Global Academic and Scientific Journal of Multidisciplinary Studies (GASJMS)

Volume 3 | Issue 7, 2025 Journal Homepage: https://gaspublishers.com/gasjms/ ISSN: 2583-8970
Email: gaspublishers@gmail.com

Morphological Characterization of Four Varieties of Domesticated Cucumber (Cucumis Sativus L.) In the Rainy Season in Bambey, Senegal

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Received: *20.07.2025* | ***Accepted:*** *05.08.2025* | ***Published:*** *07.08.2025*

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DOI: *10.5281/zenodo.16757738*

Abstract **Original Research Article**

Agriculture plays a central role in Senegal's economy, contributing to employment, food security, and poverty reduction. Horticultural production, traditionally concentrated in the Niayes region and the Senegal River Valley, is now expanding toward the Groundnut Basin. This study evaluated the vegetative growth of four cucumber (Cucumis sativus L.) varieties cultivated in Bambey. The morphological parameters analyzed were leaf production, average plant height, and collar diameter, measured at 30 and 60 days after sowing (DAS). The results showed significant variability among the varieties. At 30 DAS, the F1 Tokyo variety exhibited the highest leaf growth and plant height, while Poinsett had the greatest leaf production at 60 DAS. For collar diameter, Poinsett+ and F1 Nogano showed the highest values at 30 DAS, with F1 Nogano remaining the most vigorous at 60 DAS. These results suggest that the F1 Tokyo and F1 Nogano varieties are well adapted to the agroclimatic conditions of Bambey and show promising potential for improving cucumber production in the region.

Keywords: cucumber, agro-morphology, varieties, yield, Bambey.

Citation: Cisse, A., Sambou, A., Faye, J. D. W., Eza, B. H., & Sembene, M. (2025). Morphological characterization of four varieties of domesticated cucumber (Cucumis sativus L.) in the rainy season in Bambey, Senegal. *Global Academic and Scientific Journal of Multidisciplinary Studies (GASJMS)*, *3*(7), 1-7.

INTRODUCTION

Agriculture plays a central role in the socioeconomic life of Senegal, contributing to job creation, food security, and poverty reduction (Mbow, 2017). It employs approximately 70% of the active population, although its profitability remains low, and accounts for 9.4% of the gross domestic product (GDP) (ANSD, 2020).

Among the main components of the sector, market gardening holds a significant position. Present since the early 19th century (De Bon et al., 1993), this practice has become a pillar of the country's horticultural production, which is estimated at 1 423 250 tons an increase of 26.11% compared to the average of the previous five years (DAPSA, 2015). The Niayes, a coastal area benefiting from a climate favorable to Mediterranean horticulture, concentrate 82% of this production (DHORT, 2015; Parfonry, 1989).

However, the development of Senegalese agriculture still faces several major constraints, such as limited access to modern technologies, low soil fertility, and irregular rainfall (Bourioug, 2013). According to Hathie et al. (2017), about 19% of Senegalese households lack access to sufficient and balanced food.

In this context, agriculture represents a strategic development lever, provided that production systems are intensified through a better understanding of the interactions between crop varieties, cultivation practices, and agro-climatic conditions. Improving productivity requires, in particular, the identification and dissemination of vegetable varieties that are better adapted to local conditions (Daunay et al., 2011). This can be achieved either through the selection and ongoing improvement of existing varieties or through the introduction and evaluation of new varieties (Gaufichon et al., 2010).

It is within this framework that the present study was conducted. It aims to characterize the agro-morphological performance of four domesticated cucumber (*Cucumis sativus* L.) varieties, with the goal of enhancing their agronomic understanding and productivity in Senegal. Specifically, the study seeks to analyze

the differences in vegetative growth among the four cucumber varieties by evaluating leaf production, average plant height, and collar diameter.

MATERIALS AND METHODS

Study Area Description

The study was conducted in Senegal, a country located between latitudes 12° and 17° North, and longitudes 11° and 18° West. More specifically, the experiments took place in Bambey, at the Application and Production Center (CAP) of the Higher Institute of Agricultural and Rural Training (ISFAR) (Figure 1), with geographical coordinates of 14°57'56'' N and 16°40'82'' W. This site, located in the north-central part of the country in the Diourbel region, is situated at an altitude of 17 meters. Bambey is characterized by a tropical climate with a dry tendency, marked by two distinct seasons: a dry season from November to May, and a rainy season from June to October. In terms of relative humidity, September is the most humid month with an average of 96.87%, while June records the lowest humidity at 34.17%. Minimum humidity values range from 34.17% to 67.35%, and maximum values range from 89.43% to 96.87% (CNRA Bambey Meteorological Station, 2024).

The soil at the experimental site has the following physical and chemical characteristics: sandy texture composed of 86% sand, 6% silt, and 8% clay. The pH is slightly acidic (6.7), with an organic matter content of 5.9 $g \cdot kg^{-1}$ and a cation exchange capacity (CEC) of 5.3 $cmolc \cdot kg^{-1}$ (Trail et *al*., 2016).

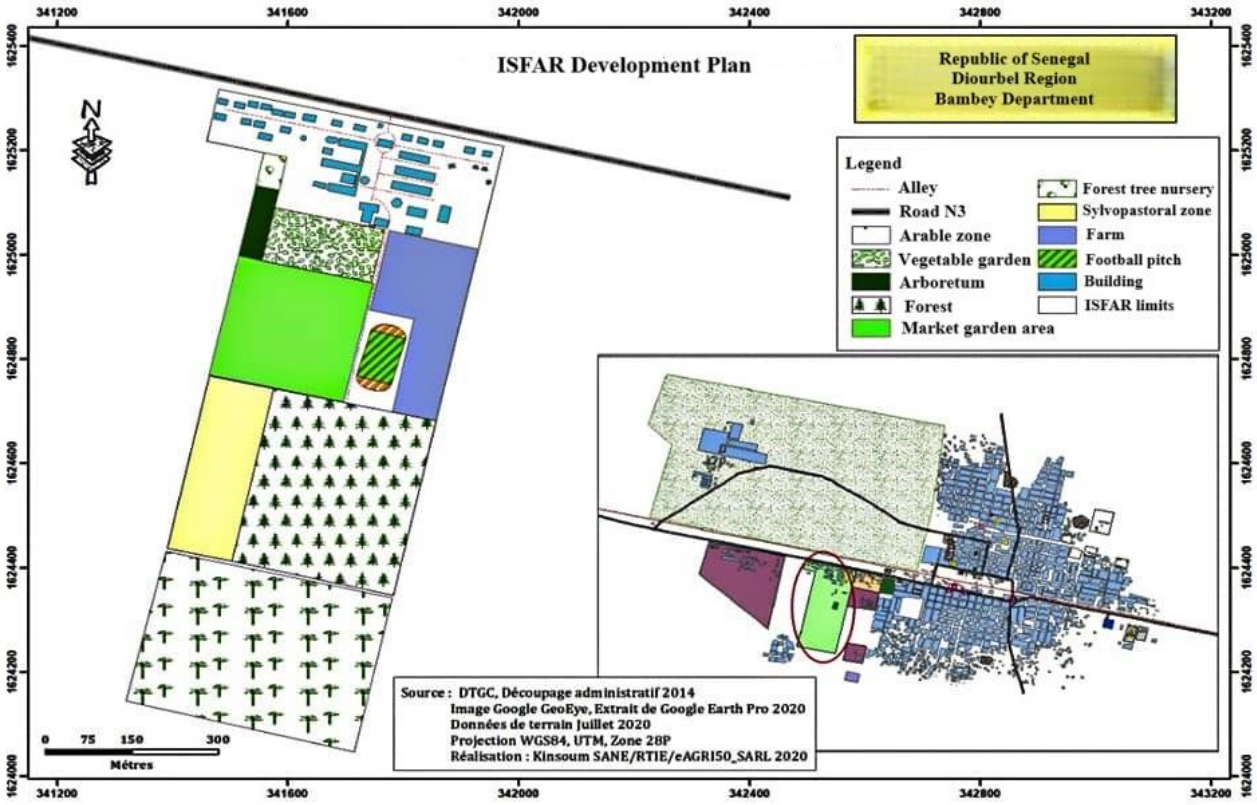

Figure 1: Location of the experimental zone (Sané, 2020)

MATERIALS

Plant Material

The experiment focused on cucumber (*Cucumis sativus* L.) using four distinct varieties: Poinsett, Poinsett+, F1 Tokyo, and F1 Nogano. Among these, the F1 Tokyo variety was selected as the control, serving as a reference for the comparative evaluation of agro-morphological performance. The main characteristics of these varieties are presented in Table 1 below.

Table 1: Characteristics of the varieties

Code	Variety	Cultivation Type	Earliness	Fruit Length	Harvest Color	Spines
V1	Poinsett	Open field	40–45 days	18–22 cm	Dark green	Yes
V2	Poinsett+	Open field	40–45 days	18–22 cm	Dark green	Yes
V3	F1 Tokyo	Greenhouse and open field	50–55 days	18–20 cm	Dark green	Yes
V4	F1 Nogano	Greenhouse and open field	40–45 days	18–20 cm	Dark green	Yes

Technical Equipment

In this cucumber (*Cucumis sativus* L.) experiment, several tools were used to carry out fieldwork and collect data. A measuring tape was used to determine plant height, while a caliper allowed for precise measurement of the collar diameter. A hoe was used for weeding operations. Finally, a scale was employed to weigh neem leaves used in phytosanitary treatments.

METHODS

Experimental Design

The trial was conducted using a randomized complete block design (RCBD), also known as Fisher blocks, which is particularly suitable for fields with some degree of heterogeneity. This design allows for effective comparison of multiple treatments while minimizing the influence of soil variability. It also provides an estimate of the variation attributable to differences between blocks. In our study, the factor under investigation was the cucumber variety, with four (4) treatments corresponding to the tested varieties. The design included four (4) replications, for a total of 16 elementary plots (Figure 2). Within each elementary plot, seeds were sown in four rows, with 0.5 meters spacing between rows and between planting holes within each row.

For the evaluation of agro-morphological parameters, five (5) cucumber plants were randomly selected in each elementary plot and considered as the usable plot (Figure 3).

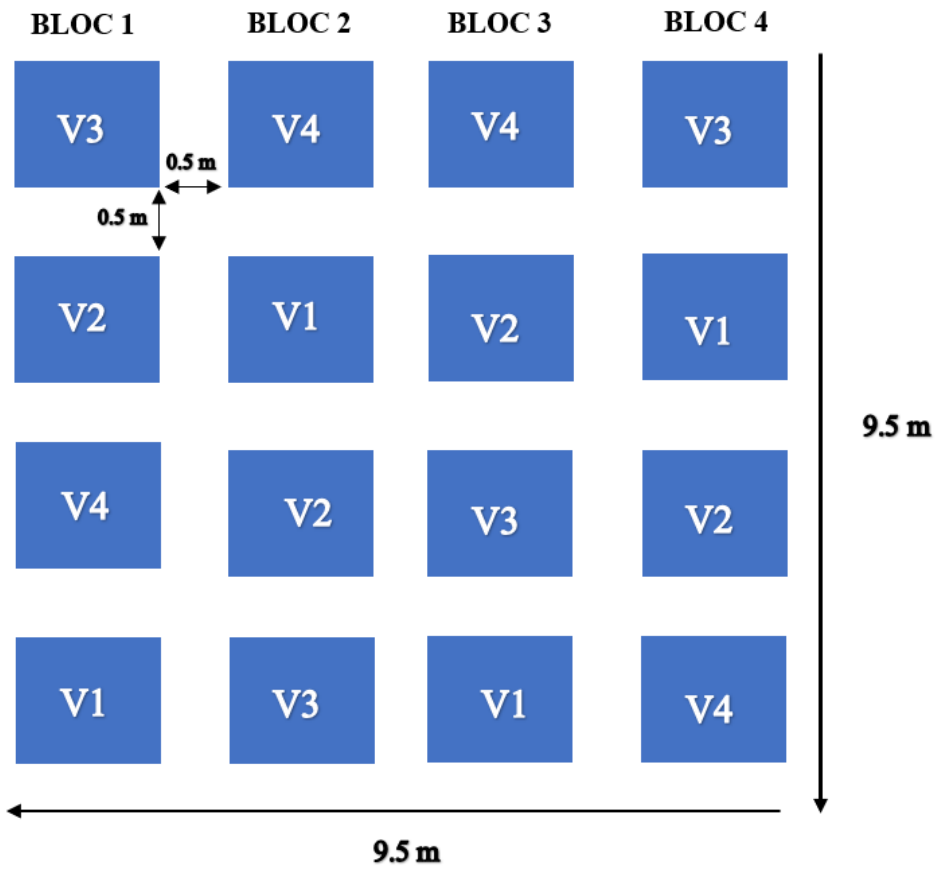

Figure 2 : Schematic of the experimentation system

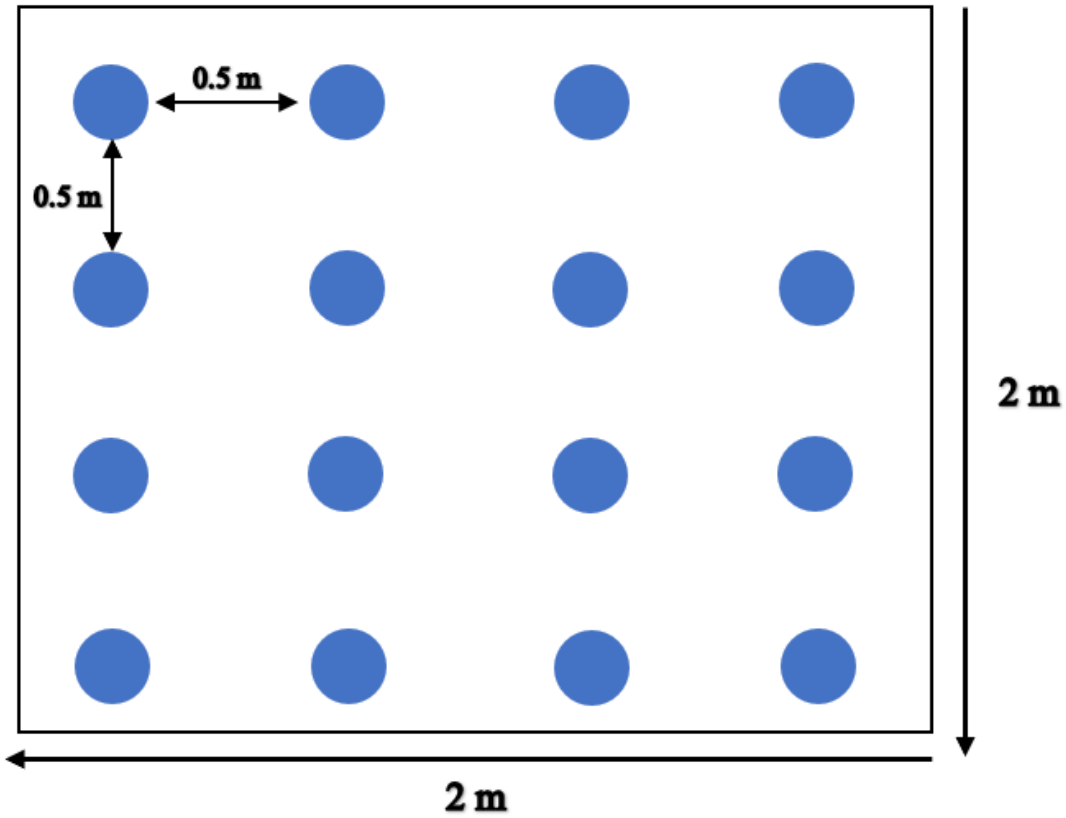

Figure 3 : Schematic of the experimental unit

Trial Management

The trial was conducted on a plot that had been previously cleared, leveled, and laid out according to a precise plan. The soil was loosened and amended with sheep manure, which was incorporated into planting holes 20 cm deep. Manual sowing took place on August 1st, 2022, with three seeds per hole, followed by thinning at 15 days to retain only one plant per hole. Maintenance operations included hoeing, staking (initiated upon the appearance of tendrils), manual and mechanical weeding, as well as supplemental irrigation in case of drought (five watering sessions in total). Plant protection was ensured through the application of a neem leaf-based solution, sprayed at 15, 30, and 45 days after sowing.

Measurements and Observations

The morphological parameters considered in this study were:

- Collar diameter,
- Plant height,
- Number of leaves per plant.

For data collection, five (5) plants were randomly selected from each elementary plot. Observations were carried out at two key stages of the crop cycle: on the 30th and 60th day after sowing (DAS).

Data Processing and Statistical Analysis

The collected data were entered and organized using Microsoft Excel 2013, which was also used to create tables and presentation charts. Statistical analyses were performed using XLSTAT software. An analysis of variance (ANOVA) was conducted to assess the effect of the different varieties on the studied parameters. In cases of significant differences, means were compared using the Student-Newman-Keuls (SNK) test at a 5% significance level ($p < 0.05$).

RESULTS

Leaf Production According to Cucumber Varieties

Figure 4 illustrates the average leaf production per cucumber plant at 30 and 60 days after sowing (DAS). At 30 DAS, the average number of leaves per plant ranged from 9.4 to 12.2. Analysis of variance revealed a highly significant effect of the varieties on this parameter ($P < 0.0001$). The F1 Tokyo and F1 Nogano varieties showed the highest average number of leaves, with 12.2 and 11.6 leaves per plant respectively, while the Poinsett and Poinsett+ varieties recorded lower values, around 9.6 and 9.4 leaves per plant.

At 60 DAS, the average number of leaves per plant ranged from 23.6 to 33.1. The Poinsett variety stood out with the highest leaf production, averaging 33.1 leaves per plant, whereas Poinsett+ (23.9), F1 Tokyo (23.8), and F1 Nogano (23.6) showed significantly lower values. The analysis of variance confirmed a significant varietal effect on leaf production at this stage (P = 0.027).

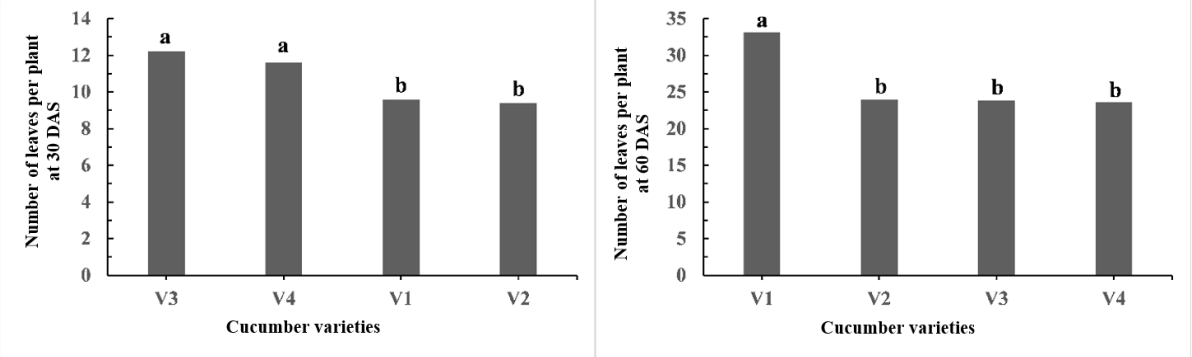

Figure 4 : Leaf production according to cucumber varieties

Average Plant Height According to Cucumber Varieties

Figure 5 shows the progression of average cucumber plant height at 30 and 60 days after sowing (DAS). At 30 DAS, the average height varied significantly among the varieties, ranging from 13.3 cm to 44.0 cm. Statistical analysis revealed a highly significant effect of variety on plant height (P < 0.0001). The F1 Tokyo variety showed the greatest average height, with 44.0 cm per plant, while the Poinsett+ variety had the lowest, with only 13.3 cm. The F1 Nogano and Poinsett varieties occupied intermediate positions, with 23.0 cm and 20.4 cm per plant, respectively.

At 60 DAS, analysis of variance confirmed a highly significant varietal effect on plant height (P < 0.0001). The F1 Tokyo variety remained the tallest, with an average height of 160.7 cm per plant, whereas the Poinsett, F1 Nogano, and Poinsett+ varieties showed considerably shorter plant heights.

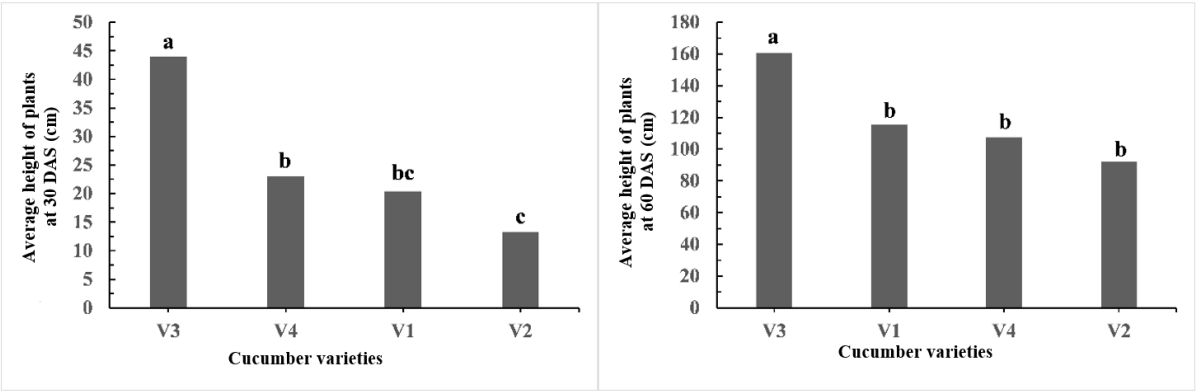

Figure 5 : Average plant height according to cucumber varieties

Collar Diameter of Cucumber Plants According to Varieties

Figure 6 illustrates the variation in collar diameter of cucumber plants at 30 days after sowing (DAS). At this stage, the average diameter ranged from 9.4 to 10.5 mm. The Poinsett+ and F1 Nogano varieties showed the largest diameters, reaching 10.5 mm per plant, while the F1 Tokyo (9.5 mm) and Poinsett (9.4 mm) varieties recorded the smallest values. Analysis of variance confirmed a highly significant varietal effect on this parameter (P < 0.0001).

At 60 DAS, statistical analysis also revealed a highly significant effect of variety on collar diameter (P = 0.007). The F1 Nogano variety stood out with the highest average diameter, measuring 12.9 mm per plant, while F1 Tokyo recorded the lowest, with an average of 11.3 mm. The Poinsett+ and Poinsett varieties showed intermediate values between these two extremes (Figure 6).

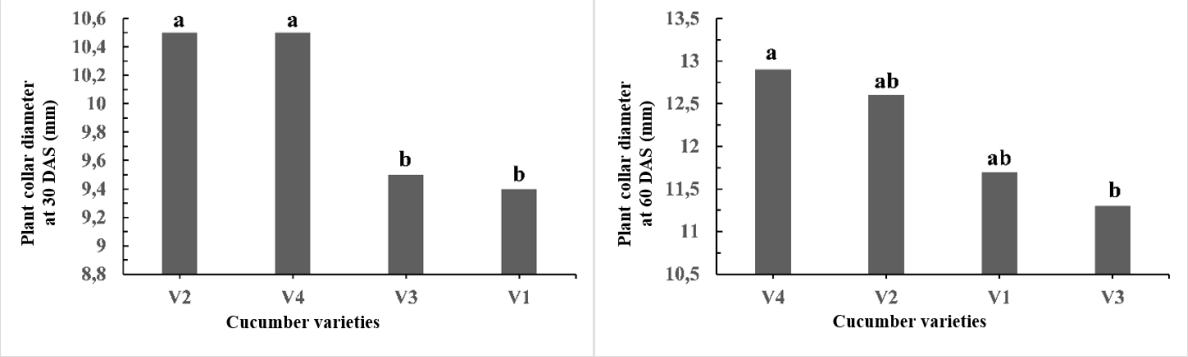

Figure 6 : Collar Diameter of Plants According to Varieties

DISCUSSION

The observations and measurements focused primarily on morphological parameters, namely the number of leaves, plant height, and collar diameter, depending on the cucumber variety. Statistical analysis revealed a significant effect of variety on leaf production at both 30 and 60 days after sowing (DAS). The F1 Tokyo variety stood out with the highest number of leaves at 30 DAS, while the Poinsett variety had the greatest leaf surface area at 60 DAS. This high leaf production observed in Poinsett at 60 DAS could be explained by the fact that vegetative growth peaks during this period. These results are consistent with those of Nieuwenhuis & Nieuwelink (2005), who reported that early-maturing varieties tend to be less productive in terms of foliage.

Regarding plant height, the F1 Tokyo variety recorded the greatest average heights at both 30 and 60 DAS. The analysis of variance confirmed a significant effect of variety on this parameter. These findings align with the work of Ndiaye (2021) on potato, which shows that plant growth needs follow an exponential curve during the flowering stage. Moreover, Zongo (1991) indicated that plant height is closely related to the plant's development cycle. However, Boufares (2012) challenged this pattern, emphasizing in his study that stem height does not always evolve linearly throughout the growth cycle.

As for stem diameter, significant differences were also observed among the varieties. The F1 Nogano variety stood out for its notable stem vigor, providing greater structural strength. These results highlight considerable genetic variability among the studied varieties. They are consistent with the findings of Badji (1999), who noted that fast-growing, early-maturing genotypes tend to produce greater biomass, optimize the use of available water, and are less sensitive to environmental stress compared to late-maturing genotypes. These results are also similar to those obtained by Diouf (2020) on other cucumber varieties.

CONCLUSION

In Senegal, horticultural production, traditionally concentrated in the coastal Niayes strip and the Senegal River Valley, is gradually diversifying geographically, particularly towards the Groundnut Basin regions. This transition is accompanied by a progressive reduction in areas devoted to peanut cultivation in favor of horticultural crops, especially during the rainy season. The study conducted in Bambey focused on four domesticated cucumber (*Cucumis sativus* L.) varieties to assess their adaptability to local pedoclimatic conditions. The results highlighted significant variability among the different varieties. The F1 Tokyo variety stood out for its rapid growth, notably in height and leaf production at 30 days after sowing (DAS). Based on these observations, the F1 Tokyo and F1 Nogano varieties appear to be the best adapted to the agroclimatic conditions of Bambey, exhibiting superior morphological characteristics. They thus represent promising options for the development of optimized cucumber production in this region of the Groundnut Basin.

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