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Effect of Apical Cutting on the Growth of Cucumber (*Cucumis sativus* L.) at the Site of Hummay Salamna University of Diffa, Niger

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

Cucumber (*Cucumis sativus* L.) is an important vegetable crop that contributes to dietary diversification and farmers' incomes. Improving cucumber productivity and quality remains an important agronomic and economic challenge. However, cucumber cultivation is often characterised by low yields and high mineral fertiliser costs. Cutting the apical tip of the main stem is an agronomic practice that may improve crop performance. The main objective of this study was to evaluate the effect of apical cutting on cucumber growth. The trial was conducted during the 2025 rainy season at the Hummay Salamna University site using a factorial randomised complete block design with four replications. During the vegetative stage, approximately 5 cm of the main-stem apex was removed using pruning shears previously disinfected with alcohol. The results showed that apical cutting significantly increased

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collar diameter, plant height, the numbers of primary and secondary branches, the number of buds and leaf area. Responses to apical cutting varied among varieties according to the parameter measured. Further studies in other climatic areas of Niger are needed to confirm these effects on cucumber growth and yield and to identify the most appropriate stage for apical cutting.

Keywords: Cucumber; apical cutting; growth; source of income; Diffa; Niger.

1. Introduction

In Africa, agriculture remains a fundamental pillar of economic and social development, contributing to employment, income generation and food security among rural populations (Ministère de l'Agriculture et de l'Élevage, 2025). Vegetable crops, in particular, are becoming increasingly important in irrigated production systems because they diversify farmers' sources of income and improve the supply of fresh produce to urban markets (Egg & Wade, 2006; INRAN & PMERSA-MTZ, 2019; Ministère de l'Agriculture et de l'Élevage, 2025). In Niger, a Sahelian country characterised by high rainfall variability and structural dependence on agriculture, irrigated crops represent a strategic response to agroclimatic constraints and contribute to economic resilience (INS, 2023; TAAT Clearinghouse, 2021). In this context, cucumber (*Cucumis sativus* L.) is an important vegetable crop that contributes to dietary diversification, vitamin intake and producers' incomes (Borecka & Karaś, 2025). Accordingly, improving cucumber productivity and quality represents a major agronomic and economic challenge for local production systems (Ministère de l'Agriculture et de l'Élevage, 2025; TAAT Clearinghouse, 2021).

A greenhouse study in Sudan showed that soil type and chicken-manure treatments affected cucumber growth and yield, illustrating the importance of cultivation conditions when assessing crop performance (Elgali *et al.*, 2025).

The Diffa region, characterised by sandy loam soils susceptible to nutrient depletion and water stress, experiences low yields associated with high mineral fertiliser costs and progressive deterioration of soil fertility. Given these constraints, adopting improved cultivation practices is an important response to this challenge (Boukar Kellou *et al.*, 2022). Among these practices, removal of the main-stem apex is relatively inexpensive and straightforward to implement and may improve cucumber productivity. Previous studies of apical cutting in cultivated species have reported effects on leaf, fruit and seed production (Abdul-Baki *et al.*, 2001; Olasantan & Salau, 2008; Ahmed & Oladiran, 2012; Mardhiana *et al.*, 2017; Kattel *et al.*, 2023; Boukar Kellou *et al.*, 2020). This technique aims to suppress apical dominance, stimulate branching, promote more uniform production and optimise yield (Boukar Kellou *et al.*, 2022). The apex produces auxin, a plant hormone involved in apical dominance, which can inhibit the development of lateral branches (Domagalska & Leyser, 2011; Olasantan & Salau, 2008).

In protected cucumber cultivation, Dulam *et al.* (2024) found that pruning and training treatments interacted to influence crop yield, although their interventions differed from the apical cutting examined in the present study. Dholi *et al.* (2024) also reported changes in cucumber flowering and yield following a combined 3G-cutting and ethephon treatment under the conditions studied in Nepal.

More recently, Cheng *et al.* (2025) reported that pruning method and cultivar were associated with differences in cucumber plant architecture across growth stages. Conversely, Ando *et al.* (2025) observed lower yield with repeated rejuvenation pinching in winter–spring greenhouse cucumber production, indicating that the effects of pruning cannot be assumed to be uniform across cultivation systems.

However, the effects of main-stem apical cutting at different stages on the growth of the three cucumber varieties evaluated here remain to be assessed under the specific field conditions of Diffa.

In this context, the general objective of the present study was to assess the effect of apical cutting on cucumber growth and yield in the municipality of Diffa.

2. Materials and Methods

2.1 Presentation of the Study Site

The study was conducted at Hummay Salamna University of Diffa, on the north-western outskirts of the city, along a major route. The study site has soils ranging from sandy clay with low fertility to fertile clay loam (PIDUREM, 2025). Rainfall in 2025 was characterised by a particularly wet August, with 229.1 mm, exceeding the historical monthly average (DMN, 2025) (Fig. 1). However, rainfall distribution was irregular, with prolonged dry spells in September (DMN, 2025). April and May were particularly hot, with maximum temperatures regularly reaching or exceeding 41°C. October 2025 was slightly cooler than normal (DMN, 2025).

2.2 Biological Materials

The plant material consisted of three cucumber (*Cucumis sativus* L.) varieties originating from Niger, Nigeria and the United States (Table 1). The varieties differ in botanical type, fruit colour, fruit shape, fruit size and biological cycle (Fig. 2). These varieties were selected on the basis of seed availability among farmers and technical services.

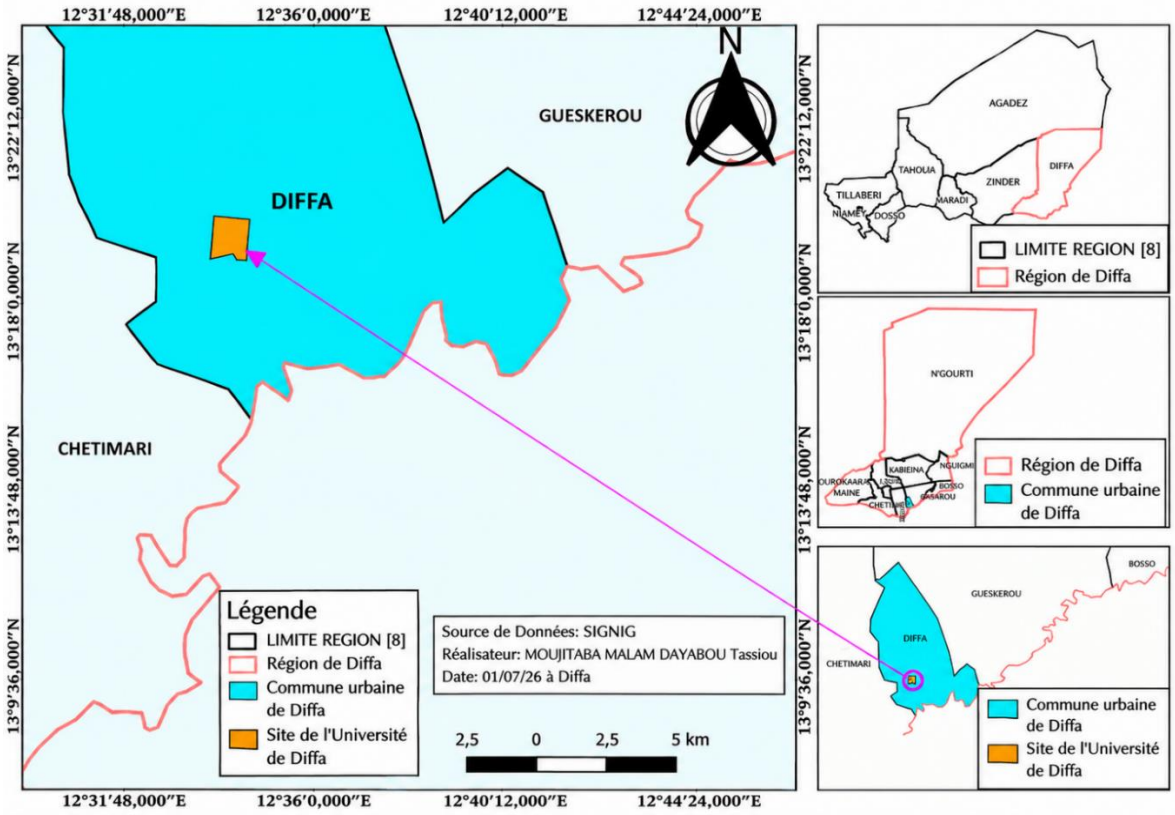


Fig. 1. Location of the study site (Source: SIGNIGER)

Table 1. Botanical types, country of origin and characteristics of the different varieties studied

Varieties	Botanical type	Fruit color	Fruit shape	Fruit size	Biological cycle	Country of origin
Smooth variety (V1)	White Gourji	Cream or very pale green skin Slightly	more oval (short or stocky)	18 to 20 cm	50 to 60 days	Nigeria, Niger
Striped variety (V2)	Striped Gourji	Light green with darker longitudinal lines	Short (oval)	18 to 20 cm	45 to 60 days	Nigeria, Niger
V3	Poinsett 76	Dark green, smooth	Cylindrical	More than 20 cm	60 to 77	United States



Fig. 2. Different cultivated varieties

2.3 Experimental Setup and Conduct of the Experiment

The experiment was conducted on a heterogeneous site using a factorial randomised complete block design with two factors: cucumber variety at three levels (V1, V2 and V3) and apical cutting at four levels (C0: control; C1: 15 days after sowing [JAS]; C2: 25 JAS; and C3: 35 JAS) (Fig. 3). The experimental design comprised four replications within an area of 525 m² (35 m × 15 m), with each replication forming a block. Each block contained 12 experimental units of 6 m² (3 m × 2 m). Blocks were separated by 1 m, as were the experimental units. Each experimental unit contained three rows of five planting positions, spaced 0.5 m apart, giving 15 seed holes per unit. In total, there were 720 seed holes distributed across 48 plots (Fig. 3).

Following establishment of the experimental layout, cucumber seeds were sown on 28 July 2025 after 20 mm of rainfall. Emergence was observed at 5 JAS for the local varieties and 7 JAS for Poinsett 76. Before sowing, seed germination was assessed in the laboratory using Petri dishes containing 10 seeds each. Crop maintenance included tying, trellising, weeding, uncoupling and irrigation. Staking began when the first branches appeared, using *Azadirachta indica* stakes and nets to encourage vertical growth and improve fruit quality. The first weeding and unweeding operations were conducted at 18 JAS, followed by three manual weeding operations at 27, 35 and 43 JAS. Irrigation was applied according to plant requirements, mainly in the morning or evening. For phytosanitary protection, fruits were separated from the soil using plant debris, and a neem-extract-based biopesticide was used against insect pests. Symptoms of yellowing, foliar necrosis and internal fruit rot were also observed. Harvesting began at maturity, using disinfected shears, from 48 JAS for V1 and V2 and 55 JAS for V3; harvesting occurred every three days for the local varieties and daily for V3.

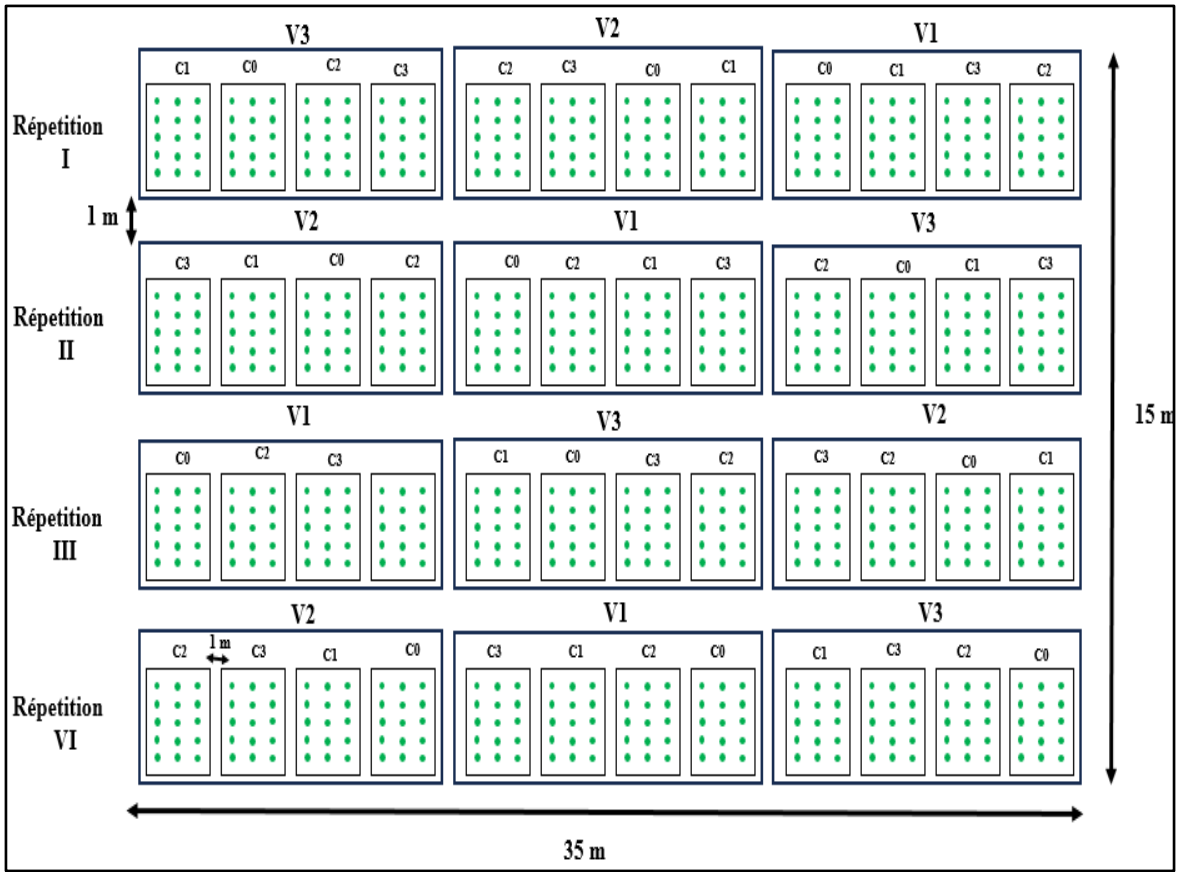


Fig. 3. Experimental design

2.4 Apical Cutting Method on the Main Stem

The method involved removing approximately 5 cm of the main-stem apex during the vegetative stage using pruning shears previously disinfected with alcohol. Apical cutting was performed at three different times: 15, 25 and 35 days after sowing (JAS). Uncut plants of each variety served as controls. The treatments were as follows:

C0: no apical cutting of the main stem (control);
C1: apical cutting of the main stem at 15 JAS;
C2: apical cutting of the main stem at 25 JAS;
C3: apical cutting of the main stem at 35 JAS.

2.5 Data Collection

Six central plants were selected in each experimental unit for observation and measurement. At maturity, measurements included plant height, collar diameter, number of buds, numbers of primary and secondary branches, and leaf area.

2.6 Data Processing

Data were analysed using RStudio 4.3.3 after testing for normality with the Shapiro–Wilk test and homogeneity of variance with Levene's test. Where the assumptions were met, a two-factor analysis of variance (ANOVA) was conducted to assess the effects of cutting treatment, variety and their interaction. Means for the measured variables were compared using the Student–Newman–Keuls test at the 5% significance level.

3. Results

3.1 Plant Height

Table 2 presents the effect of main-stem apical cutting on cucumber plant height. The analysis showed a highly significant effect of cutting on plant height ($p < 0.001$).

Table 2. Effect of main stem cutting on plant height in three varieties

Varieties	C0	C1	C2	C3
V1	88.5e	101b	93,4d	86.7e
V2	89.1e	106a	96.4cd	88.3e
V3	78.5f	97.5bc	88.6e	80.4f
Means ±	85.36c	101.5a	92.8b	85.13c
SD	1.54	2.97	1.96	4.04
Cuts	< 2e-16***	< 2e-16***	< 2e-16***	< 2e-16***
Cuts x varieties	0.00367**	0.00367**	0.00367**	0.00367**

*C0: control; C1, C2, C3: apical cutting of the main stem carried out at the stages of 15, 25, and 35 days after sowing, respectively. The numbers bearing the same letter(s) on the same line are not significantly different at the p > 0.05 threshold; **: highly significant; ***: very highly significant; SD: Standard Deviation*

Early cutting at 15 JAS produced the greatest mean plant height (101.5 cm), whereas the control and C3 treatments produced the lowest mean heights (Table 2). Significant differences were also observed among varieties. Variety V2 was the tallest (106 cm), whereas V3 was the shortest (97.5 cm). Variety V3 (101 cm) had an intermediate mean length. The cutting-by-variety interaction was highly significant ($p = 0.00367$) (Table 2).

3.2 Collar Diameter

The analysis showed that apical cutting had a highly significant effect on collar diameter ($p < 0.001$). However, the cutting-by-variety interaction was not significant (Table 3). Early cutting at 15 JAS produced the greatest collar diameter (11 cm). The other cutting treatments produced similar collar diameters (approximately 10 cm). The greatest collar diameter was recorded in V2 and the smallest in V3 (Table 3).

Table 3. Effect of cutting the main stem on the diameter at the crown of the plant in three varieties of cucumber

Varieties	C0	C1	C2	C3
V1	10.4b	11.0ab	10.5b	10.4b
V2	10.5b	11.3a	10.7ab	10.5b
V3	10.6ab	10.9ab	10.8ab	10.5b
Means ±	10.38b	11.06a	10.66ab	10.46b
SD	0.57	0.49	0.56	0.44
Cuts	1.33e-05***	1.33e-05***	1.33e-05***	1.33e-05***
Cuts x varieties	0.056ns	0.06ns	0.06ns	0.06ns

*C0: control; C1, C2, C3: apical cutting of the main stem carried out at the stages of 15, 25, and 35 days after sowing, respectively. The digits bearing the same letter(s) on the same line are not significantly different at the p > 0.05 threshold; ns: non-significant (p > 0.05); ***: very highly significant. SD: Standard Deviation*

3.3 Number of Primary Branches

Table 4 presents the effect of main-stem apical cutting on the number of primary branches. Analysis of variance showed a highly significant effect of cutting ($p < 0.001$). Early cutting produced the greatest number of primary branches (21 branches per plant), whereas the control produced the fewest. The other cutting treatments resulted in similar numbers of primary branches (Table 4). A similar increase under early cutting was observed for V1 and V3, although V2 produced the greatest number of primary branches. The cutting-by-variety interaction was not significant ($p = 0.139$) (Table 4).

Table 4. Effect of apical cutting of the main stem on the number of primary branches in three (3) varieties of cucumber

Varieties	C0	C1	C2	C3
V1	15.4±1.60ef	20.3±1.67b	17.8±1.22cd	15.8±1.95def
V2	15.8±1.70def	23.5±2.50a	18.8±0.38bc	17.7±1.92cde
V3	15.8±1.76def	20.4±1.83b	17.4±0.9cdef	15.3±1.83f
Means ±	15.66c	21.39a	18b	16.26c
SD	1.63	9.5	0.83	1.9
Cuts	< 0.001***	< 0.001***	< 0.001***	< 0.001***
Cuts x varieties	0.139ns	0.139ns	0.139ns	0.139ns

*C0: control; C1, C2, C3: apical cutting of the main stem carried out at the stages of 15, 25, and 35 days after sowing, respectively. The numbers bearing the same letter(s) on the same line are not significantly different at the p > 0.05 threshold; ns: non-significant (p > 0.05); ***: very highly significant. SD: Standard Deviation*

3.4 Number of Secondary Branches

The results in Table 5 show that main-stem apical cutting significantly increased the number of secondary branches per plant.

Table 5. Effect of cutting the main stem on the number of secondary branches in three varieties of cucumber

Varieties	C0	C1	C2	C3
V1	16.2cde	24.8a	20.4b	20.7bc
V2	14.3de	25.8a	19.3bc	16.4cde
V3	13.1e	17.6b	16.6cd	14.5cde
Means ±	14.53cde	22.73a	18.76b	17.2bc
SD	1.76	2.69	2.02	1.09
Cuts	< 2e-16***	< 2e-16***	< 2e-16***	< 2e-16***
Cuts x varieties	0.0185*	0.0185*	0.0185*	0.0185 *

*C0: control; C1, C2, C3: apical cutting of the main stem carried out at the stages of 15, 25, and 35 days after sowing, respectively. The numbers bearing the same letter(s) on the same line are not significantly different at the p > 0.05 threshold; *** : very highly significant; * : significant. SD: Standard Deviation*

The number of secondary branches per plant was greatest under early cutting (C1), followed by C2. The other treatments produced fewer secondary branches (Table 5). Cutting at 15 JAS produced similar increases in V1 and V2. Similar numbers of secondary branches were recorded for V3 and V2 at 35 JAS and for V3 at 15 JAS and V1 at 25 JAS (Table 5). In addition, under the later cutting treatments (25 and 35 JAS), V1 and V2 showed similar numbers of secondary branches. The cutting-by-variety interaction was significant (Table 5).

3.5 Leaf Area

Analysis of variance showed that apical cutting significantly affected leaf area (Table 6). The greatest increase was observed under early cutting. Responses were similar for V1 and V2 at 25 and 35 JAS and for V2 and V3 at 35 JAS. However, in V3, cutting at 15 and 25 JAS had effects similar to those of the control (Table 6). The cutting-by-variety interaction was not significant (p = 0.307).

Table 6. Effect of main stem cutting on leaf area (cm 2) in three (3) cucumber varieties

Varieties	C0	C1	C2	C3
V1	131a±31.2bc	147±34.3ab	105±17.5c	111±17.7bc
V2	131±21.7abc	153±47.9a	113±25.6bc	102±12c
V3	130±28.7abc	128±15.5abc	122±31.6abc	104±12.2c
Means ±	130.66b	142.66a	113.33c	105.66c
SD	27.2	32.56	24.9	13.96
Cuts	< 0.001***	< 0.001***	< 0.001***	< 0.001***
Cuts x varieties	0.307ns	0.307ns	0.307ns	0.307ns

*C0: control; C1, C2, C3: apical cutting of the main stem carried out at the stages of 15, 25, and 35 days after sowing, respectively. The digits bearing the same letter(s) on the same line are not significantly different at the p > 0.05 threshold; ns: non-significant (p > 0.05); *** : very highly significant. SD: Standard Deviation*

3.6 Number of Buds Per Plant

Analysis of variance showed that main-stem apical cutting had a highly significant effect on the number of buds (p < 0.001). Cutting at 15 JAS produced the greatest number of buds, followed by cutting at 25 JAS. The increase was similar in V1 and V2 (Table 7). However, late cutting produced numbers of buds similar to those of the control in all varieties. The cutting-by-variety interaction was also highly significant (p < 0.001).

Table 7. Effect of apical cutting of the main stem on number of buds in three varieties of cucumber

Varieties	C0	C1	C2	C3
V1	12.3±1.07de	28.2±3.43a	18.4±2.31c	11.8±0.866de
V2	11.8±1.75de	30±3.36a	20.3±b1. 92c	11.7±2.39de
V3	9.92±0.9de	22.4±3.37b	13.8±1.14d	12.7±4.89de
Means ±	11.34de	26.86a	17.5b	12.06c
SD	1.24	0.97	1.79	12.06
Cuts	< 0.001***	< 0.001***	< 0.001***	< 0.001***
Cuts x varieties	< 0.001***	< 0.001***	< 0.001***	< 0.001***

*C0: control; C1. C2. C3: apical cutting of the main stem carried out at the stages of 15. 25. and 35 days after sowing. respectively. The numbers bearing the same letter(s) on the same line are not significantly different at the p > 0.05 threshold; ***: very highly significant. SD: Standard Deviation*

4. Discussion

This study evaluated the effect of apical cutting on cucumber (*Cucumis sativus* L.) growth at the experimental site of Hummay Salamna University in Diffa. Apical cutting had a highly significant effect on plant height, with the greatest mean observed following early cutting (C1). This response may reflect compensatory growth associated with the redistribution of assimilates towards the stem and lateral branches. Comparable effects were reported in cucumber by Mardhiana *et al.* (2017), who observed changes in plant vigour and stem development following pruning. Early cutting also significantly increased collar diameter compared with the control, suggesting greater structural robustness. Increased stem diameter following pruning or pinching was reported by Anwar *et al.* (2019) in watermelon and Boukar Kellou *et al.* (2022) in Guinea sorrel. These authors associated the suppression of apical dominance with changes in stem development and plant architecture. Thus, under the conditions of the present study, early cutting was associated with improvements in both plant height and collar diameter.

Regarding branching, the results showed significant increases in the numbers of primary and secondary branches following apical cutting. This response is consistent with the release of apical dominance: removal of the terminal bud reduces the influence of auxin produced at the apex and permits axillary bud development, resulting in increased branching (Domagalska & Leyser, 2011). Similar findings have been reported for okra, in which pinching increased branch numbers and altered plant architecture (Ibrahim *et al.*, 2012; Kattel *et al.*, 2023). The general pattern of increases under C1 and C2 is also consistent with observations of branching responses to apical cutting in other vegetable crops (Boukar Kellou *et al.*, 2020; Susanto *et al.*, 2015).

Early cutting increased cucumber leaf area compared with the control. This may contribute to greater light interception, although photosynthetic capacity was not measured directly. The result highlights the importance of cutting stage, as earlier intervention allows more time for subsequent leaf development. Work conducted under protected cultivation has also reported changes in cucumber foliage following apical clipping (Nwankwo *et al.*, 2016). The number of buds showed a similar pattern, with a marked increase under early cutting (C1), a smaller increase under C2 and values under cutting at 35 JAS close to those of the control. This response is consistent with the redistribution of growth towards developing buds after removal of the apex, as reported for other vegetable crops (Susanto *et al.*, 2015).

5. Conclusion

Apical cutting improved the measured growth characteristics of cucumber under the conditions of this study. Cutting at 15 JAS produced the greatest collar diameter, plant height, numbers of primary and secondary branches, number of buds and leaf area. These findings highlight the importance of choosing an appropriate cutting stage and accounting for varietal responses when managing cucumber growth. Early apical cutting at 15 JAS may therefore be considered as a growth-management practice under conditions similar to those evaluated in Diffa.

6. Limitations

This study was conducted at a single site in Diffa during one rainy season and involved three cucumber varieties. Consequently, responses may differ under other soils, rainfall patterns and management conditions. The measurements reported concern vegetative growth characteristics; although harvesting is described, fruit yield outcomes are not presented in the results. The study therefore cannot establish whether the observed increases in branching, bud number and leaf area translate into higher cucumber yield. Additional field evaluations across seasons and locations would help assess the consistency of the treatment responses.

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Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. ChatGPT, Claude and Perplexity were used solely to assist with grammatical refinement and

reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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