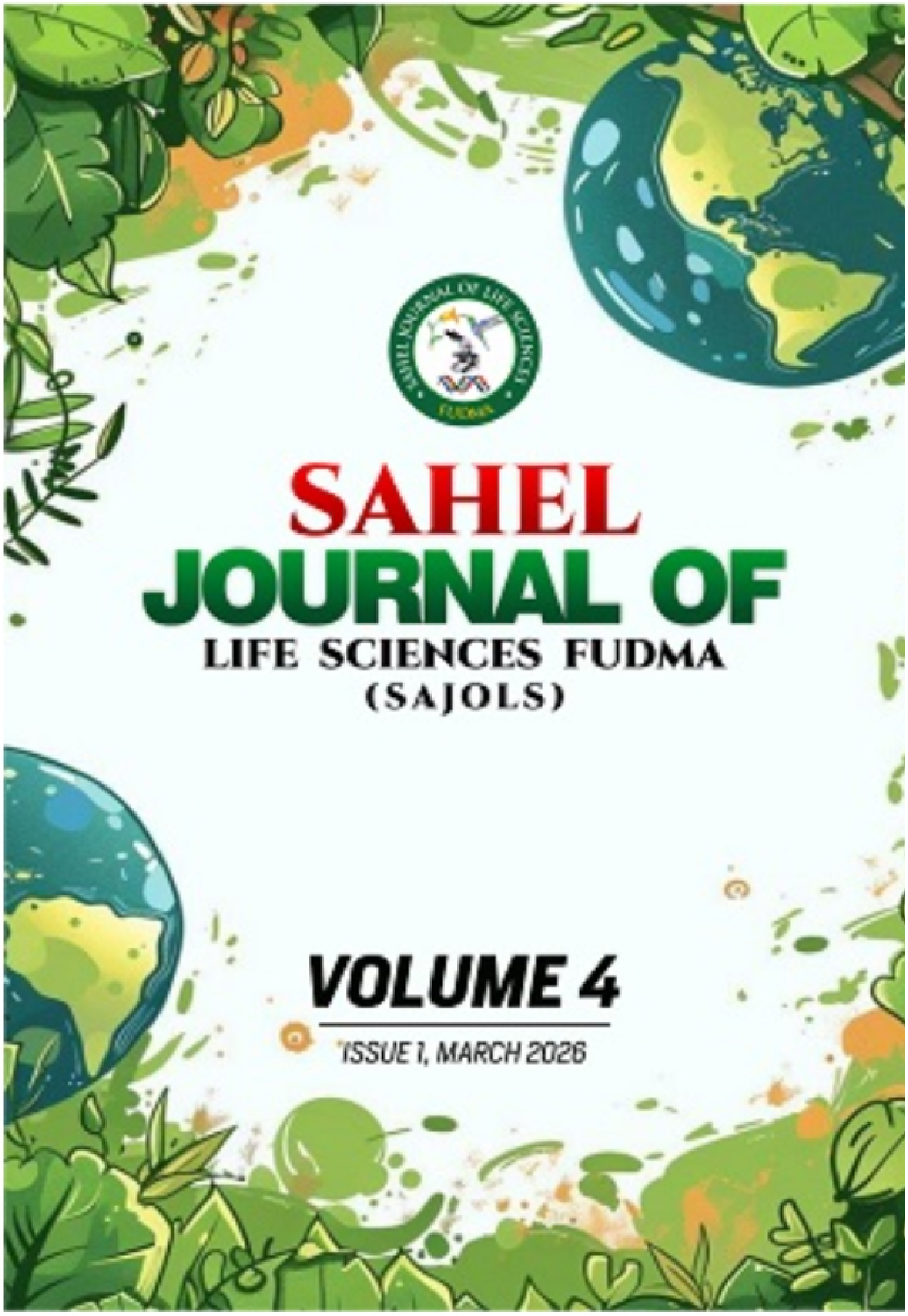
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Research Article

Survey on Infestation and Damage of *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) in Some Maize Fields in Kano, Nigeria

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ABSTRACT
Spodoptera frugiperda (fall armyworm), an invasive pest native to the Americas, was first reported in Africa in 2016 and has since spread to over 44 countries across the continent. To confirm its presence and assess infestation levels and damage severity in Kano State, Nigeria, a field survey was conducted in selected Local Government Areas during both the dry and rainy seasons. The survey covered maize farms in Kura, Gwarzo, Tofa and Minjibir, using a random sampling method. Results indicated higher infestation and damage severity during the dry season, with the highest infestation rate recorded in Gwarzo (96%), and followed by Kura (89%). The damage severity was highest in Kura (8.0), followed by Gwarzo (6.8) on a 9.0 scale. In the rainy season, the highest infestation and damage severity were observed in Minjibir (75%, 5.35) and Gwarzo (51%, 4.25) respectively. These findings confirm the widespread presence and significant impact of *Spodoptera frugiperda* in the study area. Regular surveillance, monitoring and the implementation of integrated pest management strategies are recommended to mitigate the pest`s adverse effect on maize production. The results may also inform policy decisions regarding *Spodoptera frugiperda* management in Kano State.

Keywords: Crop damage; Fall armyworm; Infestation; Maize; Survey

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INTRODUCTION

Maize (*Zea mays* L.) stands as one of the most vital staple crops globally, particularly in sub-Saharan Africa, where it underpins food security, livelihoods, and livestock feed production. Despite its agricultural importance, maize cultivation faces persistent challenges from biotic stressors, including pathogenic fungi, bacteria, and viruses: such as rusts, smuts, and maize streak virus as well as a diverse array of insect pests. Key among these pests are stem borers (*Busseola fusca*, *Chilo partellus*), maize weevils (*Sitophilus zeamais*), and lepidopteran larvae like cutworms (*Agrotis* spp.) and armyworms, which collectively diminish both field yields and post-harvest grain quality. These biotic pressures exacerbate production losses, further threatening food availability in tropical and subtropical regions (IITA, 2010).

A particularly devastating pest of maize is the fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae), a highly polyphagous species indigenous to the Americas. While it infests over 80 host plants, including sorghum (*Sorghum bicolor*), millet, rice and maize remain its preferred host, sustaining the most severe economic damage (Overton *et al.,* 2021; Kenis *et al.,* 2023). The adult moths exhibit strong nocturnal activity and are capable of extensive migratory flights, with populations in North America seasonally dispersing from the southern United States into Canada (Westbrook *et al.,* 2016).

First reported in Africa in 2016, *Spodoptera frugiperda* rapidly colonized sub-saharan Africa within a year (Day *et al.,* 2017) and has since invaded large parts of Asia and Oceania (CABI, 2021). Both laboratory and field observations confirm maize as the optimal host for oviposition and larval development (Meagher *et al.,* 2021). The larvae inflict extensive defoliation, targeting whorls, tassels, and reproductive tissues, thereby impairing photosynthesis and directly reducing grain yield (Chimweta *et al.,* 2019).

Uncontrolled infestations can result in near-complete crop failure, with documented yield losses reaching 73% during severe outbreaks (Overton *et al.,* 2021; Kenis *et al.,* 2023). The pest's rapid expansion and destructive potential have raised significant alarm, especially in resource-limited regions where access to effective management strategies remains inconsistent. Kano state was chosen for this study because it is one of the most important maize producing regions in northern Nigeria and plays a strategic role in national food security. The state support both rain and dry season irrigated maize farming, particularly through extensive irrigation schemes, making it an ideal location to compare seasonal dynamics of *Spodoptera furigifeda* infestation and damage. Despite the economic importance of maize in Kano State, localized and field-based data on the infestation levels and damage severity of *Spodoptera furigifeda* remain limited. Most existing reports focus on broader regional assessment, which may not adequately capture district-level variations in pest incidence, seasonal trends, and production systems. Conducting this study in Kano State therefore helps to bridge this knowledge gap by providing empirical, location-specific evidence on fall armyworm distribution and impact. These regional disparities emphasize the need for context-specific research and adaptive integrated pest management (IPM) strategies.

MATERIALS AND METHODS

The methodology adopted in this study was based on standard field survey and damage assessment procedure as described by FOA (2018), Koffi *et al*. (2020). A field survey was conducted to assess the infestation levels and damage caused by *Spodoptera frugiperda* on maize farms across selected local government areas of Kano state, Nigeria, during the rainy and dry seasons of 2023. A random sampling method was employed for data collection.

The surveys were carried out both during the rainy and dry season in Gwarzo, Tofa, Kura and Minjibir LGAs. At each farm, five sampling sites were selected. Within each site a $3m^2$ plot was demarcated, and ten maize plants were randomly selected and examined for signs of infestation. Observation focused on the presence or absence of the pest, infestation levels and damage severity.

The percentage of infestation per quadrant was calculated using the formula:

$$\%\ \text{Fall Army Warm infestation} = \frac{Number\ of\ Fall\ Army\ Warm\ infested\ plants}{Total\ number\ of\ plants\ observed} \times 100$$

(FAO, 2018)

Scale Description of leaf damage severity on maize plant

The scale of Davis and Williams (2017) was used as follows:

0 - No visible leaf damage

1 - Only pinhole damage on leaves

2 - Pinhole and shot hole damage to leaf

3 - Small elongated lesions (5–10 mm) on 1–3 leaves

4 - Midsized lesions (10–30 mm) on 4–7 leaves

5 - Large elongated lesions (>30 mm) or small portions eaten on 3–5 leaves

6 - Elongated lesions (>30 mm) and large portions eaten on 3–5 leaves

7 - Elongated lesions (>30 cm) and 50% of leaf eaten

8 - Elongated lesions (30 cm) and large portions eaten on 70% of leaves

9 - Most leaves with long lesions and complete defoliation observed

The data collected for the survey were subjected to T-test at 5% level of significance. Damage severity per field was calculated using the formula: PD = Vd/ Pt × 100% where (PD = percentage of damaged plants, Vd = plants with visual damage and Pt = total plants examined). Average damage per district was calculated using LD = ∑ Di /Pt where, (LD = average plant damage per field, ∑ Di = sum of scores of individual plants and Pt = total plants surveyed (Caniço *et al.,* 2020).

RESULTS

Results in Table 1 presents the percentage infestation and damage severity of *Spodoptera frugiperda* in maize fields across selected LGAs during the rainy season, showed there were significant differences ($P \leq 0.05$) in the mean percentage infestation and damage severity of *Spodoptera frugiperda* among the surveyed LGAs during the rainy season. Minjibir recorded significantly higher infestation and severity (75%, 5.35) compared to other locations, while Gwarzo and Kura showed statistically similar infestation levels. Tofa had the lowest infestation and severity (23%, 2.75), which differed significantly from the other LGAs.

During the dry season, as shown in Table 2, significant differences ($P \leq 0.05$) were also observed among the surveyed LGAs. Gwarzo recorded the highest percentage infestation (96%), which differed significantly from the other locations. Tofa and Kura (89% each) showed similar infestation levels but were significantly higher than Minjibir (65%). For damage severity, Kura with 8.00 recorded the highest severity score, which was statistically comparable to Gwarzo (6.80) but significantly higher than those recorded in Tofa and Minjibir (5.5 and 5.5) respectively.

The comparison between seasons is presented in Table 3. The results showed a significant difference ($P < 0.05$) between the rainy and dry season. The highest mean percentage infestation (84.75%) and damage severity (6.45) were recorded during the dry season in irrigated maize fields. In contrast, the rainy season recorded the lowest mean percentage infestation and severity of 47.75% and 4.02 respectively, in rain-fed maize fields.

Table 1: Mean percentage infestation and damage severity of *Spodoptera frugiperda* in Maize Fields across selected LGAs during the Rainy season

LGA	%infestation (Mean ± SE)	Severity (Mean ± SE)
Gwarzo	51.00 ± 0.00^{b}	4.25 ± 0.00^{b}
Tofa	23.00 ± 0.00^{c}	2.75 ± 0.00^{c}
Kura	42.00 ± 0.00^{b}	3.90 ± 0.00^{b}
Minjibir	75.00 ± 0.00^{a}	5.35 ± 0.00^{a}

Values represent mean ± standard error (SE). Means within column followed by different superscript letters are significantly different at $P \leq 0.05$ according to Student's t-test, while means with the same superscript letters are not significantly different. SE = Standard Error of the Mean.

Table 2: Mean percentage infestation and damage severity of *Spodoptera frugiperda* in Maize Fields across selected LGAs during the Dry season

LGA	%infestation (Mean ± SE)	Severity (Mean ± SE)
Gwarzo	96.00 ± 0.00^{a}	6.80 ± 0.00^{a}
Tofa	89.00 ± 0.00^{b}	5.50 ± 0.00^{b}
Kura	89.00 ± 0.00^{b}	8.00 ± 0.00^{a}
Minjibir	65.00 ± 0.00^{c}	5.50 ± 0.00^{b}

Values represent mean ± standard error (SE). Means within column followed by different superscript letters are significantly different at $P \leq 0.05$ according to Student's t-test, while means with the same superscript letters are not significantly different. SE = Standard Error of the Mean

Table 3: Comparison of Mean Percentage Infestation and Severity of Rain Fed and Irrigated Maize Fields Surveyed in Kano

Season	Infestation%	Damage severity
Rainy	47.75^{b}	4.06^{b}
Dry	84.75^{a}	6.45^{a}

Means within the same column followed by different superscript letters are significantly different at $P < 0.05$ according to Student's t-test

DISCUSSION

The present study confirms the widespread occurrence of fall armyworm (*Spodoptera frugiperda*) in maize fields across Kano State and demonstrates clear seasonal differences in infestation levels and damage severity. Overall, infestation and crop damage were significantly higher during the dry season, particularly in irrigated maize fields, compared to the rainy season. This seasonal variation highlights the strong influence of environmental and agronomic factors on fall armyworm population dynamics.

Based on the survey conducted, infestation and damage were more severe during the dry season compared to the dry season. The highest mean percentage infestation and severity score were recorded in irrigated maize growing areas, while the lowest mean infestation percentage and severity score were observed in rainfed maize growing areas. These findings might probably be attributed to climatic factors, as similar results in percentage of infested fields and plants per district and season were reported by Caniço, *et al.* (2020).

The percentage of infested plants per field was consistently higher in the dry season across all districts. The plant damage was more severe during the dry season, particularly in the Gwarzo district, where an average damage score of 6.8 was recorded-indicating that 70-80% of the plant surface was damaged by fall armyworm (FAW) larvae. However, no significant differences in damage intensity were observed among districts during the rainy season. The damage intensity within the same district across seasons revealed that the dry season consistently exhibited higher values than the rainy season. A higher number of larvae per field was also recorded in the dry season. This pattern might probably be due to climatic conditions. When maize whorls are filled with water fall armyworm larvae are forced to abandon them, while egg masses and small larvae are washed onto the ground, ultimately reducing pest populations. This was observed and reported by Garcia *et al.* (2017) that fall armyworm population density is negatively influenced by rainfall. Temperature also plays a crucial role in FAW and other noctuid species has shown that rising temperatures contribute to population growth.

In contrast, the lower infestation and damage severity observed during the rainy season may be largely due to the direct and indirect effects of rainfall on fall armyworm survival. Heavy rainfall can dislodge egg masses and early instar larvae from maize whorls, leading to increased mortality. Additionally, water accumulation in maize whorls has been shown to force larvae to abandon feeding sites, further reducing infestation levels. These findings align with earlier reports indicating a negative relationship between rainfall intensity and fall armyworm population density (Garcia *et al.,* 2017).

Temperature may also play a significant role in explaining the observed seasonal differences. Higher temperatures during the dry season can accelerate larval development, increase feeding activity, and enhance reproductive rates in fall armyworm populations. Previous studies have demonstrated that rising temperatures favor the population growth of *Spodoptera frugiperda* and other noctuid pests, thereby increasing the severity of crop damage under dry conditions (Day *et al.,* 2017).

Spatial variation in infestation and damage severity among the surveyed local government areas further suggests that local agronomic practices, maize growth stages, and microclimatic conditions influence pest pressure. For instance, the consistently higher damage scores recorded in Kura and Bunkure may reflect intensive dry-season maize cultivation, continuous cropping, and limited adoption of integrated pest management practices. Similar district-level differences in infestation patterns have been reported in other African maize-producing regions (Baudron *et al.,* 2019; Day *et al.,* 2017).

The significantly higher mean infestation and damage severity observed in irrigated maize fields compared to rainfed fields underscore the need for targeted pest management strategies during the dry season. Without timely intervention, sustained infestations during irrigated farming may serve as a reservoir for fall armyworm populations, facilitating their spread into rainfed systems at the onset of the rainy season. Overall, the findings of this study reinforce the importance of continuous surveillance and season-specific management of fall armyworm in Kano State. Integrated pest management approaches that combine regular monitoring, cultural control practices, and judicious use of environmentally safe control measures are essential to minimize yield losses and reduce the long-term impact of this invasive pest on maize production.

CONCLUSIONS

The survey conducted revealed that; *Spodoptera frugiperda* was found to infest maize fields in Kano State, Nigeria, during both the dry and wet seasons. The pest was found to be more damaging in irrigated maize farms during the dry season with Kura recording the highest level of sustained damage. The infestation level was also higher during dry season farming, with Gwarzo Local Government Area experiencing the highest infestation among the surveyed areas. Based on the findings, pest management efforts should be intensified during the dry season, particularly in irrigated maize fields and high infestation areas such as Gwarzo and Kura LGAs. Regular surveillance and timely intervention are essential to prevent severe damage. The adoption of integrated pest management strategies, combined with improved agronomic practices is strongly recommended to ensure sustainable control.

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Conflicts of interest
The authors declare no conflict of interest.

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Authors' contributions
Ismaila Bello: Conceived and designed the study, conducted the research
Abubakar Shuaibu: Contributed to the execution of the research, wrote the entire manuscript, critically reviewed the manuscript and provided substantial corrections throughout the work.
Bashir Jahun: provided substantial corrections and guidance throughout the work.
Hajara Ashir: Contributed in proofreading and provided substantial corrections.
Matthew Adebola: Assisted in proofreading and helped incorporate necessary revisions to the manuscript.

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