment T1 (3.39) had the highest fruit length, followed by T2 (3.26 cm). Treatment T4 (18.662 t/ha) recorded the highest yield, followed by T3 (12.650 t/ha). Thus, treatment T4 (Aub.vm) performed

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best, followed by treatment T3 (Aub.bv). These two varieties will be made available to producers to combat food insecurity. The data obtained will also serve as a basis for the aubergine variety improvement programme in Chad.

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