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ORIGINAL RESEARCH ARTICLE

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## Effect of Some Farming Systems on Insect Pests Infestation on Groundnut [*Arachis hypogaea* (L.)] in Mubi, Northern Guinea Savanna

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### ABSTRACT

The study evaluated the influence of some farming systems (tillage types) on infestation caused by insect pests on the growth and yield of groundnut in Mubi Northern Guinea Savannah. The work was carried out at the Teaching and Research Farm (FAO/TCP) of the Department of Crop Science, Adamawa State University, Mubi during the 2024 and 2025 cropping seasons. The experimental design used was the Randomized Complete Block Design (RCBD). There were three treatments replicated three times. The treatments included the three farming systems: Ridges/Mounds (T1), Conventional Tillage (T2), and Zero Tillage (T3). Data on insects damage, vegetative growth, pod health, and fresh pod weight were collected and analyzed using ANOVA and DMRT ( $P \leq 0.05$ ). Results obtained indicated that, insects abundance and damage were uniform across all farming systems, suggesting that regional environmental factors, rather than soil manipulation, primarily dictate pest pressure. However, the farming systems significantly affected productivity: the Ridges/Mounds system (T1) consistently proved superior, recording the highest number of undamaged pods and the highest fresh pod weight in both years (74.67 and 78.00 g). This significantly outperformed Zero Tillage (63.33 and 70.00g) and Conventional Tillage (46.00 and 50.10g), a finding attributed to improved conditions for groundnut peg penetration and pod development in ridged soil. The study concludes that, groundnut productivity in the Mubi region is optimally enhanced by adopting the Ridges/Mounds (T1) system in combination with the high-yielding groundnut variety. It is strongly recommended that this superior cultural practice be integrated with comprehensive Integrated Insects Management Practices (IIMP), as tillage alone is insufficient for pest control for ensuring robust and sustainable groundnut production.

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### Introduction

Groundnut [*Arachis hypogaea* (L.)] belongs to the family Leguminosae and is one of the most important oil seed crops in the world (Brink

and Belay, 2006; FAOSTAT, 2020; FAO. (2021; Anonymous, 2022; Sarangthem *et al.*, 2023).

Groundnut has been recognized around the world by an assortment of colorful names.

While the Americans call it peanut, it is known by several other names such as African nut, Chinese nut, Manila nut, Kipper nut, Hawks nut, Jar nut, Earth chestnut, Monkey nut, Goobers pea, Ground pea, and Ground bean (Johnson *et al.*, 1981). Locally, in Nigeria especially in the Northern part where it is largely cultivated, it is known as “gyada” in Hausa, “Okpa” in Igbo, “epa” in Yoruba (Wood and Ambridge, 1996; Oaya *et al.*, 2026). In Adamawa State where the study area is located, it is also known as “Wada” in Kilba and Bura, Yungur speaking people refer to it as “Shiyara” and Higgi people call it “Kullache (Samaila and Malgwi, 2012; Oaya and Malgwi, 2013).

Although, groundnut has relatively gained importance, the origin of the crop dates back to 350 BC (Hammons, 1994). With a humble beginning, groundnuts have gained prominence for its economic importance and nutritional value on a global scale and is now cultivated throughout the world (Shakarappa *et al.*, 2009). Among the several factors responsible for low productivity in groundnut and a major threat to its cultivation is the widespread attack by insect pests and diseases (Bana *et al.*, 2022). The major insect pest of groundnut is aphid (*Aphis craccivora* Koch), others are leaf miner (*Apraerema modicella*), tobacco caterpillar (*Spodoptera litura* Fab.), red hair caterpillar (*Amsacta albistriga* Butler), and thrips (*Scirtothrips dorsalis*) just to mention but a few (Rahman *et al.*, 2021).

Groundnuts fix nitrogen in the soil and increase soil organic matter and carbon content of the biomass is incorporated into the soil (Witcombe and Tiemann, 2022). Aphid multiplies more rapidly late in the spring and with the increase in temperature, its population increases (Oaya, 2020).

In-vivo studies in brinjal also indicated the maximum reduction of aphids (67.3–72.3%) within 5–14 days after application of *A.*

*squamosa* 40 EC formulation at 1.0% dose followed by *P. pinnata* 40 EC (Purkait *et al.*, 2019). Severe aphid infestations causes stunting, crinkling, and curling of leaves, delayed flowering, which results in reduction in yield. Large populations of the pest secrete substantial quantities of honeydew, which favours the growth of sooty mold on leaves and reduces the photosynthetic efficiency of the plants (Ghosh, 2017).

Pest and disease management has assumed greater importance in increasing agricultural production. Environment-friendly management is necessary to reduce yield loss in groundnut and mitigate increasing public concern over pesticide residues in the food (Kokalis-Burelle *et al.*, 1997; Lukmanulet al., 2020).

Insect pests attack is one of the principal factors that affect grain yield of crops, which in turn increases post-harvest losses and increases food security challenges. Different control measures and management methods have been used by several researchers and farmers alike for the control of insect pests of groundnut on the field but could not provide sustainable results. There is no empirical data found in the study area with respect to work done on using farming system to manage or control insect pests infestation. Therefore, this research was carried out to evaluate effects of some farming systems on infestation and abundance on two varieties of groundnut (*Arachis hypogaea*) in Mubi Northern Guinea Savannah.

## Materials and Methods

### The Study Area

Field experiment was conducted at the Teaching and Research Farm FAO/TCP Department of Crop Science, Adamawa State University, Mubi during the 2024 and 2025 cropping seasons to evaluate the effect of some farming systems on insect pests infestations and abundance on groundnut [*Arachis hypogaea*

(L.)] in Mubi, Northern Guinea Savannah. Mubi is located between latitude 9° 30'N of the equator and longitude 13° 14'E of the Greenwich Meridian at an altitude of 696m above mean sea level in the northern savannah ecological zone of Nigeria. The area is characterized by stumps, shrubs, grassland and trees (Adebayo et al., 2020).

#### **Source of Seed**

The seeds were bought from certified seed vendors in the Mubi main market. They were sorted out before sowing.

#### **Experimental Design and Treatments**

The experimental design was laid out in a Randomized Complete Block Design (RCBD). The treatment consisted of three farming systems viz: conventional tillage, mound/ridges and zero tillage). The groundnut variety used was the Kwachamba. They were replicated three times respectively. The total land area was 15.5m x 7m = 108.5m<sup>2</sup> and each subplot size was 2m x 2m = 4m<sup>2</sup>.

#### **Cultural Practices**

##### **Land Preparation, Sowing, Thinning, Spacing, Weeding and Harvesting**

The land was manually cleared using hoe, cutlass and machete to remove shrubs and stumps in order to obtain a flat land area. It was later partitioned into the required sizes for the experiment.

The sowing operation was carried out manually. When rainfall was fully established, two (2) seeds were sown per hole at the depth of 2 cm and at the recommended standard spacing.

The thinning exercise was carried out manually at two (2) weeks after sowing to remove weak and excess seedlings in the experimental plots. The spacing was done at 30cm inter and 20cm intra-spacing (in between plants and rows). The weeding exercise was done at four weeks (4) after sowing and as when necessary to keep the experimental plots

free from weed infestation. The groundnut plants were harvested manually by hand-pulling when the pods had attained physiological maturity.

#### **Data Collection**

##### **Plant Height (cm)**

Plant height was measured from five (5) selected plants per plot at 3, 6 and 9 weeks after sowing, and the mean was recorded.

##### **Days to first flowering**

This was done by visual observation, taking note of when the plants attained first flowering, and the number of days taken to achieve it, was recorded.

##### **Fifty Percent (50%) flowering**

Fifty percent (50%) flowering was determined by visual observation of the plants until half of the flowers had appeared and the number of days taken to achieve it, was recorded.

##### **Number of Leaves**

The number of leaves was counted from the same five (5) selected plants per plot at 3, 6, and 9 weeks after sowing and the average was taken.

##### **Number of damaged leaves at 3, 6 and 9 weeks after sowing.**

The number of damaged groundnut leaves was determined by selecting five plants per plot, and the average was taken.

##### **Number of damaged and infested flowers**

The number of damaged and infested flowers was counted manually by randomly selecting (5) plants per plot at 3, 6 and 9 weeks after sowing, and the mean was recorded.

##### **Number of damaged and infested Pods**

The number of damaged and infested pods was counted manually after harvest from five (5) randomly selected plants per plot, and the mean was recorded.

### **Number of undamaged and uninfested pods**

The number of undamaged and uninfested pods was counted manually after harvest from five (5) randomly selected plants per plot, and the mean was recorded.

### **Weight of fresh pods (g)**

The weight of fresh pods was taken after uprooting five (5) sample plants from each treatment and weighing them using an electronic weighing scale, and the mean was recorded.

### **Statistical Analysis**

Data collected was subjected to analysis of variance (ANOVA) using SAS Version 9.8 (2020) and treatment means were separated using Least Significant Difference (LSD) at  $P \leq 0.05$ .

## **Results**

### ***Effects of Insect Pests Infestation on Plant Height and Number of Leaves at 3, 6 and 9 WAS as Influenced by Farming Systems during the 2024 and 2025 Cropping Seasons***

The results of the Effects of Farming Systems on Plant Height and Number of Leaves at 3, 6 and 9 WAS are presented in Table 1. The results shows that, the zero tillage (control) farming system had the highest plant height at 3, 6 and 9 weeks after sowing for both 2024 and 2025 cropping seasons (10.57 and 12.00, 13.90 and 14.80, 19.36 and 20.50cm), followed by planting on ridges (9.99 and 10.10, 12.31 and 13.60, 17.53 and 18.10cm) and the least was reported in conventional farming system (9.60 and 9.20, 12.18 and 13.50, 17.40 and 18.50 cm) respectively at 0.05 level of probability.

Similarly, the number of leaves at 3, 6 and 9 weeks after sowing is reported in Table 1 for both 2024 and 2025 cropping seasons.

According to the results, the highest number of leaves at 3, 6 and 9 weeks after sowing was reported in zero tillage (control) farming system (54.73 and 60.50, 98.47 and 105.00, 150.43 and 160.50) followed by planting on ridges (51.53 and 53.00, 97.68 and 100.00, 137.27 and 145.50) and the least was observed in conventional farming system (47.97 and 49.20, 85.40 and 95.20, 124.20 and 135.42) respectively at 0.05 level of probability.

### ***Effects of Insect Pests Infestation on Damaged Flower and Leaves at 3, 6 & 9 WAS as Influenced by Farming Systems for 2024 and 2025 Cropping Seasons***

The results of the Effects of Farming Systems on Damaged Flowers and Leaves at 3, 6 and 9 WAS for 2024 and 2025 cropping seasons are presented in Table 2. The results shows that, the ridge farming system had the highest number of damaged flowers at 3, 6 and 9 weeks after sowing (2.30 and 2.80, 4.23 and 4.50, 6.00 and 6.50), followed by zero tillage (control) farming system (2.50 and 2.50, 4.30 and 4.50, 4.97 and 5.50) and the least was reported in conventional farming system (2.20 and 2.50, 3.60 and 4.10, 4.20 and 5.00) respectively at 0.05 level of probability.

Similarly, the damaged leaves at 3, 6 and 9 weeks after sowing for 2024 and 2025 are reported in Table 2. According to the results, the zero tillage (control) farming system recorded the highest number of damaged leaves at 3, 6 and 9 weeks after sowing (3.43 and 4.10, 4.07 and 6.20, 16.16 and 17.00) followed by conventional farming system (3.47 and 3.75, 5.37 and 5.80, 15.70 and 16.50) and the least was observed in ridges farming system (3.40 and 3.50, 5.50 and 5.80, 14.13 and 15.80) respectively at 0.05 level of probability.

| Treatment | PHT    | NL 3  | PHT    | NL 6  | PHT    | NL 9   | PHT    | NL 3  | PHT    | NL 6   | PHT (cm) | NL 9   |
|-----------|--------|-------|--------|-------|--------|--------|--------|-------|--------|--------|----------|--------|
|           | (cm) 3 | WAS   | (cm) 6 | WAS   | (cm) 9 | WAS    | (cm) 3 | WAS   | (cm) 6 | WAS    | 9 WAS    | WAS    |
|           | WAS    |       | WAS    |       | WAS    |        | WAS    |       | 6 WAS  |        |          |        |
|           |        |       | 2024   |       |        |        |        |       | 2025   |        |          |        |
| T1        | 8.99   | 51.53 | 12.31  | 97.68 | 17.53  | 150.27 | 9.20   | 53.00 | 13.50  | 100.00 | 18.50    | 16050  |
| T2        | 9.60   | 47.97 | 12.18  | 85.40 | 17.40  | 124.20 | 10.10  | 49.20 | 13.60  | 95.20  | 18.10    | 135.42 |
| T3        | 10.57  | 54.73 | 13.90  | 98.47 | 19.36  | 137.43 | 12.00  | 60.50 | 14.80  | 105.00 | 20.50    | 145.50 |
| P of F    | NS     | **    | *      | NS    | NS     | *      | NS     | *     | **     | NS     | NS       | *      |
| SE ±      | 1.52   | 13.54 | 1.64   | 13.65 | 4.22   | 13.90  | 1.60   | 14.00 | 1.80   | 14.10  | 5.10     | 4.20   |

**Table 2:** Effects of Farming Systems on Insect Pests Infestation as it relates to Damaged Flowers and Leaves of Groundnut for 2024 and 2025 Cropping Seasons at 3, 6 and 9 WAS

| Treatments |      | 2024 |      |      |      |       | 2025 |      |      |      |      |       |
|------------|------|------|------|------|------|-------|------|------|------|------|------|-------|
|            | DF 3 | DL 3 | DF 6 | DL 6 | DF 9 | DL 9  | DF 3 | DL 3 | DF 6 | DL 6 | DF 9 | DL 9  |
| T1         | 2.30 | 3.40 | 4.23 | 5.50 | 6.00 | 14.13 | 2.50 | 4.10 | 4.50 | 6.20 | 6.50 | 17.00 |
| T2         | 2.20 | 3.47 | 3.60 | 5.37 | 4.20 | 15.70 | 2.60 | 3.75 | 4.10 | 5.80 | 5.50 | 15.80 |
| T3         | 2.50 | 3.43 | 4.30 | 4.07 | 4.97 | 16.16 | 2.50 | 3.50 | 4.00 | 5.40 | 5.00 | 16.50 |
| P of F     | NS   | NS   | NS   | NS   | NS   | NS    | NS   | NS   | NS   | NS   | NS   | NS    |
| SE $\pm$   | 1.07 | 1.70 | 1.74 | 4.91 | 2.45 | 31.59 | 1.15 | 2.10 | 2.50 | 5.00 | 2.80 | 32.10 |

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### Effects of Insect Pests Infestation on Damaged and Undamaged Groundnut Pod as Influenced by Farming Systems in 2024 and 2025 Cropping Seasons

The results of the Effects of Farming Systems on Damaged Pods for both 2024 and 2025 cropping seasons are presented in Table 3. The results shows that, the ridge farming system had the highest number of damaged pods (4.17 and 4.25), followed by zero tillage (control) farming system (3.73 and 3.80) and the least was reported in conventional farming

system (3.43 and 3.55) respectively at 0.05 level of probability.

Similarly, the undamaged pods are reported in Table 3. According to the results, the ridges farming system recorded the highest number of undamaged pods (8.73 and 9.00) followed by zero tillage (control) farming system (7.30 and 7.50) and the least was observed in conventional farming system (5.30 and 5.50) respectively at 0.05 level of probability.

**Table 3:** Effects of Farming Systems on Insect Pests Infestation as it Relates to Damaged and Undamaged Groundnut Pods for 2024 and 2025 Cropping Seasons

| Treatments | Damaged Pods |      | Undamaged Pods |      |
|------------|--------------|------|----------------|------|
|            | 2024         | 2025 | 2024           | 2025 |
| T1         | 4.17         | 4.25 | 8.73           | 9.00 |
| T2         | 3.73         | 3.80 | 5.30           | 5.50 |
| T3         | 3.43         | 3.55 | 7.30           | 7.60 |
| P of F     | NS           | NS   | **             | **   |
| SE ±       | 1.51         | 1.46 | 2.46           | 2.55 |

T1 = Ridges, T2 = Conventional Tillage, T3 = Control, NS = Not Significant, \*\* = Highly Significant

### Effects of Insect Pests Infestation on Weight of Fresh Pods and 50% Flowering of Groundnut as Influenced by Farming Systems for 2024 and 2025 Cropping Seasons

The results of the Effects of different farming systems on the fresh pods weight of groundnut growth and yield for both 2024 and 2025 cropping seasons are presented in Table 4. The results show that, the ridges farming system had the highest number of fresh pods weight (74.67 and 78.00g), followed by zero tillage (control) farming system (63.33 and 70.0g) and the least was reported in

conventional farming system (46.00 and 50.10g) respectively at 0.05 level of probability.

Similarly, the fifty (50%) flowering are reported in Table 4. According to the results, the conventional farming system recorded the highest number of 50% flowering (29.67 and 33.10) followed by zero tillage (control) farming system (29.50 and 32.00 ) and the least was observed in ridges farming system (29.00 and 32.00) respectively at 0.05 level of probability.

**Table 4:** Effects of Farming Systems on Insect Pests Infestation as it Relates to Weight of Fresh Pods

| Treatment | Fresh Pods Weight (G) |        | 50% Flowering |       |
|-----------|-----------------------|--------|---------------|-------|
|           | 2024                  | 2025   | 2024          | 2025  |
| T1        | 74.67                 | 78.00  | 29.00         | 32.00 |
| T2        | 46.00                 | 50.10  | 29.67         | 33.10 |
| T3        | 63.33                 | 70.20  | 29.50         | 32.50 |
| P of F    | **                    | **     | NS            | NS    |
| SE ±      | 186.89                | 196.00 | 0.83          | 0.90  |

## Discussions

### *Vegetative Growth Response (Plant Height and Number of Leaves)*

Plant height at 3, 6, and 9 weeks after sowing (WAS) was not significantly influenced by farming systems in both 2024 and 2025 cropping seasons. Although non-significant, plants under the control system (T3) were slightly taller across growth stages, suggesting that minimal soil disturbance may support early elongation. This agrees with earlier reports that groundnut height is largely genotype-driven and only moderately affected by tillage practices (Amin *et al.*, 2019; Singh and Chaudhary, 2018).

In contrast, number of leaves was significantly affected at 3 and 9 WAS. At 3 WAS, the control (T3) produced the highest leaf count, while at 9 WAS, ridging (T1) produced the highest number. This shift implies that ridging improves soil structure and root establishment over time, enabling more vigorous late-stage vegetative growth. Increased leaf area enhances photosynthetic efficiency, which is fundamental for pod development (Nwosu and Okonkwo, 2021). These results align with findings that ridged soils improve aeration and nutrient uptake, supporting sustained vegetative expansion (Ghosh and Patra, 2020).

### *Insect Pests Damage on Flowers and Leaves across Farming Systems*

Insect Pests damage on flowers and leaves showed no significant differences across farming systems at all sampling periods and at both seasons. This suggests that, insect pests movement and feeding were uniform across the field, unaffected by soil disturbance. Similar observations were reported by Ibrahim and Yahaya (2019), who noted that insect pests distribution is influenced more by weather patterns, host plant characteristics, and natural enemies than by tillage systems.

The uniform insect pests pressure also reflects the favorable environmental conditions (warm temperatures and moderate humidity) during the early rainy season in Mubi, which are known to promote their population buildup (Sani *et al.*, 2020).

### *Pod Damage and Pod Health Under Different Farming Systems*

Pod damage did not differ significantly among farming systems; however, undamaged pods showed significant differences. Ridging (T1) produced the highest number of undamaged pods, while conventional tillage (T2) produced the lowest in both seasons.

Ridging is known to enhance soil aeration, reduce compaction, and promote stronger peg penetration and pod development (Dauda and Ogunlela, 2018). The higher number of healthy pods in ridged plots in both seasons may indicate improved plant resilience and better pod-setting conditions. These findings are consistent with previous research showing that ridged soils reduce biotic stress impacts and enhance crop recovery from insect feeding (Olawale and Daramola, 2017).

### *Effect of Farming Systems on Yield (Fresh Pod Weight)*

Farming systems significantly affected fresh pod weight. Ridging (T1) produced the highest fresh pod weight, followed by the control (T3), while conventional tillage (T2) produced the lowest.

The superiority of ridging in both 2024 and 2025 cropping seasons can be attributed to improved drainage, reduced waterlogging, better root penetration, and enhanced nutrient availability (Ghosh and Patra, 2020; Ipinmoroti and Adeyemi, 2016). These soil conditions create a favorable environment for peg penetration and pod filling- two critical components of groundnut productivity. The

relatively poor performance under conventional tillage may be due to soil compaction and reduced aeration, which hinder peg penetration (Kuye and Hamsa, 2018). This general trend agrees with earlier studies that reported higher groundnut yields on ridged or raised-bed systems compared to flat planting (Bishi et al., 2020).

## Conclusion

The findings of this study in both 2024 and 2025 cropping seasons concludes that, ridging is the most effective farming system for improving groundnut growth, pod health, and yield in Mubi Northern Guinea Savanna of Nigeria, which is consistent with other studies showing that ridged soils support better aeration and moisture regulation. Insect pests infestation was widespread and largely unaffected by farming systems, implying that environmental factors such as temperature and relative humidity were more influential in determining insect pests population build up and levels than soil manipulation practices, a trend similarly noted by many research findings in literature.

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