



**EFFECT OF STAKING METHODS ON THE GROWTH AND YIELD OF WATERMELON
(*CITRULLUS LANATUS*)**

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ABSTRACT

This study investigated the effect of staking methods on the vegetative growth and yield of watermelon (*Citrullus lanatus*, Thunb.) at the experimental plot of the Federal College of Forestry, Jericho, Ibadan, Nigeria. The treatment consisted of three (3) staking methods (staking (T1), no staking/ground trailing (T2) and trellis (T3)). These treatments were laid out in a Randomized Complete Block Design (RCBD) replicated three times. Growth parameters assessed at weekly intervals over twelve weeks includes: leaf count, leaf area (cm²), stem diameter (cm), stem length (cm), number of flowers, fruit count, and fruit weight (kg). Results of the experiment showed that, trellis-supported plants consistently outperformed the other treatments across all measured parameters. Trellis plants recorded the highest leaf count (115.74), leaf area (7.61 cm²), stem length (55.39 cm), flower number (23.81), fruit count (12.55), and fruit weight (0.95 kg). Ground-trailing plants generally recorded the lowest values. These findings indicated that trellis significantly enhances the vegetative growth and yield of watermelon and is recommended for adoption by farmers and agricultural practitioners in humid tropical environments.

Keywords: Watermelon, Staking, Trellis, Vegetative, Growth, Yield.

INTRODUCTION

Agriculture remains the foundation of food security and economic development in sub-Saharan Africa, with vegetable crops playing an increasingly important role in household nutrition and income generation. Watermelon (*Citrullus lanatus* [Thunb.] Matsum. & Nakai) is one of the most widely consumed cucurbits crops globally, valued for its high-water content, nutritional richness, and adaptability to tropical and sub-tropical climates (Zohary and Hopf, 2000; Liu, 2006). Originating in the Kalahari Desert of southern Africa, watermelon spread to Egypt, the Mediterranean, and eventually to Asia and the Americas; China is today the world's largest producer (Freedman and Myers, 2000). Watermelon belongs to the family Cucurbitaceae and is botanically classified as a pepo - a modified berry with a thick rind (exocarp) and fleshy interior (mesocarp and endocarp). The fruit is an excellent source of vitamins A, B6, and C as well as potassium and lycopene, conferring both nutritional and potential pharmacological benefits (Figueroa *et al.*, 2012; Maynard and Maynard, 2012). Watermelon has also been reported to possess insecticidal properties against mosquito vectors of malaria and filariasis (Mittal, 2003).

Despite its economic and nutritional importance, watermelon productivity in Nigeria remains constrained by the traditional practice of allowing vines to trail on the ground. Ground trailing exposes plants to soil-borne pathogens, increases the incidence of fruit rot, reduces photosynthetic efficiency due to canopy overcrowding, and causes aesthetic blemishing of fruits through the formation of yellow contact patches (NARC, 2008). Staking and trellising, widely employed with other cucurbit and solanaceous crops, offer potential remedies to these constraints by elevating the canopy, improving air circulation, and facilitating disease and pest management. However, the systematic evaluation of staking methods specifically for watermelon in the humid tropics of Nigeria has received limited attention in the scientific literature. This study was therefore designed to assess the comparative influence of three growing conditions—staking (T1), ground trailing without support (T2), and trellis



support (T3)—on the vegetative growth and yield of watermelon, with a view to recommending an optimal cultural practice for farmers.

The general objective of this study was to determine the effect of staking on the growth and yield of watermelon. The specific objectives were to:

- (i) examine the response of *Citrullus lanatus* to three growing methods: staking, trellis, and ground trailing;
- (ii) compare the growth rate and yield parameters of each method; and
- (iii) assess fruit size, and incidence of diseases and pests under each method.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the experimental plot of the Federal College of Forestry, Jericho, Ibadan, Oyo State, Nigeria (latitude 7°09'N, longitude 3°58'E). The site receives an annual rainfall of 1,300–1,500 mm, with a mean daily temperature of 37.2°C and average relative humidity of 75–80% (FRIN, 2025).

Planting Material

Citrullus lanatus seeds were purchased from Dugbe Market, Ibadan. Seeds were sown on 2 May, 2025 and the experiment terminated on 30 July, 2025. Germination was observed on the fifth day after sowing.

Treatments and Experimental Design

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three treatments and three replications ($3 \times 3 = 9$ plots). The total experimental area measured 7 m \times 10 m; individual flat beds measured 2 m \times 3 m, separated by 0.5 m walkways. Seeds were sown at a spacing of 60 cm \times 60 cm, with two seeds per hole, thinned to one plant per stand after establishment. The three treatments were:

- T1 – Staked: individual bamboo stakes (≈ 1.5 m) inserted beside each plant and the main stem tied at intervals;
- T2 – Ground (no support): vines allowed to trail freely on the soil surface;
- T3 – Trellis: a horizontal wire-and-string trellis constructed at 1.2 m height over the beds.

Data Collection

Growth data were collected at weekly intervals for twelve weeks. The parameters recorded were: (1) leaf count—number of fully expanded leaves per plant counted manually; (2) leaf area—measured with a transparent graduated ruler (cm²); (3) stem diameter (collar diameter)—measured with a Vernier calliper (cm); (4) stem length—measured with a metre rule (cm); (5) number of flowers—recorded by visual count; (6) fruit count—number of marketable fruits per plant; and (7) fruit weight—recorded at harvest using a digital balance (kg).

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) using IBM SPSS Statistics for RCBD procedures. Treatment means were separated using the Least Significant Difference (LSD) test at the 5% probability level. Duncan's Multiple Range Test (DMRT) was applied to stem diameter means and coefficient of variation (%CV) is reported for each parameter.

RESULTS

Pre-Planting Soil Characteristics

Table 1 presented result of the pre-planting soil analysis for the experimental site. Pre-planting soil analysis carried out at the IITA Analytical Laboratory (2025) revealed a pH of 6.2, nitrogen content of 0.072%, phosphorus of 4.89 c/mol, potassium of 0.22 c/mol, and calcium of 1.70 c/mol, indicating a moderately fertile sandy loam suitable for watermelon cultivation.

Table 1: Pre-planting Soil Chemical Properties of the Experimental Site

Parameters	Values
pH (H ₂ O)	6.2
Nitrogen (%)	0.072
Phosphorus (c/mol)	4.89
Potassium (c/mol)	0.22
Calcium (c/mol)	1.70

Effect of Staking Method on Leaf Count

Table 2 presented the weekly leaf count data across the three treatments over the 12-week study period. The result revealed that, trellis-supported plants (T3) recorded the highest mean leaf count of 115.74, followed by staked plants (T1) with 110.24, while ground-trailing plants (T2) recorded the lowest mean of 108.72 (Table 2). The %CV ranged from 1.61% to 30.10%, indicating moderate data variability. The LSD test confirmed significant differences among treatments at several time points.

Table 2: Effect of Staking Method on Leaf Count of Watermelon

Treatment	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Wk12	Mean
T1(Staked)	13.30	19.30	56.70	73.30	100.67	129.30	139.30	150.70	183.70	199.00	35.30	222.30	110.240
T2(Ground)	11.70	18.00	57.00	75.00	100.67	128.30	139.70	154.00	176.00	193.00	34.30	217.00	108.72
T3(Trellis)	11.00	19.30	58.00	76.30	108.30	137.30	147.70	159.30	191.30	211.00	36.70	232.70	115.74
LSD	3.94	1.87	4.99	10.70	9.59	10.33	131.70	4.99	14.40	12.70	4.67	13.50	7.76
GM	12.00	2.00	35.4	57.2	74.9	103.2	142.2	154.7	183.7	201.0	18.9	224.0	111.88
%CV	16.43	4.99	4.08	3.33	4.88	3.64	3.63	1.61	3.92	3.15	2.82	30.1	4.62

Effect of Staking Method on Leaf Area

The result as presented in Table 3 showed that, trellis supported plants recorded the highest mean leaf area (7.61 cm²), followed by staked plants (6.65 cm²), while ground-trailing plants produced the smallest leaf area (5.88 cm²). The relatively high %CV in weeks 9 and 2 (27.06% and 23.08%, respectively) suggests some within-treatment variability at those growth stages.

Table 3: Effect of Staking Method on Leaf Area (cm²) of Watermelon

Treatment	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Wk12	Mean
T1(Staked)	–	2.00	3.00	4.00	5.00	5.83	7.27	8.37	9.57	10.63	11.80	12.30	6.65
T2(Ground)	–	1.00	2.00	3.00	4.00	5.00	6.10	7.50	8.90	9.90	11.10	12.10	5.88
T3(Trellis)	–	1.33	2.33	3.33	4.87	5.53	7.17	8.20	16.10	10.70	11.80	12.70	7.61
LSD	–	0.67	0.67	0.13	0.13	0.99	0.57	0.61	6.24	0.81	0.81	0.36	1.04
GM	–	1.44	2.44	3.44	4.62	5.46	6.84	8.12	11.50	10.40	11.60	12.40	6.52
%CV	–	23.08	13.64	9.68	1.44	9.08	4.19	3.78	27.06	3.87	3.88	1.45	8.43

Effect of Staking Method on Stem Diameter

Effect of staking method on stem diameter (cm) of watermelon is presented in Table 4. The result indicated that, after 12 weeks, trellis-supported plants (T3) produced the largest mean stem diameter (1.29 cm), followed closely by staked plants (T1, 1.26 cm) and ground-trailing plants (T2, 1.22 cm). Duncan's Multiple Range Test indicated that T1 and T3 were not significantly different from each other but were significantly superior to T2 in several weekly assessments.

Table 4: Effect of Staking Method on Stem Diameter (cm) of Watermelon

Treatment	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Wk12	Mean
T1(Staked)	0.27	0.50	0.73	0.83	0.90	1.07	1.30	1.08	1.87	2.10	2.27	2.33	1.26
T2(Ground)	0.30	0.47	0.77	0.80	0.90	1.00	1.20	1.57	1.70	1.93	2.00	2.00	1.22
T3(Trellis)	0.23	0.47	0.77	0.83	0.93	1.00	1.20	1.60	1.80	2.00	2.20	2.40	1.29
LSD	0.09	0.09	0.16	0.09	0.07	0.13	0.20	0.31	0.24	0.24	0.352	0.39	0.18
GM	0.27	0.48	0.76	0.82	0.91	1.02	1.23	1.59	1.79	2.01	2.16	2.24	1.72
%CV	17.68	9.87	10.81	5.72	3.66	6.52	8.11	9.84	6.72	5.98	8.18	8.66	8.48

Effect of Staking Method on Stem Length

The result as presented in Table 5 showed that, trellis plants attained the greatest mean stem length (55.39 cm), followed by ground-trailing plants (54.56 cm) and staked plants (48.33 cm). The relatively lower stem length in the staked treatment may reflect physical restriction of horizontal growth, as the main stem was trained vertically

Table 5: Effect of Staking Method on Stem Length (cm) of Watermelon

Treatment	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Mean
T1(Staked)	2.27	6.67	13.67	21.50	29.00	36.30	43.00	47.50	49.80	51.30	49.00	48.30	48.33
T2(Ground)	2.33	6.33	15.33	22.00	30.00	37.50	44.00	48.20	50.40	52.30	51.20	54.60	54.56
T3(Trellis)	2.67	6.66	19.67	25.30	33.70	41.00	48.30	50.70	53.60	55.20	54.80	55.40	55.39
LSD	1.15	2.58	4.42	3.20	3.85	4.10	4.55	3.92	3.14	2.87	3.52	3.39	3.18
GM	2.56	6.56	16.22	22.90	30.90	38.30	45.10	48.80	51.30	52.90	51.70	52.80	52.76
%CV	22.59	19.69	10.81	8.12	6.52	5.98	6.32	4.87	3.62	3.24	4.18	3.66	4.25

Effect of Staking Method on Flower Production

Effect of staking method on number of flowers per plant of watermelon is presented in Table 6. The result revealed that, flowering was first observed in week 7. Trellis plants produced the most flowers (mean 23.81), followed by staked plants (22.29) and ground-trailing plants (16.87). The consistently higher flower count in T3 suggests that improved light interception under trellis conditions promoted reproductive development.

Table 6: Effect of Staking Method on Number of Flowers per Plant

Treatment	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Mean
T1(Staked)	–	–	–	–	–	–	8.00	22.00	30.00	43.00	46.67	56.00	22.29
T2(Ground)	–	–	–	–	–	–	4.33	9.00	21.67	29.33	38.33	46.67	16.87
T3(Trellis)	–	–	–	–	–	–	7.33	23.00	32.67	46.67	50.67	59.67	23.81
LSD	–	–	–	–	–	–	1.49	3.27	8.06	7.24	9.87	8.54	4.02
GM	–	–	–	–	–	–	6.56	18.00	28.11	39.56	45.22	54.11	20.95
%CV	–	–	–	–	–	–	11.37	9.07	14.33	9.15	10.91	7.89	5.91

Effect of Staking Method on Fruit Count

The result as presented in Table 7 showed that, fruit set was first recorded in week 9. Trellis-supported plants (T3) produced the highest mean fruit count (12.55), followed by staked plants (T1,

10.91) and ground-trailing plants (T2, 10.83). The marginal difference between T1 and T2 in fruit count suggests that simple staking confers less advantage over ground culture than a full trellis system.

Table 7: Effect of Staking Method on Fruit Count per Plant

Treatment	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Mean
T1(Staked)									7.67	17.00	27.00	35.67	10.91
T2(Ground)	-	-	-	-	-	-	-	-	8.67	19.33	29.67	34.33	10.83
T3(Trellis)	-	-	-	-	-	-	-	-	7.76	23.00	34.33	39.67	12.55
LSD	-	-	-	-	-	-	-	-	1.15	7.60	4.85	9.52	2.57
GM	-	-	-	-	-	-	-	-	8.00	19.78	30.33	36.56	11.38
%CV	-	-	-	-	-	-	-	-	7.22	19.22	8.00	13.02	4.72

Effect of Staking Method on Fruit Weight

Table 8 indicated that, fruit weight data were first recorded in week 10. Trellis plants produced the heaviest fruits (mean 0.95 kg), more than double the weight recorded for staked (0.47 kg) and ground-trailing (0.39 kg) plants. This result has important economic implications, as heavier fruits command higher market prices.

Table 8: Effect of Staking Method on Fruit Weight (kg) of Watermelon

Treatment	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Wk12	Mean
T1(Staked)	-	-	-	-	-	-	-	-	-	0.43	1.00	1.93	0.47
T2(Ground)	-	-	-	-	-	-	-	-	-	0.50	1.00	1.23	0.39
T3(Trellis)	-	-	-	-	-	-	-	-	-	0.47	1.07	1.70	0.95
LSD	-	-	-	-	-	-	-	-	-	0.09	0.13	0.89	0.14
GM	-	-	-	-	-	-	-	-	-	0.47	1.02	1.62	0.44
%CV	-	-	-	-	-	-	-	-	-	10.10	6.52	27.46	4.65

DISCUSSION

The results of this study demonstrated a clear and consistent advantage of trellis cultivation over simple staking and ground trailing across all vegetative and yield parameters assessed. The superiority of trellis plants in leaf count, leaf area, and stem diameter is consistent with the established principle that vertical training of cucurbit vines improves light penetration into the canopy, thereby enhancing photosynthetic rate and dry matter accumulation (Liu, 2006; NARC, 2008).

The higher flower count and fruit set in trellis-grown plants align with findings for other cucurbit crops, where improved canopy architecture has been linked to enhanced pollinator access and more efficient assimilate partitioning to reproductive organs (Figuroa *et al.*, 2012). The markedly higher fruit weight in the trellis treatment (0.95 kg vs. 0.47 and 0.39 kg for staked and ground-trailing plants, respectively) suggests that trellis support enables plants to sustain a higher photosynthetic rate for longer, allowing greater assimilate supply to developing fruits.

Ground-trailing plants consistently performed least well across most parameters, consistent with reports that vine contact with moist soil promotes the incidence of *Pythium* and *Fusarium* rot, thereby diverting metabolic resources from growth and reproduction (Dane and Raymond, 2007; Maynard and Maynard, 2012). The slightly higher stem length recorded for ground-trailing plants compared to staked plants is likely an artefact of horizontal vine elongation rather than true structural growth, and does not translate into superior yield.



The moderate %CV values recorded across treatments (generally below 15%) indicate acceptable experimental precision and validate the conclusions drawn from mean comparisons. The pre-planting soil pH of 6.2 was within the optimal range of 6.0–7.0 recommended for watermelon, and adequate levels of macronutrients suggest that differential treatment responses reflect cultural management rather than edaphic constraints.

CONCLUSION AND RECOMMENDATION

This study demonstrated that the trellis method of cultivation consistently and significantly improves the vegetative growth and yield of watermelon (*Citrullus lanatus*) compared to simple staking and ground trailing. Trellis-grown plants recorded superior performance in leaf count, leaf area, stem diameter, flower production, fruit count, and fruit weight, with fruit weight values approximately twice those obtained under the other treatments.

Based on these findings, trellis cultivation is recommended as the preferred growing method for watermelon production in humid tropical environments such as Ibadan, Nigeria. Government extension services, farmers, and horticultural practitioners are encouraged to adopt trellis systems to enhance crop productivity, reduce post-harvest losses, and improve the marketable quality of watermelon fruits. Future research should examine the economics of trellis installation, optimal trellis height and mesh configuration, and the interaction of staking method with irrigation regimes and fertiliser application rates.

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