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Original Research Article

Effect of Variation in Pod Length on Seed Yield and Yield Components in Groundnut (Arachis Hypogaea L.) in Jalingo, Taraba State

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Abstract: Groundnut (Arachis hypogaea L.) is an important legume crop in Nigeria, valued for its oil, protein, and economic benefits. Pod length is a key determinant of seed yield and yield components, yet limited studies have explored its effects in Jalingo, Taraba State. This study evaluated the influence of pod length variation on seed yield and yield components (number of pods per plant, number of seeds per pod, and 100-seed weight) in groundnut at the College of Agriculture, Science and Technology, Jalingo. A randomized complete block design (RCBD) was used with three replications. Data were collected on pod length, seed yield, and yield components, and analyzed using ANOVA and correlation. Results revealed significant variability in pod length, with longer pods contributing to higher seed yield due to increased seed number and size. The findings suggest that selecting for longer pod length could enhance groundnut productivity in Jalingo.

Keywords: Groundnut, yield, pod/plant and commercial varieties.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.), also known as peanut, is one of the most important leguminous crops globally, serving as a key source of edible oil (40–50%), plant-based protein (25–30%), and essential micronutrients (FAO, 2021). In Nigeria, groundnut is a major cash crop for smallholder farmers, contributing significantly to food security and income generation, particularly in the northern regions, including Taraba State (Abdulkadir *et al.,* 2020). Despite its economic importance, groundnut productivity in Nigeria remains below its potential due to factors such as poor genetic yield potential, environmental stresses, and limited adoption of improved varieties (Ojiewo *et al.,* 2018). Pod characteristics, particularly pod length, play a crucial role in determining seed yield and yield components in groundnut. Pod length is a heritable trait that influences the number of seeds per pod, seed size, and overall pod filling efficiency (Khedikar *et al.,* 2018). Studies have shown that longer pods tend to accommodate more seeds, leading to higher yield potential (Upadhyaya *et al.,* 2012). However, the extent of pod length variation and its direct impact on yield components have not been extensively studied in the agro-ecological conditions of Jalingo, Taraba State.

In groundnut breeding programs, selecting for optimal pod size and seed characteristics is essential for developing high-yielding varieties. Previous research in similar agro-ecologies has demonstrated that pod length correlates positively with seed weight and harvest index (Hamidou *et al.,* 2019). Additionally, environmental factors such as soil fertility, rainfall distribution, and temperature fluctuations can influence pod development and final yield (Ntare *et al.,* 2017). Understanding these interactions is critical for recommending suitable genotypes for Jalingo's farming systems.

This study, therefore, seeks to:

1. Assess the extent of genotypic variation in pod length among selected groundnut genotypes.
2. Evaluate the relationship between pod length and yield components Determine the impact of pod length on final seed yield under Jalingo's growing conditions.

The findings from this research will provide valuable insights for groundnut breeders and farmers in selecting and developing varieties with desirable pod traits for enhanced productivity in Taraba State and similar agro-ecologies.

2. MATERIALS AND METHODS STUDY AREA

The experiment was conducted at the College of Agriculture, Science and Technology, Jalingo (Latitude: 8°54'N, Longitude: 11°22'E), characterized by a tropical savanna climate.

Experimental Design: Ten groundnut genotypes were evaluated in an RCBD with three replications. Each plot measured 3 m × 2 m, with 25 cm inter-row and 10 cm intra-row spacing.

Data Collection:

- **Pod length (cm):** Measured from 10 randomly selected mature pods per plot.
- **Number of pods per plant:** Recorded from five tagged plants.
- **Number of seeds per pod:** Average count from 10 pods per plot.
- **100-seed weight (g):** Weight of 100 oven-dried seeds.
- **Seed yield (kg/ha):** Calculated from harvested plot yield adjusted to 12% moisture.

Statistical Analysis: Data were analyzed using ANOVA and Pearson's correlation in SAS 9.4.

3. RESULTS AND DISCUSSION

3.1 Variation in Pod Length among Groundnut Genotypes

The study revealed significant differences ($P < 0.05$) in pod length among the ten groundnut genotypes evaluated (Table 1). Pod length ranged from 1.8 cm to 3.4 cm, with Genotype G8 exhibiting the longest pods (3.4 cm) and Genotype G2 is having the shortest (1.8 cm). This variation suggests genetic diversity in pod morphology, which can be exploited in breeding programs for yield improvement.

Table 1: Mean Pod Length of Groundnut Genotypes

Genotype	Pod Length (cm)	Classification
G1	2.5 ± 0.3	Medium
G2	1.8 ± 0.2	Short
G3	2.7 ± 0.4	Medium
G4	3.1 ± 0.3	Long
G5	2.4 ± 0.2	Medium
G6	3.0 ± 0.3	Long
G7	2.2 ± 0.2	Medium
G8	3.4 ± 0.4	Long
G9	2.6 ± 0.3	Medium
G10	2.9 ± 0.3	Long

Classification: *Short (<2.0 cm), Medium (2.0–3.0 cm), Long (>3.0 cm) (Adapted from Khedikar et al., 2018* The observed variation in pod length aligns with findings by Upadhyaya *et al.,* (2012), who reported pod lengths between 1.5 cm and 3.5 cm in diverse groundnut germplasm. The longer pod length in G4, G6, G8, and G10 suggests potential genetic superiority in seed filling capacity, which may translate to higher yields.

3.2 Effect of Pod Length on Yield Components

A. Number of Pods per Plant

The number of pods per plant varied significantly ($P < 0.05$), ranging from 12 to 25 (Table 2). Genotypes with longer pods (G4, G6, G8, G10) produced fewer pods per plant compared to short-podded genotypes, likely due to resource allocation trade-offs (more energy invested in pod elongation rather than pod number).

Table 2: Yield Components across Pod Length Categories

Pod Length Category	Pods/Plant	Seeds/Pod	100-Seed Weight (g)
Short (<2.0 cm)	23 ± 2.1	1.5 ± 0.2	28.5 ± 1.2
Medium (2.0–3.0 cm)	18 ± 1.8	2.1 ± 0.3	35.2 ± 1.5
Long (>3.0 cm)	15 ± 1.5	2.8 ± 0.4	42.6 ± 2.0

The negative correlation (r = -0.65) between pod length and pod number per plant suggests a compensatory mechanism, where plants with longer pods produce fewer but better-filled pods. This finding is consistent with Hamidou *et al.,* (2019), who observed similar trends in drought-adapted groundnut varieties.

B. Number of Seeds per Pod

Long-podded genotypes had significantly (*P < 0.01*) more seeds per pod (2.8) compared to short-podded genotypes (1.5). This indicates that pod length directly influences seed number, which is critical for yield determination. The strong positive correlation (r = 0.72) between pod length and seeds per pod supports earlier reports by Khedikar *et al.,* (2018), who identified QTLs (quantitative trait loci) associated with pod length and seed number.

C. 100-Seed Weight

The 100-seed weight was highest in long-podded genotypes (42.6 g) and lowest in short-podded ones (28.5 g). This suggests that longer pods support larger seeds, likely due to better assimilate partitioning. This result agrees with Ntare *et al.,* (2017), who found that pod length is a key determinant of seed size in groundnut, influencing market value and oil content.

Table 3: Seed Yield (kg/ha) Across Genotypes

Genotype	Seed Yield (kg/ha)
G1	1250 ± 85
G2	980 ± 72
G3	1350 ± 92
G4	1650 ± 105
G5	1200 ± 80
G6	1700 ± 110
G7	1100 ± 75
G8	1850 ± 120
G9	1300 ± 88
G10	1750 ± 115

The long-podded genotypes (G4, G6, G8, G10) recorded 15–25% higher yields than short-podded ones, reinforcing the importance of pod length in yield improvement. The positive correlation (r = 0.81) between pod length and yield aligns with Ojiewo *et al.,* (2018), who emphasized that pod traits are critical for groundnut breeding programs.

4. CONCLUSION AND RECOMMENDATIONS

- Pod length significantly affects seed yield and yield components, with longer pods producing fewer but heavier seeds.
- Genotypes G4, G6, G8, and G10 are recommended for further breeding due to their superior yield performance.
- Future studies should explore molecular markers linked to pod length for marker-assisted selection.

List of Groundnut Genotypes Evaluated

Genotype Code	Variety Name (if applicable)	Pod Length Category	Key Traits
G1	SAMNUT-24	Medium (2.5 cm)	Early maturing, drought-tolerant
G2	Bahausa	Short (1.8 cm)	Low yield but disease-resistant
G3	ICGV-IS 13842	Medium (2.7 cm)	High oil content
G4	SAMNUT-22	Long (3.1 cm)	High-yielding, bold seeds
G5	SAMNUT-26	Medium (2.4 cm)	Good shelling percentage
G6	ICGV-IS 131090	Long (3.0 cm)	Resistant to *Aspergillus* infection
G7	Yarmadani	Medium (2.2 cm)	Adapted to low soil fertility
G8	SAMNUT-23	Long (3.4 cm)	Largest pods, high market value
G9	ICGV-IS 13917	Medium (2.6 cm)	Dual-purpose (oil and confectionery)
G10	SAMNUT -25	Long (2.9 cm)	High pod-filling rate

Table 4: Pearson's Correlation Coefficients (r) Between Pod Length, Yield Components, and Seed Yield

Trait	Pod Length	Pods/Plant	Seeds/Pod	100-Seed Weight	Seed Yield
Pod Length (cm)	1.00	-0.65**	0.72**	0.66**	0.81**
Pods per Plant		1.00	-0.58*	-0.42	-0.37
Seeds per Pod			1.00	0.75**	0.69**
100-Seed Weight (g)				1.00	0.84**
Seed Yield (kg/ha)					1.00

Significance levels:

- * = Significant at *P < 0.05*, ** = Significant at *P < 0.01*

Discussion of Correlation Study

Pod Length as a Key Yield Determinant

The strong positive correlation between pod length and seed yield (r = 0.81, P < 0.01) aligns with the "source-sink" theory in groundnut physiology. Longer pods provide:

Enhanced sink capacity: Accommodate more seeds (2.8 vs. 1.5 seeds/pod in long vs. short pods) due to extended placental tissue (Boote, 1982).

Better assimilate partitioning: Larger pod volume correlates with higher 100-seed weight (r = 0.66), suggesting efficient photoassimilate translocation (Hamidou *et al.,* 2019).

Contrast with Other Legumes: In chickpea, pod length shows weaker yield correlations (r = 0.35–0.50) due to single-seeded pods (Singh *et al.,* 2021). Groundnut's multi-seeded pods amplify length effects.

Trade-offs in Yield Components

The negative correlation between pod length and pod number **(**r = -0.65) reflects a resource allocation trade-off:
Energy prioritization: Genotypes investing in pod elongation (e.g., G8) produce 40% fewer pods than short-podded types (G2), consistent with the "yield component compensation" principle (Adams, 1967).
Seed Size vs. Seed Number Dynamics

The correlation patterns reveal two pathways to high yield:

1. **Fewer, larger seeds**: Long pods → heavier seeds (100-seed weight r = 0.84 with yield).
2. **More, smaller seeds**: Short pods → higher pod count but lower seed weight.

Table 5: Contrast with Previous Studies

Trait Correlation	This Study (Jalingo)	Sahelian Zone (Ntare, 2017)	Humid Tropics (Okello, 2020)
Pod length vs. yield	0.81**	0.62*	0.55*
Pod length vs. pods/plant	-0.65**	-0.41	-0.72**

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