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# Survey Of The Insect Pests Of Vegetables Crops And Management Methods Used By Farmers In Niger

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***Abstract***
***Background:*** *In Niger, the vegetable production contributes improving the living conditions of households. However, the production is influenced by biotic and abiotic constraints. The objective of this study was to identify insect pests associated to the tomato, cabbage, onion and moringa and the management methods used by producers.*
***Material and methods:*** *The study involved six vegetable growing sites in Maradi and Tahoua regions. Individual interviews involved 86 farmers and direct observations were carried out in the producers' fields. Samples were collected and incubated in the laboratory for the identification of natural enemies. The constraints mentioned by respondents were pest pressure, the poor soil fertility and the low availability of improved seeds.*
***Results:*** *The majority of farmers use chemical methods to manage entomological and soil fertility constraints. Observations in the fields led to identify several insect pests and revealed that 11.57% of tomato fruits were infested by Helicoverpa armigera and 60.84% of cabbage plants by Plutella xylostella. Three natural enemies of aphid have been identified.*
***Conclusion****: These results can serve to update the list of vegetable production constraints and contribute to integrated pest management of vegetable crops and improve vegetables production in Niger.*
***Keywords:*** *vegetables, insect pests, control methods, natural enemies*

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## I. Introduction

Agriculture is one of the main activities contributing to 40% of the socio-economic development of the world's population. It employs more than 40% of the world's employments, including more than 52% in Africa and Asia (MOMAGRI, 2016). Within this sector, vegetable plays an important role in human nutrition and is a key source of economic development in cities (Ngom et al., 2020). It employs more than 800 million people and contributes more than 33% of global agricultural production (Kanda et al., 2014).

Global vegetable production is estimated to 1.17 billion tons in 2022 (Statista, 2024). While in Africa, production is estimated to 73.14 million tons in 2021 (Statista, 2023). West Africa accounts for almost 50% of this production, or nearly 43 million tons according to FAO (Douet, 2017).

In Niger, total vegetable production is estimated to 6,120,372.67 tons grown on 238,196.65 ha (MA, 2022). The vegetable production is estimated to 3,597,720.65 tons (58.78% of total production) on 116,827.13 ha (49% of sown area). Several crops are grown, including onions, cabbage, tomatoes and moringa (MA ,2022). The vegetables products contribute for improving the food and nutritional quality of rural and urban populations through their mineral, vitamin content (Dan-Badjo et al., 2013). They make a significant contribution to household income in particular, and to the country's economy in general (Ngom et al., 2020).

Although vegetable crops play a key role in the economy, human and animal nutrition, their production is subjected to numerous biotic and abiotic constraints including pests, diseases, low soil fertility, water management, cultivation practices, expensive seeds and fertilizers, poor human capacity building, inappropriate pest management (Mondedji et al., 2014; Hama et al., 2018).

Generally, among all these constraints in sub-Saharan Africa, pests and diseases are the biggest threats to the production of these crops and are the main causes of yield loss (Adékambi and Adégbola, 2008; Kanda et al., 2014; Mondedji et al., 2015). Abdoul et al. (2016) reported 70% infestation on tomato plants by Bemisia tabaci in Niger while Dao et al. (2016) recorded 3 species of leaf leafhoppers on Moringa in Burkina Faso. Similarly, studies by Djomaha and Ghogomu (2016) in Cameroon showed that P. xylostella damage to cabbage leaves can vary from 0 to 50%. Zappala et al. (2013) found 20% predators and 80% parasitoids of T. absoluta in Europe.

To limit the damage caused by pests and diseases, farmers use insecticides (often unregistered), cultural practices, pesticidal plants and parasitoids (Bafada et al., 2019; Ouédraogo et al., 2019; Ossey et al., 2023; Mano et al., 2023). Unfortunately, these solutions are far from sufficient, as vegetable productivity is currently threatened by persistent fluctuations in climatic parameters such as temperature and rainfall, the consequences of which include flooding, an increase in insect pests, the occurrence of new insects and a decrease in the population of natural enemies (Thomson et al., 2010; Atidegla et al., 2017; Zaid et al., 2019; Ngom et al., 2020). Thus, it is necessary to investigate the constraints based on the current climatic, as there are little studies conducted in Niger on the constraints of vegetable crops production and the different management methods used by farmers.

## II. Materials And Methods

***Sampling of surveyed producers***

The sample of farmer surveyed from the Farmers' Organizations s (FOs) working with the Sahel IPM project. Sampling was done on the basis of the number (N) of famers in each site. These samples are 12%, 16% and 14%respectively at Angoual mata, Radi and Djirataoua for the Maradi region. In the Tahoua region, 13% of producers in Doguéraoua, 13% in Guidan Idder and 16% in Tounfafi were surveyed. The face-to-face interviews was done. The questionnaire focused on the following: identification of the farmers, information on vegetable production, constraints of vegetables production, control methods used and future of production. The proportions of respondents per site was determined by using the following formula: **P= n/N*100**.

With P: population, n: number of respondents, N: total number of producers/OPs.

The survey covered vegetable farmers producing at least one of these crops: cabbage, onion, tomato and moringa.

**Sampling of insect**

Plants were sampled in the farmers' fields for insect identification. In each field, five (5) quadrants were established including at four (4) corners of field and one (1) in the center. The surface area of a quadrant was 18 $m^2$ (6 m x 3 m). For the tomato, cabbage and onion crops, five (5) randomly selected plants following the X pattern were used for observations in each quadrant. A total of twenty-five (25) plants were observed in each field. For insect pests of the moringa tree, observations were carried out on twenty-five (25) plants randomly selected from the rows in each plot. A total of 39 fields were used

**Data collection**

***Insect infestation and damage on plants***

Observations were done on the plants within the quadrants, and all aerial organs, leaves and fruit, were inspected. A plant is said to be infested when its aerial organs are altered (perforations, deformations) or when insects or eggs are present on its organs.

Damage was observed on leaves and fruits showing attack sign. The percentage of damage was determined based on the number of leaves or fruits attacked and the total number of

leaves or fruit observed. For fruit, damage due to caterpillar were counted and observed, dedicated and caterpillars were noted if they were present inside. Insects were caught and taken to the laboratory for rearing. The insect identification guide was used to characterize the type of damage per insect species.

***Breeding and identification of insect pests and natural enemies in the laboratory***

Pests caught at the larval stage were reared until adult emergence. They were identified on the basis of a description of their morphological characteristics, using the French Polynesia insect and mite recognition guide (Grandgirard, 2010). The insects were reared at a feeding frequency of 24 hours, which was maintained until their death.

Natural enemies were observed and collected from plants sampled in the plots. They were identified in the laboratory using the same guide.

***Data processing***

Percentage of insect infestation on tomato fruits and cabbage leaves were calculated using the following formula:

$$\text{Percentage of infested leaves} = \frac{\text{Number of infested leaves}}{\text{Total number of infested}} \text{ X } 100$$

$$\text{Percentage of infested fruits} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \text{ X } 100$$

Proportional data were subjected to transformation (Asine) before ANOVA with the formula T=Asine (Racine (V/100).

***Data analysis***

SPSS (20) was used for the various analyses. The Student Newman Keuls test for independent samples was used to compare quantitative data, and the Chi-square test was used to compare qualitative data. Analysis of variance (ANOVA) was performed and the S-N-K test at the threshold of $\alpha = 0.05$.

## III. Results

***Producer characteristics and perceptions***

A total of 86 farmers were surveyed, 43 for each of the two regions. The majority of those surveyed were adults (57%) with an average age of 48 in the Maradi and 46 in the Tahoua region. In terms of level of education, the survey revealed that an average of 94% of producers were literate.

**Major constraints for vegetable production**

Ten (10) constraints to crop production were identified as perceived by farmers in both two regions (Table 1). Insect pests (87.04 to 100%) and diseases (26.92to 41.46%) were the main constraints cited by growers on all crops. On cabbage, mites and low fertility were the secondary constraints reported by vegetable producers. For moringa, mites were mentioned by 26.83 %of respondents as a secondary constraint while low soil fertility was cited in second place by tomato growers.

**Growers' knowledge of insect pests**

Several insect pest species were cited by famers in both two regions on the four (4) crops

(Table 2). The number of pests mentioned on crops did not vary according to region ($p>0.05$) for tomato, cabbage and onion. However, in the case on moringa the insect pest *N. blitealis* was mentioned by only 10% of farmers in the Tahoua compared with 100% in the Maradi (Table 2).

Six (6) insect pests were mentioned on tomato among which H. *armigera was the most fresquent* with 37.5% in Maradi and 33. % in Tahoua. In second place was occupied by *T. absoluta* with 20.55% in Maradi and 21.12% in Tahoua.

In cabbage, six (6) insect pests with the predominance of *P. xylostella* and *B. brassicae* according to 19.16and 15.83% of respondents respectively in the Maradi region. Concerning infestations in the Tahoua region, 28.48% and 22.72% of famers mentioned *P. xylostella* and *B. brassicae* as the main pests.

On the onion crop, farmers counted three (3) species of insect pests, the most important of which were Thrips 60.56±4.57 in Tahoua versus 11.25±3.78% in Maradi. Thus, 14.88±8.63% and 15.69±3.69% of respondents in the Tahoua and Maradi regions mentioned H. undalis as a secondary crop pest.

**Control methods used by growers against insect pests**

Several methods are used by growers to deal with insect pests. Among those surveyed, only 4.65% use no protection method at all. Chemical treatment was mentioned by 100±0% of growers in the Maradi region and by 97.5±2.5% of those in the Tahoua region (Table 3). Biological treatment was mentioned by 16.67±5.82% of growers in Maradi and 32.5±7.5% of those in Tahoua. Few growers mentioned cultivation or mechanical methods (Table 3).

**Pest species recorded in farmers' fields**

The main insect pests identified during observations in the plots belonged to three (3) orders: Lepidoptera, Hemiptera Thysanoptera and a mite (Figure 2). Lepidoptera and hemiptera were the most frequent, accounting for 45.45% and 36.36% of the numbers collected respectively. A total of 9 insect species (*Helicoverpa armigera*, *Tuta absoluta, Hellula undalis, Plutella xylostella, Noorda blitealis, Aphis gossypii, Bemisia tabaci, Nezara viridula, Thrips tabaci*) and one spider species (*Tetranychus urticae)* were recorded. All the insect pest species recorded are comparable between the two regions

**Vegetable crops infestations in producers' fields**

Insect pest infestation levels were identical in both regions.

The highest infestations were noted in cabbage crops, with 93.33% of plants infested. Tomatoes and moringa were moderately infested (69.86% and 50% respectively), while onions were less infested (25.33%) (Figure 3).

**Level of insect pest infestation in farmers' fields**

During observations in growers' fields, seven (7) species of insect pests were identified on the tomato crop, with infestation levels ranging from 4% to 19% (Table 4). Infestation *by B. tabaci* was the highest at 19%, while the lowest infestation of 4% concerned red mite (*T. urticae*) and thrips (*T. tabaci*). On onions, the highest infestation rate of 5.33% concerned *T. tabaci*, compared with 4.67% for *H. undalis*. *P.* xylostella was the main insect pest infesting cabbage crops, with 12.94% of plants infested. This infestation rate was 2 to 3 times higher than that of *H. undalis* on both crops. A single insect pest*, N. blitealis*, was noted on the moringa crop. The average percentage of infestation by this insect was 50%.

**Observations of leaf and fruit damage**

Observations of tomato fruit in the plots revealed damage caused by the noctuid caterpillar *Helicoverpa armigera*. An average of 20.74±1.1 tomato fruits per plant were noted. Also, 2.4±0.16 fruits were attacked, with an average of 2.7±0.20 holes per fruit. An average of 2.58±0.74 caterpillars were recorded per fruit.
It was also noted that 11.57% of fruits were damaged by *H. armigera*.

*Plutella xylostella* damage on infested cabbage leaves was very severe, affecting 60.84% of leaves. Observations revealed that 9% of aerial leaves were perforated by cabbage moth caterpillars per plant.
Defoliant caterpillar damage to moringa plants was 10%.

**Natural enemies of insect's pest of vegetable crops**

During observations in the plots, two (2) species of predatory ladybug were identified:

*Harmonia octomaculata* Fabricius (1781) and *Coelophora inaequalis* Fabricius (1755). Both are aphid predators. The mite *Amblyseius largoensis* Muma (1955) has also been identified on onion and tomato crops. However, no parasitoid species were observed during the study.

**Table 1:** Vegetables crop production constraints according to farmers in the two regions

| Constraints | Cabbage | Moringa | Onion | Tomato |
|---|---|---|---|---|
| Mites | 16.67±6.92 $^{bc}$ | 26,83±7,00 $^{c}$ | 3,72±2,59 $^{c}$ | 14.29±6.00 $^{cd}$ |
| Accessibility | 3,33±3,33 $^{c}$ | 0±0 $^{d}$ | 0,04±0,02 $^{c}$ | 8,57±4,80 $^{d}$ |
| Flow | 0±0 $^{c}$ | 4,88±3,40 $^{d}$ | 5,56±3,14$^{c}$ | 0±0 $^{d}$ |
| Fertility | 21.43±7.89 $^{bc}$ | 9,76±4,69 $^{d}$ | 31,48±6,38 $^{b}$ | 24.39±6.79 $^{bc}$ |
| Insects | 100±0 $^{a}$ | 100±0 $^{a}$ | 87,04±4,61 $^{a}$ | 100±0 $^{a}$ |
| Diseases | 26,92±8,87 $^{b}$ | 41,46±7,79 $^{b}$ | 37,74±6,72 $^{b}$ | 37,14±8,28 $^{b}$ |
| Rodents | 3,33±3,33 $^{c}$ | 0±0 $^{d}$ | 5,56±3,14 $^{c}$ | 6.06±4.21 $^{cd}$ |
| Seeds | 20±7.42 $^{bc}$ | 4,88±3,40 $^{d}$ | 14,81±4,88 $^{c}$ | 14.29±6.00 $^{cd}$ |
| Low T° | 6,67±4,63 $^{c}$ | 0±0 $^{d}$ | 9,28±3,98 $^{c}$ | 2,86±2,85 $^{d}$ |
| High T° | 6,67±4,63 $^{c}$ | 2,44±2,43 $^{d}$ | 5,56±3,14 $^{c}$ | 5.88±4.09 $^{cd}$ |
| ANOVA | F= 29.25; p<0.001 | F= 61.92; p< 0.001 | F= 38.79; p< 0.001 | F= 30.98; p< 0.001 |

**Table 2**: Vegetable crop pests listed by producer in both study regions

| Crops | Insect pests | Proportion of responses in Maradi (%) | Proportion of responses in Tahoua (%) | Chi-square tests |
|---|---|---|---|---|
| Cabbage | *Plutella xylostella* | 19.16±3.63 ns | 28.48±12.42 ns | $X^2$ = 2.00; p= 0.57 |
| | *Hellula undalis* | 8.33 ns | 15.34±4.15 ns | $X^2$ = 4.00; p=0.26 |
| | *Mamestra brassicae* | 8.33 ns | 5.88 ns | $X^2$ = 2.00; p= 0.15 |
| | *Brevicoryne brassicae* | 15.83±9.16 ns | 22.72±3.36 ns | $X^2$ = 5.00; p= 0.28 |
| | *Phyllotreta nemorum* | | 11.76 ns | ---- |
| Moringa | *Pieris brassicae* | | 5.88 ns | ---- |
| | *Noorda blitealis* | **100±0*** | **10*** | $X^2$ = ; p<0.04 |
| | *Tetranychus urticae* | 25.69±4.22 ns | 9.19±3.30 ns | $X^2$ = 5.00; p= 0.28 |
| Onion | *Thrips tabaci* | 11.25±3.78 ns | 60.56±4.57 ns | $X^2$ = 6.00; p= 0.30 |
| | *Hellula undalis* | 15.69±3.69 ns | 14.88±8.63 ns | $X^2$ = 5.00; p= 0.20 |
| | *Helicoverpa armigera* | 6.25 ns | 13.25±5.24 ns | $X^2$ = 1.33; p= 0.51 |
| Tomato | *Helicoverpa armigera* | 37.5±15.77ns | 33.01±6.95 ns | $X^2$= 6.00; p= 0.30 $X^2$ = 4.00; |
| | *Tuta absoluta* | 20.55±2.42 ns | 21.12±9.14 ns | p=0.4 |
| | *Aphis gossypii* | 9.16±1.73 ns | 10.88±0.88 ns | $X^2$ = 5.00; p= 0.28 |
| | *Thrips tabaci* | 20 ns | 9.19±3.30 ns | $X^2$ = 2.00; p=0.36 |
| | *Bemisia tabaci* | 9.58±2.91 ns | 11.25±1.25 ns | $X^2$ = 3.00; p=0.2 |
| | *Tetranychus urticae* | 19.16±5.83 ns | 9.19±3.30 ns | $X^2$ = 4.00; p= 0.26 |

**ns:** not significant; *: significant

**Table 3:** Control methods used by growers against crop pests in both regions

| Methods | Maradi (%) | Tahoua (%) | Chi-square |
|---|---|---|---|
| Biological method | 16,67±5,82$^{b}$ | 32,5±7,5$^{b}$ | 24.39±4.77$^{ns}$ |
| Chemical method | 100±0$^{a}$ | 97,5±2,5$^{a}$ | 98.78±1.22$^{ns}$ |
| Cultivation method | 4,76±3,32$^{c}$ | 12,5±5,29$^{c}$ | 8.54±3.10$^{ns}$ |
| Mechanical method | 0±0 $^{c}$ | 2,5±2,5$^{c}$ | 1.22±1.22$^{ns}$ |
| **Anova** | F= 196.25; p<0.001 | F= 75.331; p<0.001 | |

**ns:** not significant

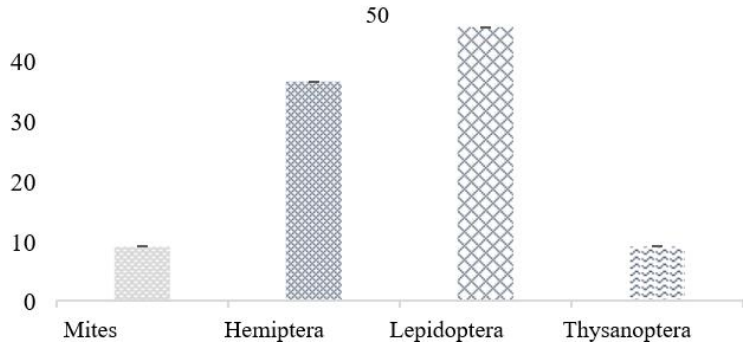


Figure1: Proportion of per category pest or insect Order in respondents' plots

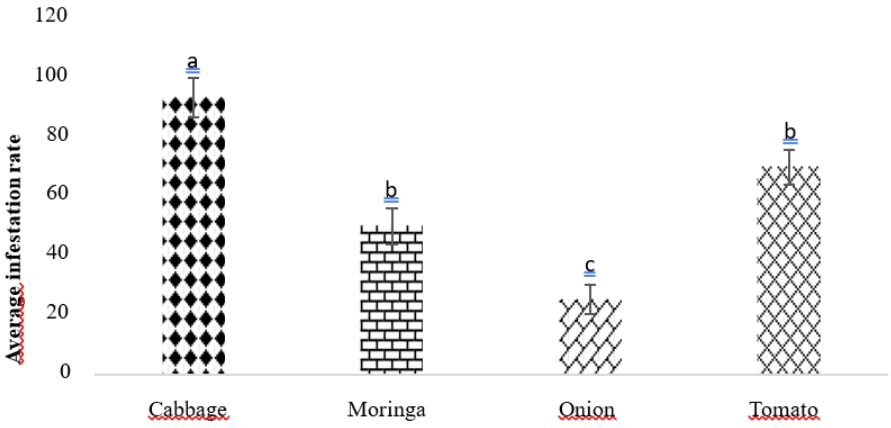


**Figure 2: Insect pest** Infestation rate on vegetable crops in growers' plots

**Table 4:** Insect pest infestation rate of four crops recorded in farmers' fields

| Crops | Insect pests | Average Infestation rate |
|---|---|---|
| **Tomato** | *Helicoverpa armigera* | 4, 55 |
| | *Tuta absoluta* | 6 |
| | *Aphis gossypii* | 14,57 |
| | *Thrips tabaci* | 4 |
| | *Bemisia tabaci* | 19 |
| | *Tetranychus urticae Nezara viridula* | 4 |
| | | 7,5 |
| **Cabbage** | *Plutella xylostella Hellula undalis* | 12,94 4 |
| **Onion** | *Thrips tabaci Hellula undalis* | 5, 33 4,67 |
| **Moringa** | *Noorda blitealis* | 50 |

## IV. Discussion

***Producer characteristics***

The survey involved 86 growers, only 19% of whom were women. The high rate (94%) of literate producers noted could be linked to the influence of a large number of growers with Coranic education. This rate

is close to the 87% reported in a similar survey, while Zabeirou et al. (2018) in a survey in the Madaoua area reported a ratio of 33% of literate producers.

***Producers' perception***

The survey revealed that vegetable crop production is influenced by ten (10) constraints. Thus, 87 to 100% of growers mentioned insect pest attacks on the 4 crops. Similarly, physical observations in the production plots revealed insect pest infestation rates close to those reported by growers.

This high insect pest pressure on crops could be linked to cropping practices (crop residue management, lack of crop rotation) and the effects of climate change (rising temperatures). These results corroborate those reported by (Kanda et al., 2014) in Togo and (Olaniran et al., 2014) in Nigeria, where 74 to 78% of growers reported entomological constraints on vegetable crop production. Diseases were also cited as the main constraint on the production of these crops, a trend also reported in the work of (Mondedji et al., 2015) in Togo. Mites were noted only on moringa and tomato crops. This corroborates the assertions of Haougui et al. (2017), who cited them as the main pests of these two crops in Niger.

Respondents reported 13 species of insect pests attacking the four (4) crops surveyed. This number was higher than the 9 insect species and one mite observed in the plots. These results show that arthropods are a major constraint for vegetable crops. The information provided by respondents indicates their high level of knowledge of pests.

The proportion of species belonging to the order Lepidoptera was 1 to 5 times higher than those of other orders. This confirms the perception of growers during interviews. This could be explained by their rapid reproductive capacity and their adaptation to environmental conditions. This high proportion of Lepidopteran caterpillars has been reported in several similar studies by Imam *et al.* (2010) in Nigeria and Kanda *et al.* (2014) in Togo.

As regards the control methods used, the chemical method based on synthetic pesticides is the most widely applied by a large number of growers in both regions. The reasons for excessive use of these chemicals could be due to their ability to act immediately on pests, reduce harvest losses and increase yields. These reasons were also reported from similar surveys by Bafada *et al.,* (2019) on vegetable ing sites in Niamey, Niger and then by Mondedji *et al.,* (2015) in Togo.

The use of biopesticides was mentioned by 17% to 33% of growers in both regions. This may be explained by the low availability and small number of private units producing and selling this input.

***Vegetable crops' infestations in growers' fields***

Data from field observations confirm the results of surveys with vegetable producers. On cabbage, tomato and moringa crops, infestations by various pests ranged from 50 to 93.33%. For onions, 25.33% were infested by two pests. Seven (7) insect species were recorded on tomatoes and two (2) on cabbage, moringa and onions. However, during interviews, growers cited six (6) species on cabbage crops. This shows that crops are differently susceptible to pests. In the case of onions, the survey results also showed low pest infestation. This low sensitivity to pests could be explained by the secretion of pest-repellent substances, as demonstrated by (Arnault et al., 2005).

*B. tabaci*, which lives in colonies, is the most frequent species (19%) on tomatoes noted during observations. This result contradicts the perception of growers, the majority of whom cited it as a secondary pest. Several studies in Niger reported an infestation rate of 70% of tomato plants by this insect (Abdoul Habou et al., 2016) and in Ghana where an infestation ratio of 95.5% of plants was noted (Ofori et al., 2014).

Tomato moth (*H. armigera*) and tomato leafminer *(T. absoluta*) were rated low at 4.55% and 6% respectively. Yet these species have been heralded by growers as the main insect pests that heavily infest tomato crops. Previous studies in other areas such as Morocco, Ghana, Senegal and Côte d'Ivoire have reported high infestation rates ranging from 70% to 91.8% (Ouardi 2011; Diatte et al., 2017; Bal et al., 2022; Ossey et al., 2023).

For cabbage*, P. xylostella* is the most frequent and important pest with an infestation of 12.94%. This result is comparable to growers' perception and that of Djomaha and Ghogomu (2016), who reported 0-50% infestation in Cameroon.

Onions were lightly infested with thrips and *H. undalis*. These pests are more important in Burkina Faso, where infestation rates of between 31 and 95 are reported (Savadogo et al., 2020). An infestation rate of 50% was noted in the moringa crop by the defoliator caterpillar (*N. blitealis*), this high rate confirming growers' perception of the level of loss caused by the pest.

This percentage is comparable to the 60.20% reported by Kabre et al. (2020) in Burkina Faso.

The percentage of fruit attacked by *H. armigera* of 11.57% obtained on the tomato crop could be linked to the low density of caterpillars on the plants. This rate is lower than that obtained by Ossey et al. at 70.24 ± 5.17% (2023)

The 60.84% of cabbage leaves damaged by *Plutella xylostella* could be due to the species' ability to develop resistance to pesticides. Respondents also reported the caterpillar's resistance to several chemicals. These results are comparable with those of (Ouali N'Goran et al., 2021) who obtained 88.15% of leaves attacked by *P. xylostella* in treated plots.

The 10% damage recorded on moringa by the pest *Noorda blitealis* is very low compared to the 100% damage rate assessed by Ratnadass et al., (2011) in Niger.

Concerning natural enemies, two species of aphid-predatory ladybugs*, H. octomaculata* and *C. inaequalis*, plus a mite*, A. largoensis,* were identified. However, no parasitoids were identified. In contrast to the studies by Zappala et al, (2013) who identified 20% of predators and 80% of parasitoids of *T. absoluta*. The absence of these parasitoids could be justified by the abusive use of pesticides, a common practice in the area, which causes damage to beneficial insects; these effects of pesticides on antagonists have also been reported by Mano et al. (2023) in Burkina Faso.

This study identified the main constraints of tomato, cabbage, onion and moringa crops production, as well as their impacts, the most commonly applied management method and natural enemies, through interviews with vegetable crops and physical observations in growers' fields. The results of the study show that few women are involved in vegetable crops production, a significant number of growers are literate and the majority of these growers are adults. Insect pests, diseases, fertilization and seeds are the main constraints to vegetable crops production at the production sites. Among biotic constraints, caterpillars were the most frequently observed, with important impact on crops.

*Bemisia tabaci*, *P. xylostella T. tabaci* and *N. blitealis* were the main pests of tomato, cabbage, onion and moringa respectively. It was found that the chemical method was the most widely used by growers, and vegetable producers started to adopt the biological method in managing entomological constraints. Two species of aphid natural enemies were identified, including *H. octomaculata* and *C. inaequalis*, and one mite*, A. largoensis*.

## V. Conclusion

These results will enable contribute for implementation of integrated management methods to improve the productivity of vegetable crops.

## VI. Acknowledgement

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