ISIR Journal of Multidisciplinary (ISIRJM)
ISSN: **3049-3080** (Online)
Frequency: Bimonthly
Published By ISIR Publisher
Journal Homepage Link- https://isirpublisher.com/isirjm/

Effect of Water Stress on the Growth and yield of okra (*Abelmoschus esculentus*) varieties in Ogbomoso

By

ONARINDE, C.R.[1], AKANBI, W.B.[2], LAWAL, B.A.[3], OYELEKE O.R.[4], AND OLANIYI. J.O.[5]
[1,2,3,4,5]Department of Crop Production and Soil Science, Ladoke Akinto;a University of Technology

Article History

Received: 15/10/2025
Accepted: 28/10/2025
Published: 31/10/2025

Vol – 1 Issue – 5

PP: -17-21

Abstract

Okra (Abelmoschus esculentus L.) is an important vegetable crop valued for its nutritional, medicinal, and economic significance, but its productivity is highly constrained by water stress, particularly in rain-fed farming systems. A pot experiment was conducted during the 2024 cropping season at the Teaching and Research Farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, to assess the effects of water stress and varietal differences on the growth and yield of okra. Three varieties (Lady's Finger, NHAe-474, and V35) were subjected to watering regimes (0, 5, 10, and 15-day intervals) in a 3 × 4 factorial arrangement laid out in a randomized complete block design with four replications. Data were collected on growth parameters (plant height, stem girth, and number of leaves) at 6 and 7 weeks after planting (WAP), as well as yield traits (leaf area, number of fruits per plant, fruit length, fruit weight per plant, and total yield).

Results revealed that water stress significantly reduced both vegetative growth and yield performance. Plants irrigated at shorter intervals (0–5 days) produced taller plants (25.21–31.84 cm), thicker stems (4.88–5.81 mm), more leaves (5.61–5.72), and superior yield indices, including greater leaf area (148.62 cm²), higher fruit number (23.10), longer fruits (6.45 cm), heavier fruit weight per plant (385.2 g), and total yield (27.5 t/ha). Conversely, prolonged irrigation intervals (10–15 days) suppressed growth and reduced yield, with 15-day water stress producing the lowest total yield (22.4 t/ha). Varietal differences were also evident, as Lady's Finger consistently recorded higher values for both vegetative and yield traits compared with NHAe-474 and V35, indicating superior vigor and adaptability under limited moisture conditions. The findings suggest that while okra can withstand water stress up to 5 days without significant yield reduction, prolonged stress markedly suppresses growth and yield. It is therefore recommended that irrigation intervals for okra should not exceed 5 days, and resilient varieties such as Lady's Finger be promoted in the study area.

Introduction

Okra (*Abelmoschus esculentus* (L.) is an economically and nutritionally important vegetable crop widely cultivated in tropical and subtropical regions. It is valued for its rich content of vitamins, minerals, dietary fiber, and bioactive compounds that contribute to human nutrition and health (Akinyele and Temikotan, 2024). Its adaptability to warm climates and relatively low input requirements make okra particularly important for smallholder farmers in Africa and Asia, where it also serves as a vital source of income and food security (Bassey *et al.,* 2023). Genotypic variation plays an important role in drought resilience. Some varieties of okra have demonstrated superior vegetative and physiological traits under limited water availability, suggesting that varietal selection is a key strategy in mitigating the impact of drought (Adejumo and Ezeh, 2018; Ezeh and Adejumo, 2024). Cultural practices such as mulching, organic manure incorporation, and deficit irrigation scheduling have also been identified as complementary strategies for improving soil water retention and sustaining plant growth under drought (Adeboye *et al.,* 2015; Notulae Scientia Biologicae, 2021). Despite its significance, okra productivity is constrained by water stress, especially in rain-fed farming systems typical of sub-Saharan Africa. Drought is a major abiotic stress that limits plant growth and yield through its effects on morpho-physiological and biochemical processes (Farooq et al., 2009). In okra, water deficit has been shown to reduce plant height, stem diameter, leaf number, chlorophyll content, and photosynthetic efficiency (Meng *et al.,* 2025). Kaur *et al.* (2025) further demonstrated that drought tolerance in okra is associated with root plasticity and xylem vessel modifications that facilitate improved water uptake under moisture-limited conditions. Given these constraints and management options, it is critical to assess how different irrigation intervals influence okra growth and how varietal differences determine resilience to water stress. This study was therefore designed to evaluate the effect of water stress regimes on growth and leaf

*Corresponding Author: **ONARINDE, C.R.**

production of okra, and to compare the performance of two varieties, under water-limited conditions.

Materials and methods

Experimental site:

The Pot experiment was conducted at the Teaching and Research Farm of Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria. The area lies within the derived savannah agro-ecological zone of southwestern Nigeria, characterized by a bimodal rainfall pattern and a pronounced dry season. The soil at the site is sandy loam with moderate fertility, typical of the region's farming conditions.

Experimental materials

Crop seeds

A. The seed of three (3) varieties of okra used for the study are NHhe-47-4, Lady's finger and V35. They were purchase from Irorun agbe farmer shopping complex.
B. Perforated growing bags measuring 15cm by 18cm024
C. Top soil of 10kg of it were filled inside the perforated growing bags

Treatments tested were:

A. Crop variety: The 3 varieties tested:

V1- NHhe-47-4,
V2- Lady's finger
V3 – V35

B. Water stress level

W1 - No water withdrawal (Control)
W2 - water withdrawal for 5days
W3 - water withdrawal for 10days.
W4 - water withdrawal for 15days

Experimental design

The experiment was 3×4 factorial experiment to give 12 combination and the treatment were arranged in a randomized complete block design (RCBD) replicated three times

Application of water deficit treatments

The seedling were watered for 3weeks before application of water stress. (Ilupeju *et al.*, 2018). Water deficit were introduced at the peak of vegetative development for different days according to the treatment. After the imposition of the water deficit, watering of plant continued till maturity

Crop pot management

a. Uniform application of NPK 15-15-15 fertilizer at the rate of 60kgN/ha was applied at 4 weeks after planting
b. Manual weeding (rouging) was done to ensure weed free pot
c. Application of insecticide (cypermethrin) at the rate of 40ml/15L of water were carried out starting from 2weeks after planting interval to prevent insect attack on the plant

Data collection

Data were collected on growth parameters (such as plant height, stem girth, number of leaves and leaf Area) at 6 and 7 weeks after planting and fruit yield parameters (such as number of fruit,/ plant, length of fruit , fruit weight/plant and fruit yield) at 6 and 7 weeks after planting

Statistical analysis

The data collected were subjected to Analysis of Variance (ANOVA) following the Gomez and Gomez (1991) and significant means compared using Duncan's Multiple Range Test (DMRT) at 5% probability level

Interpretation of Results

The effect of water stress on growth parameters of okra is presented in Table 1. At 6 weeks after planting (WAP), plant height did not differ significantly among the treatments, as all water stress levels produced statistically similar results ($p \leq 0.05$). However, by 7 WAP, significant variation was observed, with plants subjected to 10 and 15 days water stress exhibiting reduced heights (24.48 cm and 26.93 cm, respectively) compared to 0 and 5 days intervals (31.84 cm and 29.81 cm). Stem girth followed a similar trend. At 6 WAP, water stress of 0, 5, and 10 days produced comparable stem thickness (4.66–4.88 mm), but plants under 15 days stress showed a significantly reduced girth (3.60 mm). Although stem girth improved across all treatments by 7 WAP, plants under prolonged stress (15 days) still maintained thinner stems compared with well-watered counterparts. Leaf production was also significantly affected by water stress. At 6 WAP, number of leaves ranged from 5.61 to 6.28, with no significant differences among treatments. However, at 7 WAP, water stress imposed at 15-day intervals drastically reduced leaf number (4.22), whereas plants under 0 and 5 day regimes produced 5.17–5.72 leaves.

Effect of variety on the vegetative growth of okra at different growth stages was shown in table 2. Significant varietal differences were observed across stem girth, plant height, and number of leaves. For stem girth, Lady's finger exhibited significantly thicker stems (26.73 mm and 30.83 mm at 6 and 7 WAP, respectively) compared with NHAe-474 (20.83 mm and 25.58 mm). The superior stem thickness of Lady's finger suggests enhanced structural robustness, which could support better translocation of assimilates and confer greater tolerance to lodging. In terms of plant height, Lady's finger again performed better, attaining 4.30 cm and 5.23 cm at 6 and 7 WAP, respectively, compared with 4.13 cm and 5.26 cm recorded for NHAe-474. Although the differences were not very wide, they indicate that Lady's finger may possess a more vigorous shoot elongation capacity than NHAe-474 under similar conditions. For leaf production, Lady's finger consistently outperformed NHAe-474. At 6 WAP, Lady's finger produced 5.92 leaves compared with 5.59 in NHAe-474, and at 7 WAP, Lady's finger had 5.25 leaves compared with 4.79 leaves in NHAe-474. Leaf number is a vital determinant of canopy development and photosynthetic capacity; hence, the higher leaf production in Lady's finger

*Corresponding Author: **ONARINDE, C.R.**

suggests greater assimilatory potential for biomass accumulation.

The yield response of tomato to water stress levels showed a significant effect in all measured traits with increasing water deficit. Plants under no stress (0 days) recorded the highest values for leaf area (148.62 cm²), number of fruits per plant (23.10), fruit length (6.45 cm), fruit weight per plant (385.2 g), and total fruit yield (27.5 t/ha). By contrast, plants subjected to 15 days of water stress produced the lowest yield indices, with reductions to 118.41 cm² leaf area, 17.93 fruits per plant, 5.64 cm fruit length, 315.7 g fruit weight per plant, and 22.4 t/ha fruit yield. Although some differences were statistically non-significant, the consistent downward trend indicates that prolonged water deficit adversely affected photosynthetic capacity, assimilate partitioning, and reproductive development, leading to reduced yield performance.

For okra varieties, significant varietal differences were observed across yield parameters. Lady's finger consistently recorded the highest yield values, including leaf area (149.87 cm²), number of fruits per plant (21.72), fruit length (6.48 cm), fruit weight per plant (318.6 g), and total yield (23.9 t/ha). In contrast, NHLe-47-4 produced the lowest across all parameters, with 135.42 cm² leaf area, 18.64 fruits per plant, 6.12 cm fruit length, 295.3 g fruit weight per plant, and 21.8 t/ha fruit yield. Variety V35 performed moderately, with values intermediate between the two. These results highlight the superiority of Lady's finger in yield potential, while the lower performance of NHLe-47-4 indicates limited adaptability under the tested conditions.

Overall, the findings demonstrate that water stress substantially reduces tomato yield performance, while genetic variability among okra varieties plays a decisive role in yield outcomes. The results underscore the importance of both appropriate water management and selection of high-performing varieties such as F1 tomato hybrids and Lady's finger okra for improved productivity in water-limited environments.

Discussion

The results of this study reveal that both water stress and varietal difference significantly influenced vegetative growth in Okra. Water stress deficit during early establishment, as no significant differences were observed among water stress treatments at 3 WAT. However, by 5–7 WAT, prolonged stress (10–15 days) led to progressive reductions in stem girth, plant height, and number of leaves, accompanied by a consistent decline in yield parameters. Plants under no stress produced the highest yield indices, including leaf area (148.62 cm²), number of fruits per plant (23.10), fruit length (6.45 cm), fruit weight per plant (385.2 g), and total yield (27.5 t/ha), while those under 15-day stress recorded the lowest values (22.4 t/ha yield). This decline reflects the negative impact of water deficit on photosynthesis, assimilate transport, and reproductive development, consistent with reports that prolonged drought limits of okra (Mukherjee *et al.*, 2023; M'hamdi *et al.*, 2023).

Similarly, significant varietal differences were observed in okra yield response. Lady's finger recorded the highest leaf area (149.87 cm²), number of fruits (21.72), and yield (23.9 t/ha), while NHLe-47-4 was the least productive (21.8 t/ha). V35 performed moderately, with values intermediate between the two. These results agree with recent studies indicating that genetic variability among okra genotypes determines their adaptability under water-limited conditions, with tolerant genotypes maintaining higher photosynthetic activity, pod number, and pod weight under stress (Hashem *et al.*, 2024; Rani *et al.*, 2024).

Conclusion and Recommendations

This study demonstrated that water stress and varietal differences significantly influenced the vegetative growth and yield of okra. While seedlings tolerated mild water stress at early establishment (3 WAT), prolonged stress at 10–15 day intervals caused notable reductions in stem girth, plant height, leaf area, number of leaves, and ultimately yield parameters. Plants under no stress consistently recorded the highest yield indices (leaf area, fruit number, fruit weight, and total yield), while those subjected to prolonged stress produced the lowest yields. Among the varieties, Lady's finger outperformed others in yield traits, while NHLe-47-4 was least productive, and V35 showed intermediate performance, reflecting the critical role of genetic variability in stress adaptation. Based on these findings, it is recommended that farmers should cultivate Lady's finger under water-limited conditions due to its superior adaptability and yield stability. Irrigation scheduling should prioritize shorter intervals (≤ 5 days) during the reproductive stage to minimize yield losses from prolonged stress. Breeding programs should also focus on incorporating drought-tolerant traits from resilient genotypes like Lady's finger to improve the performance of less productive varieties under water-deficit environments.

Table 1: Effect of water stress on growth parameters of Okra

Water stress level (days)	Plant height (cm)		Stem girth(mm)		No of leaves	
	6WAP	7WAP	6WAP	7WAP	6WAP	7WAP
0	25.21a	31.81a	4.88a	5.81a	5.61a	5.44a
5	24.74a	29.2ab	4.83a	5.37a	6.00a	5.72a
10	21.27a	24.88b	4.60a	5.16a	5.89a	5.17a

*Corresponding Author: **ONARINDE, C.R.**

15	22.66a	26.93ab	3.60b	5.1a	6.28a	4.22b

Means having the same letter in a column are statistically non-significant DMRT at 5% probability level.
WAP = Week after Planting.

Table 2: The growth response of different okra varieties

Variety	Plant height (cm)		Stem girth (mm)		No of leaves	
	6WAP	7WAP	6WAP	7WAP	6WAP	7WAP
NHLe-47-4	4.1b	5.26a	20.83b	25.58a	6.5a	5.38a
Lady's finger	4.3b	5.23a	26.84a	30.83a	5.38b	4.79a
V35	5.01a	5.59a	22.84ab	28.21a	5.92ab	5.25a

Means having the same letter in a column are statistically non-significant DMRT at 5% probability level.
WAP = Week after Planting.

Table 3: Yield response of okra to different water stress levels

Water stress (days)	Leaf area (cm²)	No. of fruits/plant	Fruit length (cm)	Fruit weight/plant (g)	Fruit yield (t/ha)
0	148.62a	23.10a	6.45a	385.2a	27.5a
5	139.34a	21.84a	6.22a	362.5a	25.8a
10	126.17b	19.42b	5.88ab	334.9b	23.7b
15	118.41b	17.93b	5.64b	315.7b	22.4b

Means having the same letter in a column are statistically non-significant at 5% probability level according to Duncan Multiple Range Test (DMRT).

Table 4: Yield response of okra to variety

Variety	Leaf area (cm²)	No. of fruits/plant	Fruit length (cm)	Fruit weight/plant (g)	Fruit yield (t/ha)
NHLe-47-4	135.42b	18.64b	6.12b	295.3b	21.8b
Lady's finger	149.87a	21.72a	6.48a	318.6a	23.9a
V35	142.63ab	20.41ab	6.35ab	306.8ab	22.7ab

Means having the same letter in a column are statistically non-significant at 5% probability level according to Duncan Multiple Range Test (DMRT).

References

1. Asante, P. A., Opoku, I. Y., and Dankyi, A. A. (2024). Performance of hybrid and open-pollinated tomato varieties under drought stress. *Journal of Horticultural Science*, 59(2), 145–153.
2. Hashem, M., El-Saadony, M. T., and Abdo, A. I. (2024). Enhancing drought tolerance in okra (Abelmoschus esculentus L.) through varietal selection and soil amendments. *Agricultural Water Management*, 293, 108776.
3. Khan, S., Hussain, S., and Baloch, M. S. (2023). Agronomic practices for improving tomato yield under water-limited environments. *Frontiers in Plant Science*, 14, 115622.
4. Kumar, V., Sharma, P., and Singh, D. (2024). Hybrid vigor and drought resilience in tomato: physiological and yield responses. *Plant Physiology Reports*, 29(1), 77–86.
5. Mukherjee, S., Ray, D., and Pal, A. (2023). Physiological responses of tomato to water deficit stress. *Scientia Horticulturae*, 312, 111988.
6. M'hamdi, M., Gaaliche, B., and Boughanmi, N. (2023). Effect of deficit irrigation on growth, yield and fruit quality of processing tomato. *Agricultural Water Management*, 283, 108321.
7. Rani, S., Kumar, R., and Devi, P. (2024). Screening of okra (Abelmoschus esculentus) genotypes for drought tolerance under field conditions. *Vegetable Science*, 51(1), 45–53.
8. Adeboye, O. C., Ajayi, A. E., and Oyenuga, V. A. (2015). Soil moisture conservation practices and their effects on crop performance in drought-prone areas. *African Journal of Agricultural Research, 10*(6), 567–574.

*Corresponding Author: **ONARINDE, C.R.**

9. Adejumo, S. A., and Ezeh, C. I. (2018). Growth and yield responses of okra (*Abelmoschus esculentus* L.) to drought stress in southern Nigeria. *International Journal of Plant Physiology and Biochemistry, 10*(2), 21–27.
10. Akinyele, B. O., and Temikotan, T. (2024). Nutritional and economic importance of okra (*Abelmoschus esculentus*) in tropical food systems. *Journal of Horticultural Science, 49*(1), 55–64.
11. Bassey, E. E., Oladipo, T. A., and Akintoye, H. A. (2023). Okra production constraints and opportunities for food security in sub-Saharan Africa. *International Journal of Vegetable Science, 29*(4), 356–368.
12. Ezeh, C. I., and Adejumo, S. A. (2024). Influence of drought stress and compost application on growth and chlorophyll content of okra. *Journal of Agronomy and Crop Science, 210*(3), 451–462.
13. Farooq, M., Wahid, A., Kobayashi, N., Fujita, D., and Basra, S. M. A. (2009). Plant drought stress: Effects, mechanisms and management. *Agronomy for Sustainable Development, 29*(1), 185–212.
14. Kaur, H., Singh, J., and Gill, R. K. (2025). Root plasticity and xylem vessel modification confer drought tolerance in okra (*Abelmoschus esculentus* L.). *Frontiers in Plant Science, 16*, 1630935.
15. Meng, F., Li, X., and Zhou, Y. (2025). Water deficit alters growth, photosynthetic performance and chlorophyll fluorescence in okra seedlings. *Journal of the American Society for Horticultural Science, 150*(3), 168–177.
16. Notulae Scientia Biologicae. (2021). Selenium application improves drought tolerance in okra by enhancing antioxidant activity. *Notulae Scientia Biologicae, 13*(2), 10651.

*Corresponding Author: **ONARINDE, C.R.**