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Prevalence and farmers perceptions of solanaceous vegetables pests with special reference to *Tetranychusevansi* in the Kara Region of Togo

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Abstract
A combined survey and field experiment were conducted in the Kora region (northern Togo) to assess farmers' perceptions of pest problems on solanaceous vegetables and to quantify the prevalence and abundance of insect and mite pests, with special emphasis on the invasive and destructive mite pest *Tetranychus evansi*. Among 38 farmers interviewed, tomato (*Solanum lycopersicum*), pepper (*Capsicum* spp.), and gboma (*S. macrocarpum*) were the main crops cultivated, while eggplant (*S. melongena*) was less common. Most farmers (73.7%) perceived yields as moderate, y*et al*l respondents (100%) reported *T. evansi* infestations mainly during the dry season. The majority (84.2%) considered the damage very severe, with yield losses estimated between 50-90%, and 81.6% had abandoned their crops due to mite attacks. Chemical control was the dominant management practice, applied weekly by all farmers. In the field experiment, both crop type and sampling date significantly influenced infestation rates and pest abundance ($p < 0.0001$). Insect infestation peaked between 49-56 days after transplanting (DAT), reaching about 60% on *S. melongena* and 50% on *S. macrocarpum*, while tomato remained the least infested (<20%). Insect populations were highest on *S. melongena* (≈6.3 per plant at 70 DAT). Mite densities were generally low throughout the trial, dominated by *Tetranychus urticae* early in the season, with *T. evansi* appearing from the fifth sampling date onward, particularly on *S. melongena* and *S. macrocarpum*. The experimental results corroborate farmers' reports that *T. evansi* is predominant in the dry season, as it was scarce in the rainy-season trial, underscoring the need to better understand climatic drivers of mite outbreaks for effective management.

Keywords: Mite pest, red spider mite, vegetable crops, survey, season

1. Introduction
Vegetable production is a vital component of food systems and an important source of livelihood for rural households in West Africa, where the demand for fresh produce is rapidly increasing (Schippers, 2000; Danso *et al*., 2002) [21, 11]. These crops are essential not only for nutrition supplying vitamins, minerals, and dietary diversity, but also for income generation among smallholder farmers. In Togo, key vegetable crops include tomato (*Solanum lycopersicum*), pepper (*Capsicum spp.*), and gboma (*Solanum macrocarpon*), which play a central role in household diets and contribute significantly to farmers' revenues (Ameyapoh *et al*., 2023) [5]. Tomato in particular has become one of the most important horticultural commodities, with production expanding steadily over the past decade (Ameyapoh *et al*., 2023) [5]. Comparable trends have been observed across the region, where tomato is both a staple vegetable and a major cash crop in countries such as Benin, Ghana, and Nigeria (Danso *et al*., 2002; Adegbola *et al*., 2018; Ugonna *et al*., 2015) [11, 3, 22].

Despite this growth, vegetable production remains constrained by major biotic stresses, especially athropod pests and pathogens that substantially reduce yields (Olayemi *et al*., 2011; Ugonna *et al*., 2015; Baidoo *et al*., 2021; Ajayi *et al*. 2022; Niassy *et al*., 2023; Fening *et al*., 2024; Ayenan *et al*., 2024; Gitonga *et al*., 2024) [20, 22, 10, 4, 18, 13, 6, 16]. Among these, mites represent particularly a severe threat due to their rapid reproductive rates, high adaptability, and capacity to cause extensive leaf damage leading to premature defoliation and yield decline. Losses of up to 90% in tomato and 50% in gboma have been reported in West Africa (Azandémè-Hounmalon *et al*., 2015) [9]. The most economically important species include the red tomato spider mite *Tetranychus evansi*, the two-spotted spider mite *Tetranychus urticae*, the tomato russet mite (*Aculops lycopersici*), and the broad mite (*Polyphagotarsonemus latus*), all of which have been associated with severe outbreaks in vegetable crops across the region

(Azandémè-Hounmalon *et al*., 2015; Adango *et al*., 2020) [9, 1]. Current control strategies in Togo, as elsewhere, rely heavily on chemical acaricides. However, their effectiveness is increasingly undermined by resistance development, the disruption of natural enemies, and risks to both human health and the environment (Githaka *et al*., 2022) [15]. Integrated pest management (IPM) approaches are urgently needed as sustainable alternatives. Yet, the design of such strategies requires baseline information on the diversity, prevalence, and impact of mite pests within local production systems. To date, no study has documented the diversity and importance of mite pests on vegetable crops in Togo. This lack of information represents a major obstacle to the development of sustainable, locally adapted management strategies.

The present study was therefore undertaken to address this gap by improving knowledge of arthropod pests in vegetable agro-ecosystems in northern Togo, with particular emphasis on *T. evansi*. Specifically, it aims (i) to assess farmers' perceptions regarding the recognition, prevalence, and impact of mite pests on four major vegetable crops (tomato, gboma, eggplant, and pepper), and (ii) to evaluate, under experimental conditions, the dynamics of insect and mite pests associated with these crops

2. Materials and Methods

2.1. Study Area

The study was conducted in the Kara region, located in northern Togo. The region has a Sudanian climate characterized by a unimodal rainfall pattern (May - October), with average annual rainfall of approximately 1.80 mm and mean temperatures ranging from 29 to 35°C. Soils are predominantly ferruginous, supporting intensive vegetable production in both urban and peri-urban systems.

2.2. Farmers' Survey

A structured questionnaire was administered to 38 vegetable farmers across selected villages and peri-urban vegetable farms in the kara region. Farmers were selected using a combination of purposive and random sampling to ensure representation of smallholder production systems. The survey aimed to gather information on farmers' knowledge and perceptions regarding: (i) vegetable crops cultivated and farmers' perception of the yield; (ii) recognition of mite pests and other arthropods on vegetable crops; (iii) prevalence and seasonal occurrence of pests, (iv) observed crop damage and yield losses attributed to mites, (v) current pest management practices, including pesticide use. Responses were analyzed using descriptive statistics in R software (R Core Team, 2023).

2.3. Field trial

To complement the survey data, experimental observations were conducted under station conditions to monitor pest dynamics. The trials were established using a randomized block design. Four blocks, each separated by 2 m, were installed, each comprising of four plots: for tomato (*Solanum lycopersicum*), eggplant (*Solanum melongena*) and pepper (*Capsicum sp*), plots measured 9.6 m in length and 1.2 m in width, while for gboma (*Solanum macrocarpum*), plots measured 4.5 m × 1.0 m. The plots were separated by 0.5 m alleys. Each plot of tomato, eggplant and pepper contained 60 plants, arranged in three rows of 20 plants, with 50 cm between rows and 40 cm between plants. Gboma plots contained 60 plants, arranged in four rows of 15 plants with 40 cm spacing between both rows and plants.

Seedlings were raised in soil nurseries for one month before transplanting. Irrigation was performed daily with borehole water, except on rainy days or immediately prior to data collection. Poultry manure (5 tones/ha) was applied as organic fertilizer at crop-specific intervals: two weeks after transplanting for eggplant, three weeks for tomato, and seven weeks for gboma. No chemical plant protection treatments were applied during the experimental period. The experiment involved the local varieties of Gboma and pepper, the 'Roma' of tomato and the 'N'galam' eggplant, which are the most commonly grown by farmers. Seeds for all varieties were purchased from the company TECHNISEM.

Data collection

The prevalence and abundance of insect and mite pests were assessed starting at 28 days after transplanting (DAT), i.e., four weeks after transplanting. Assessments were conducted weekly for a period of six weeks. Prevalence and abundance were recorded following the procedure described by Gounou *et al*. (2015) [17]. In each block, nine plants were randomly selected per plot, resulting in a total of 36 plants per block. On each selected plant, three apical leaves, three median leaves, and three basal leaves were examined in the field using a head-mounted magnifier. For plants with insufficient foliage, all available leaves were inspected, from the apical bud to the lowest leaves. Prevalence was expressed as the percentage of plants infested, while abundance was calculated as the mean number of individuals (insects or mites) per plant.

Data Analysis

Survey data were summarized with descriptive statistics. For experimental data, differences in pest abundance and damage among crops and over time were analyzed using analysis of variance (ANOVA), followed by Tukey's HSD test for mean separation at $P \leq 0.05$. Data normality and homogeneity of variance were checked prior to analysis. All statistical analyses were performed using R version 4.3.0 (R Core Team, 2023).

3. Results

3.1. Survey

Type of crops and farmers' perception of yield

From this survey, it appears that three main vegetable crops are produced in the prefecture of Kozah. Among the 38 respondents, 94.7% grow tomato (*Solanum lycopersicum*), 86.8% produce pepper (*Capsicum* spp.), 81.5% produce gboma (*Solanum macrocarpon*), and 2.6% produce eggplant (*Solanum melongena*) (Figure 1A). In addition, 81.6% of the farmers cultivate other crops such as okra (*Abelmoschus esculentus*), jute mallow (*Corchorus olitorius*), roselle (*Hibiscus sabdariffa*), cabbage (*Brassica oleracea*), green bean, lettuce (*Lactuca sativa*), and groundnut (*Arachis hypogaea*).

Regarding farmers' perception of yield, 73.7% considered it to be moderate, 15.8% good, and 10.5% low (Figure 1B).

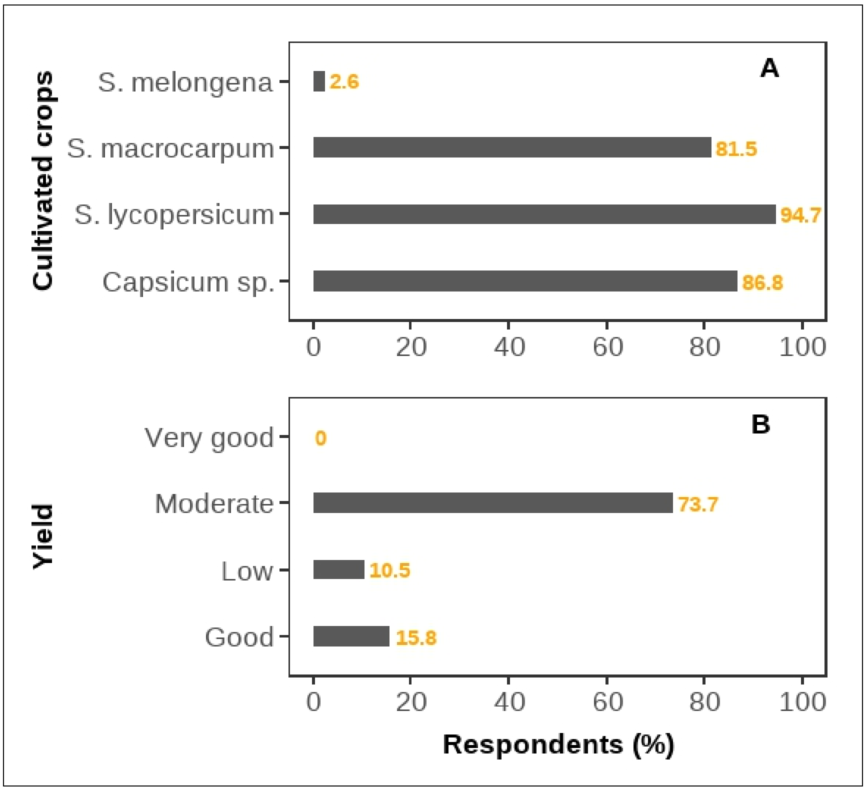

Fig 1: Types of crops cultivated by farmers and their perception of yield

Farmers' perceptions of the prevalence, recognition, and damage caused by *T. evansi*

All respondents (100%) reported having encountered *T. evansi* on their crops (Figure 2A). Locally, it is commonly referred to as "Agondola," "Nimdjo (Gnimtcho)," or "Adjagnette." Attacks were reported on tomato, gboma, pepper, eggplant. Farmers indicated that infestations typically occurred during the dry season (March to June).

Almost all respondents (84.2%) considered the damage caused by *T. evansi* to be very severe (Figure 2B), with 76.3% estimating yield losses between 50% and 90%, and in some cases reporting total crop loss (Figure 2B). In addition, 81.6% of the farmers stated that they had abandoned their crops because of *T. evansi* (Figure 2C). Among the crops abandoned, tomato (42.1% of respondents) and gboma (31.6%) were the most frequently cited.

Control methods

The primary control method reported was chemical control, cited by all respondents (100%), with applications carried out at least once per week. In addition, 23.7% of respondents stated that they combined chemical treatments with mechanical control, consisting of manual removal of plants when they were completely infested. None of the respondents reported using plant-based extracts as a control measure (Figure 3)

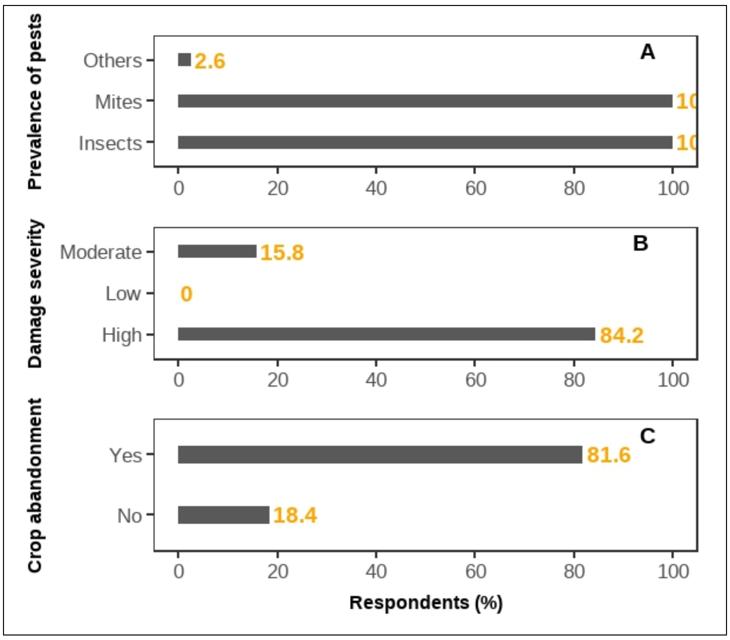

Fig 2: Farmers' perception on the prevalence of *T. evansi* (A), their damage (B) and their impact on yield (C)

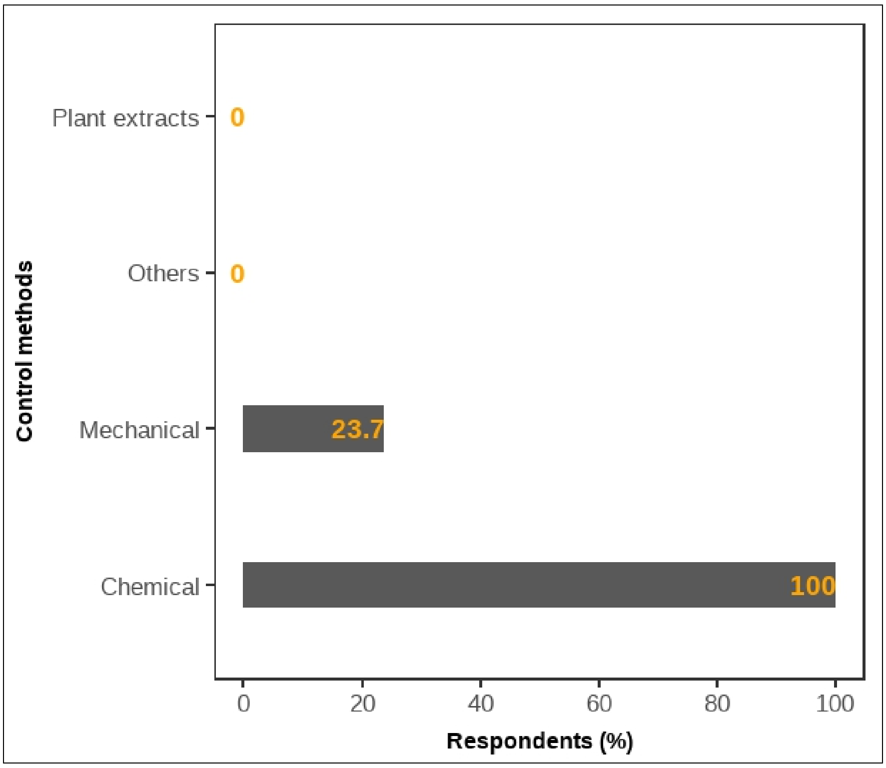

Fig 3: Control methods used by farmers against *Tetranychus evansi*

3.2. Experiments

Percentage of plants infested by insects and mites

The crop and DAT had significant effects on plant infestation insects, as well as by mites (Table 1). The percentage of plants infested by insects increased progressively from 35 to 49 days after transplanting (DAT) across all crops, then remained relatively stable until 70 DAT (Figure 19A). The highest infestation levels were recorded on *S. melongena* (≈60%) and *S. macrocarpum* (≈50%), followed by *Capsicum* sp. (≈40%). *S. lycopersicum* consistently showed the lowest infestation rates (<20%) throughout the observation period (Figure 4A).

Mite infestations were generally low during the experiment (Figure 4B). The highest percentage of infested plants (≈40%) occurred on *Capsicum* sp. at 35 DAT, after which infestations declined sharply and remained minimal. Low and sporadic infestations (<10-15%) were observed later on *S. melongena*, *S. macrocarpum*, and *S. lycopersicum.*

Table 1: Analysis of variance of the effects of DAT and crop type on plant infestation by insects and mites

Source	df	MS	F value	P
% plants infested by insects				
DAT	5	2351.5	31.3	< 0.0001
Crop	3	2474.7	73.0	< 0.0001
DAT × Crop	15	322.4	4.3	< 0.0001
Error	72	74.9	-	-
% plants infested by mites				
DAT	5	265.1	24.3	< 0.0001
Crop	3	149.6	13.7	< 0.0001
DAT × Crop	15	299.4	27.4	< 0.0001
Error	72	10.9	-	-

Table 2: Analysis of variance of the effects of DAT and crop type on the abundance of insects and mites

Source	df	MS	F value	P
Insects				
DAT	5	2.7	77.9	< 0.0001
Crop	3	36.4	1045.4	< 0.0001
DAT × Crop	15	6.6	189.8	< 0.0001
Error	72	0.03	-	-
Mites				
DAT	5	0.06	20.1	< 0.0001
Crop	3	0.03	10.6	< 0.0001
DAT × Crop	15	0.07	25.3	< 0.0001
Error	72	0.003	-	-

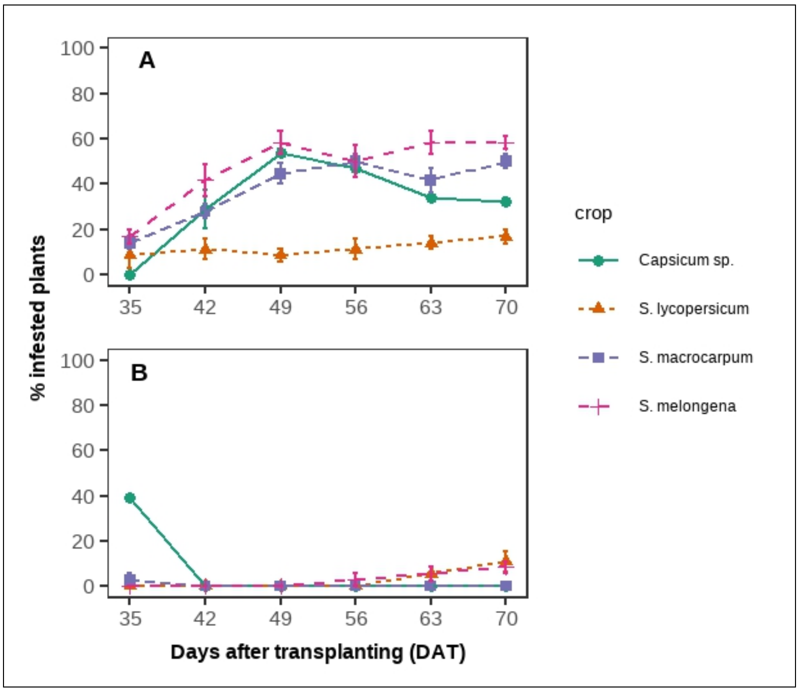

Fig 4: Percentage of plants infested by insects (A) and mites (B) on four Solanaceous crops during the trial period.

3.3 Insects and mites abundance

Figure 5 presents the dynamics of insects and mites recorded on the four crops (tomato, gboma, pepper, and eggplant) during the trial period. Overall, insect pests were recorded throughout the experiment at varying densities, with aphids being the dominant group.

Insect populations varied among crops and over the sampling period (Table 2; Figure 5A). The highest mean numbers of insects per plant were recorded on eggplant **(***S. melongena***)**, where abundance steadily increased from 1.2 individuals per plant at 35 DAT to about 6.3 individuals per plant at 70 DAT. On eggplant (*S. macrocarpum*), insect abundance also increased moderately, reaching around 2 individuals per plant toward the end of the sampling period. In contrast, tomato and pepper (*Capsicum* sp**.)** maintained consistently low insect populations (<1 individual per plant) after 42 DAT, following an initial peak on pepper at the beginning of sampling (35 DAT)

Overall, mite densities remained very low on all crops throughout the sampling period (Figure 5B). The highest density (≈0.6 mite per plant) was observed on pepper during the first sampling (35 DAT), after which populations declined and remained almost null on all crops. Slight increases were noted on eggplant and eggplant from 63 DAT, with significant differences, albeit small, observed among crops.

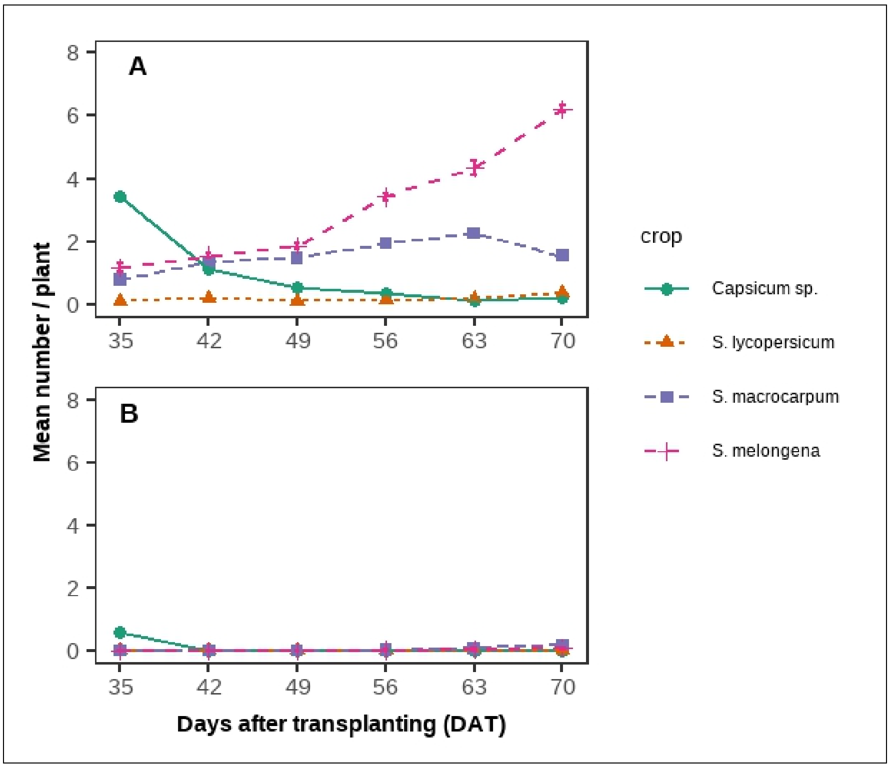

Fig 5: Mean number of insect (A) pests and mites (B) per plant recorded on the four solanaceous crops over the sampling period

4. Discussion

Survey results revealed that *T. evansi* is widely recognized by market gardeners, who associate this pest with severe yield losses, reaching up to 90% in some cases and sometimes leading to the abandonment of entire plots. Such losses represent a major economic burden for producers whose livelihoods rely heavily on these crops. The majority of respondents reported that *T. evansi* occurs mainly during the dry season, a pattern consistent with the findings of Azandémè-Hounmalon *et al*. (2022) [8], who documented similar farmer experiences in Benin

Survey results indicate that *Tetranychus evansi* is widely recognized by vegetable growers, who associate this pest with severe yield losses, estimated at up to 90% in some cases, sometimes leading to the abandonment of entire plots. Such losses highlight the major economic impact of this mite on smallholder producers, who depend heavily on these crops for their livelihoods. The vast majority of farmers reported the occurrence of *T. evansi* mainly during the dry season, consistent with the findings of Azandémè-Hounmalon *et al*. (2022) [8] in a survey of vegetable growers in Benin. The vernacular names attributed to this pest already suggest its highly destructive character, capable of causing total crop failure, which explains why 82% of surveyed farmers reported having abandoned their crops following infestations by *T. evansi*. Farmers also reported symptoms resembling *T. evansi* damage on roselle (*Hibiscus sabdariffa*) and okra (*Abelmoschus esculentus*). Although these observations remain to be confirmed by specific studies, Azandémè-Hounmalon *et al*. (2022) [8] documented the ability of *T. evansi* to expand its host range under certain conditions, suggesting that further evaluation of these local crops could be relevant. The survey data also revealed the absence of alternative control practices, such as biological control or the use of plant extracts, despite their demonstrated potential (Adango *et al*., 2020) [1]. Farmers' exclusive reliance on chemical pesticides highlights a major gap in sustainable management options.

Overall, insect pests were present throughout the experimental period at varying densities. Aphids emerged as the dominant group, corroborating the findings of Gounou *et al*. (2015) [17].

During the experimental trial, very low densities of mites, particularly *T. evansi*, were recorded, most likely due to the rainy-season conditions under which the study was conducted. Although these densities did not reach the critical levels often observed in the dry season, they confirmed the sensitivity of this pest to climatic variations, consistent with survey results in which all farmers reported *T. evansi* outbreaks as occurring in the dry season. These observations are also in agreement with the findings of Gounou *et al*. (2015) [17], Azandémè-Hounmalon *et al*. (2015) [9], and Drabo *et al*. (2023) [12].

In addition, *T. urticae* was recorded on pepper during the first sampling date. Similarly, Gounou *et al*. (2015) [17] reported *T. urticae* on pepper in northern Benin at an average density of 0.02 mites per plant. In contrast, *P. latus* was not detected during the experiment, despite its known preference for gboma (*S. macrocarpon*) (Adango *et al*., 2006) [2]. Several factors could explain this absence. A sudden decline following rapid population growth is a well-documented phenomenon in *P. latus* populations (Adango *et al*., 2006) [2]. Gerson (1992) [14] attributed such dynamics to various causes, including deterioration in plant nutritional quality, changes in environmental conditions, and the action of natural enemies. Furthermore, it should be noted that gboma had not been cultivated in the study site and its surroundings for several years, which may also explain the absence of *P. latus*.

Together, these results highlight the need to integrate farmer knowledge with ecological monitoring to design effective management strategies. Seasonal forecasting of *T. evansi* outbreaks could be critical for timely interventions, particularly during the dry season when risk is highest. Moreover, the heavy reliance on chemical pesticides calls for urgent promotion of integrated pest management (IPM) approaches, including the use of resistant varieties, cultural practices, and biological control agents, as already demonstrated in other African contexts (Nyoni *et al*., 2019) [19].

5. Conclusion

Our study confirms the importance of insect pests and mites in shaping solanaceous crop production in northern Togo. While *T. evansi* is perceived by farmers as the predominant pest in the dry season, its scarcity during the rainy-season experiment highlights the strong seasonal dynamics governing its outbreaks. Understanding these climatic drivers is essential for developing sustainable and context-specific management strategies to reduce yield losses and improve farmer livelihoods.

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Competing interests

Authors have declared that no competing interests exist.

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