

## Fluctuation of populations of *Helopeltis* spp. (Hemiptera: Miridae) major insect pests of the cashew tree (*Anacardium occidentale* L.) in the Hambôl region (Central-North Côte d'Ivoire)

Kouadio Koffi Franck Stanislas<sup>1</sup> and Ouali N'Goran San-Whouly Mauricette<sup>1,2</sup>

<sup>1</sup>Laboratory of Natural Environments and Biodiversity Conservation, Félix Houphouët-Boigny University, 01 BP V34 Abidjan 01, Côte d'Ivoire

<sup>2</sup>African Center of Excellence on Climate Change, Biodiversity and Sustainable Agriculture, Félix Houphouët-Boigny University, 01 BP V34 Abidjan 01, Côte d'Ivoire

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**ABSTRACT:** The damage caused by mirids of the genus *Helopeltis* to cashew orchards is one of the major concerns of cashew nut producers in Côte d'Ivoire. This study was conducted to determine the periods of high infestation of these pests in relation to the impact of abiotic and biotic factors. The study was conducted from 2020 to 2022 in three orchards in the Hambôl region in north-central Côte d'Ivoire. Direct and trap captures were made on 50 trees per orchard every three days. Temperature, relative humidity, rainfall and cashew tree phenology were recorded. The results revealed that *Helopeltis* is present in orchards almost all year round, with a single period of high population density. This period extends from July to January, with the peak observed in December. Population dynamics are positively correlated with relative humidity and negatively correlated with temperature. Population peaks were recorded during the flowering stage of the cashew tree. Knowledge of the fluctuation of *Helopeltis* populations could guide the choice of appropriate periods and means for an efficient control strategy.

**KEYWORDS:** population, fluctuation, *Helopeltis*, cashew tree, biotic factors, Phenology stages, Côte d'Ivoire.

### 1 INTRODUCTION

The cashew tree has become one of Côte d'Ivoire's main cash crops and plays a key socio-economic role, with national production reaching 1.2 million tonnes in 2023 [1]. The main cashew nut production areas in Côte d'Ivoire are the North, Centre, Centre-West, North-East and North-West [2]. The Hambôl region in the Centre-North produces an average of 102.284 tonnes of cashew nuts each year. It is the second largest cashew nut producing region in Côte d'Ivoire after the Béré region [3]. Cashew cultivation faces several biotic constraints, notably attacks by harmful insects [4], [5]. Of all the harmful insects that infest cashew trees, mirids of the genus *Helopeltis* are one of the major concerns for producers. These are phytophagous hemipterans whose larvae and adults feed on tender young shoots, inflorescences and immature fruits such as nuts and apples [6], [7]. According to [8], in India, annual losses due to attacks by *Helopeltis* spp. can reach 40 to 50% of the yield. The main means of controlling these pests remains chemical control. In Côte d'Ivoire, treatment periods are based on seasonal variations in pest populations [9]. However, due to current climate disturbances, seasonal variations in pests are undergoing major changes. It was necessary to update information on the population dynamics of mirids of the genus *Helopeltis* in the main cashew nut producing regions. It was in this context that the present study was conducted in the Hambôl region, with the aim of determining the periods of high population abundance of *Helopeltis* spp. Specifically, the aim was to monitor *Helopeltis* populations in cashew orchards and assess the effect of climatic parameters.

### 2 MATERIALS AND METHODS

#### 2.1 STUDY AREA

The study was conducted from December 2020 to November 2022 in the Hambôl region in north-central Côte d'Ivoire, specifically in the town of Touro. Three orchards served as study sites in this town. Site 1, located in Foro-Foro, is a 14-year-old orchard. Site 2, which

is six years old, is located 3 km from the village of Touro, and site 3, located in the village of Tôlesso, 7 km from Touro, is 10 years old. All the orchards are smallholder plantations, each covering an area of 2.5 ha.

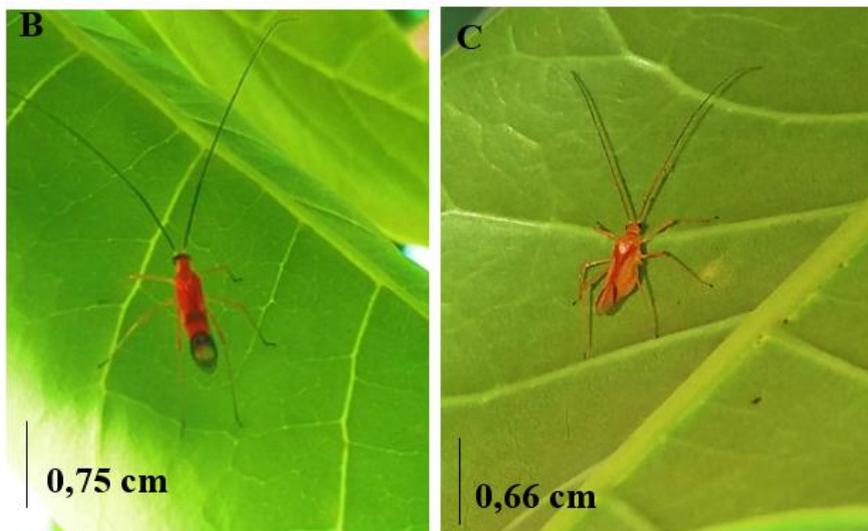
## 2.2 MATERIALS

### 2.2.1 BIOLOGICAL MATERIAL

The plant biological material consists of cashew trees from selected orchards (Figure 1). The orchards are composed of random plant material. The animal biological material consists of Hemiptera of the genus *Helopeltis* (Figure 2). Figures 1 and 2 show plant and animal biological material respectively.



**Fig. 1.** *Plant biological material*



**Fig. 2.** *Animal biological material*

### 2.2.2 TECHNICAL EQUIPMENT

#### CAPTURE EQUIPMENT

Insects were captured using traps, namely coloured containers filled with soapy water, sticky traps and sweep nets (Figure 3). Figure 3 shows the equipment used to capture *Helopeltis* individuals.



Fig. 3. Capture equipment

#### PRESERVATION EQUIPMENT

Insect samples captured during the study are preserved in 96° alcohol contained in 50 ml plastic pill bottles. The pill bottles are then labelled with the date and place of collection.

#### CLIMATE RECORDING EQUIPMENT

An EL-USB-2 data logger was used to automatically record the temperature (accuracy 1°C), dew point and relative humidity (accuracy 3.5%) in each orchard. Rainfall at the various sites was measured using direct-reading rain gauges (Figure 4). Figure 4 shows the data collection equipment.



Fig. 4. Climate recording equipment

## 2.3 METHOD

### 2.3.1 EXPERIMENTAL DEVICE FOR SAMPLING INDIVIDUALS

At each site, the experimental device for sampling individuals was set up using the transect method, following the two diagonals of the field [10]. On each transect, five (05) blocks were determined, four (04) at the extremitys and one in the centre (Figure 5). Each block consists of 25 cashew trees, and among these 25, 10 trees are chosen at random, for a total of 50 trees per site. All selected trees were

numbered using red oil paint. Traps were placed on these selected trees at a rate of one trap per cashew tree (five coloured traps and five glue traps). During collection, individuals observed on these trees were captured using a sweep net.

### 2.3.2 POPULATION MONITORING

At each experimental site and in each block, the trees were inspected every three days from 25 November 2020 to 30 November 2022. All individuals captured by traps and those captured directly using the sweep net were collected. They were placed in pill boxes containing 96° alcohol. The site, date of capture and number of individuals captured were marked on the collection boxes and on the survey sheet. The individuals were counted by species. The number of males and females captured was noted and the average number of individuals per month was calculated. Abiotic parameters, namely temperature, relative humidity and rainfall, were recorded. The phenological stages of the cashew tree were also noted during the various captures. The stages are vegetative growth (pre-flowering and post-harvest), flowering and fruiting. Figure 5 shows the experimental device used in the study.

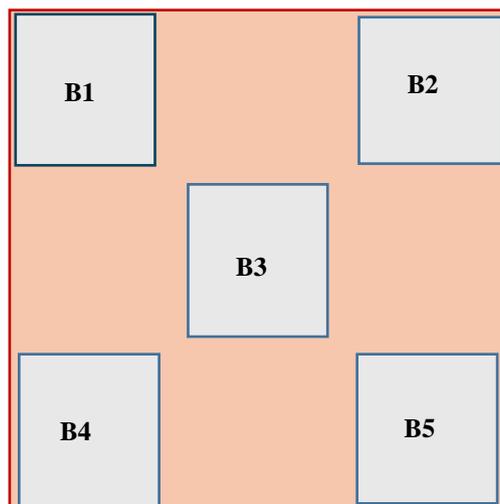


Fig. 5. Experimental device

## 3 RESULTS

### 3.1 FLUCTUATION IN HELOPELTIS SPP POPULATIONS FROM DECEMBER 2020 TO NOVEMBER 2022

The results showed a cyclical trend over the 24 months of the study. In total, only six individuals of the *Helopeltis* genus were observed during the month of April in both years of the study. This number increased slightly over the next two months, from 37 individuals in May to 85 individuals in June. From June onwards, numbers almost doubled over the following three months, from 152 individuals in July to 254 individuals in August and then to 509 individuals in September. From October onwards, numbers increased significantly, from 704 individuals captured in October to 937 individuals in November, reaching a peak in December with 1,606 individuals captured. From January onwards, a decline in numbers was observed. With 289 individuals captured in January, the number of *Helopeltis* species fell to 92 individuals in February and then to 20 individuals captured in March.

Across all sites, a total of 4,691 individuals were captured in 24 months in cashew orchards. 2,514 individuals of *Helopeltis schoutedeni* were captured compared to 2,177 individuals of *Helopeltis corbisieri*, representing respective rates of 53.59% and 46.41%. However, analysis of variance revealed no significant difference between these two numbers ( $p > 0.05$ ).

Site 1 recorded the highest average number of individuals in the blocks with 2,652 individuals, followed by site 3 (1,331 individuals) and site 2 (708 individuals). Comparison of the average numbers of *Helopeltis* individuals per site revealed a significant difference between sites 1 and 2 ( $p < 0.05$ ). However, no significant difference was observed between sites 1 and 3 or between sites 2 and 3 ( $p > 0.05$ ).

During year 1 (1st December 2020 to 30th November 2021), the average number of individuals was 2,729, compared to 1,962 individuals during the second year of the study (1st December 2021 to 30th November 2022). However, analysis of variance reveals a non-significant difference between these two populations ( $p > 0.05$ ) (see Figure 6). Figure 6 shows the average numbers of *Helopeltis* individuals by site and month of collection.

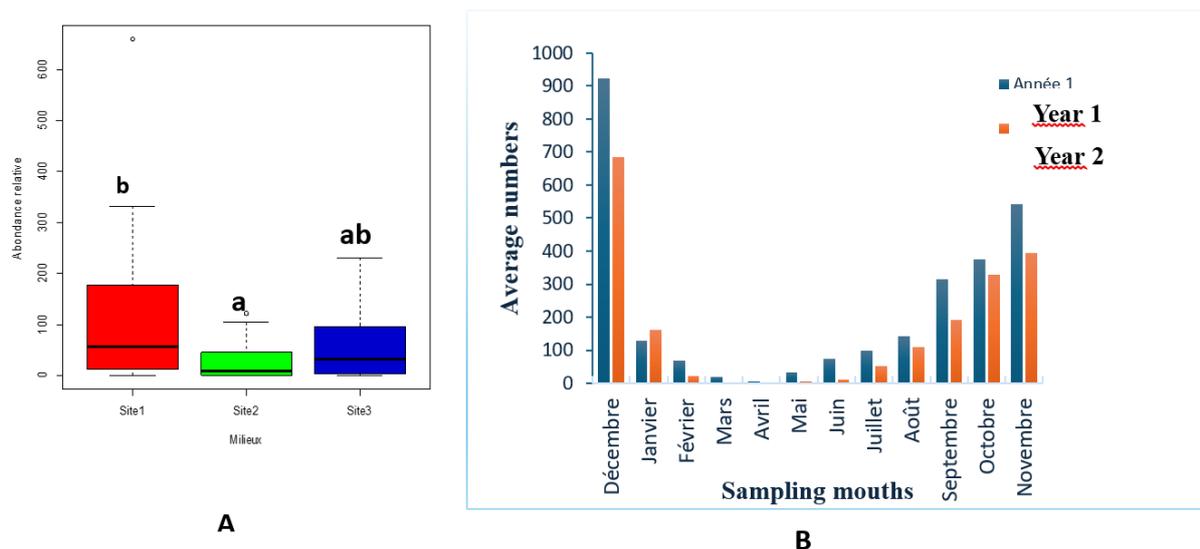


Fig. 6. Average numbers of *Helopeltis* spp. according to the three sites (A) and the two years of collection (B)

Table 1. Correlation between the average numbers of individuals captured according to capture sites

	Estimation standard	Error	t-value	Pr(> t )	Test de Tuckey
Site 1- Site 2	-81,13	24,13	-3,362	0,0036	**
Site 1- Site 3	-55,04	24,13	-2,281	0,0655	Ns
Site 2- Site 3	26,08	24,13	-1,081	0,0529	Ns

Tuckey test at the 5% threshold: '\*\*\*':  $p < 0,001$ ; '\*\*':  $p < 0,01$ ; '\*':  $p < 0,05$ ; ':  $p < 0,1$

### 3.2 INFLUENCE OF ABIOTIC FACTORS ON FLUCTUATIONS IN HELOPELTIS SPP POPULATIONS

#### RAINFALL

The results of this study revealed that population levels and rainfall fluctuate in the same direction. Indeed, analysis of variance showed a positive but non-significant correlation between population fluctuations and rainfall ( $p > 0.05$ ). In general, the number of individuals of the genus *Helopeltis* increases from May onwards after the first rains. This number increases slowly, from 37 individuals in May to 254 individuals in August. The number of individuals collected then increases significantly between September and October, from 509 individuals in September to 704 individuals in October. This period corresponds to the rainy season in the Hambôl region. In addition, a more significant increase in the population level of individuals of the genus *Helopeltis* is observed, from 937 individuals in November to 1,606 in December. The peak was recorded in December at the beginning of the dry season when rainfall was moderate (Figure 7).

#### TEMPERATURE

This study observed that population and temperature fluctuate in opposite directions ( $r = -0.31$ ). Indeed, analysis of variance showed a significant negative correlation between fluctuations in *Helopeltis* populations and temperature ( $p < 0.05$ ). High population levels were observed from August to October when temperatures were below 25°C (Figure 7). The highest average numbers of *Helopeltis* individuals captured were recorded during months with average temperatures between 25 and 27°C.

#### RELATIVE HUMIDITY

The population level of individuals of the genus *Helopeltis* and relative humidity change in the same direction ( $r = 0.08$ ). Indeed, analysis of variance showed a positive but non-significant correlation between population fluctuations and relative humidity ( $p > 0.05$ ). In general, the insects appear gradually after the first rains in May and persist when humidity is above 80%. However, there is a decrease until the insects disappear almost completely when humidity is below 80% (Figure 7). Analysis of the influence of humidity on the fluctuation of *Helopeltis* spp. revealed that high relative humidity values are favourable for adult development. Conversely, low humidity levels are unfavourable. Figure 7 shows the average numbers of *Helopeltis* individuals according to abiotic parameters.

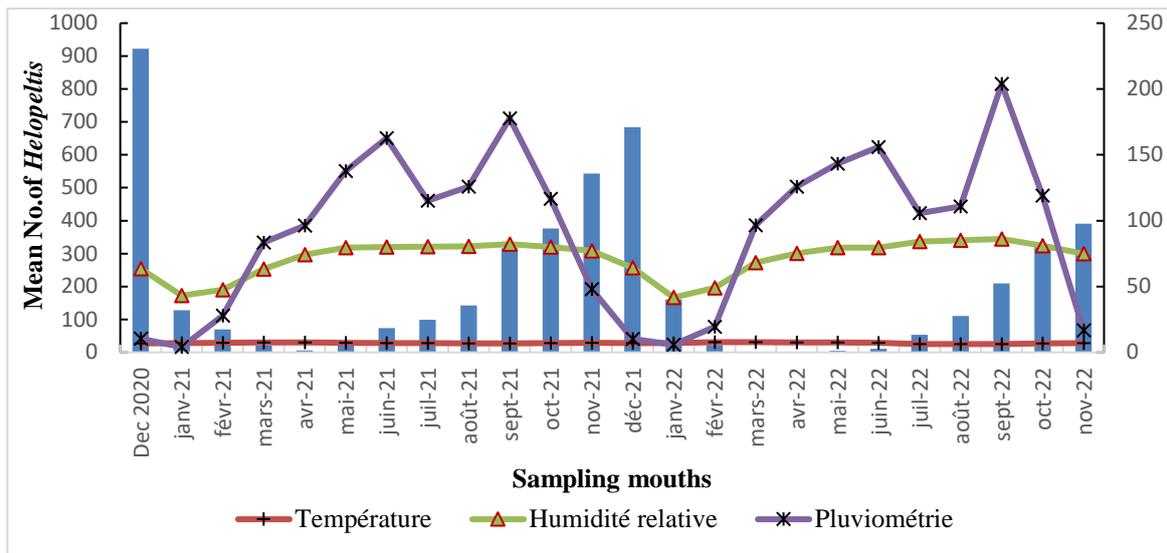


Fig. 7. Population fluctuation of *Helopeltis* spp. as a function of abiotic factors

3.3 INFLUENCE OF BIOTIC FACTORS ON FLUCTUATIONS IN HELOPELTIS SPP. POPULATIONS

The different phenological stages of the cashew tree are post-harvest vegetative growth, pre-floral vegetative growth, flowering and fruiting. These four phases are observed from May to August, September to November, December to January and February to April, respectively.

In the Hambôl area, from January to early May, a gradual decrease in the population of *Helopeltis* spp. was observed in orchards, even tending to disappear in April. The number of individuals captured fell from 289 in January to only six (6) in April. This period corresponds to the fruiting phase of the cashew tree. During the vegetative stage, which lasts from late May to October, an increase in the population of *Helopeltis* spp. is observed, ranging from 37 individuals in May to 704 individuals in October. This population first increases slightly from May to August, which corresponds to leafing (post-harvest vegetative growth), and then increases more sharply from September to October during the pre-flowering vegetative stage. From November to December, the population level of *Helopeltis* spp. increases sharply from 937 individuals in November to 1,606 in December. This period corresponds to the flowering stage of the cashew tree (Figure 8). The same trend was observed during the two years of the study. Figure 8 shows the evolution of the *Helopeltis* population level according to the phenology of the cashew tree.

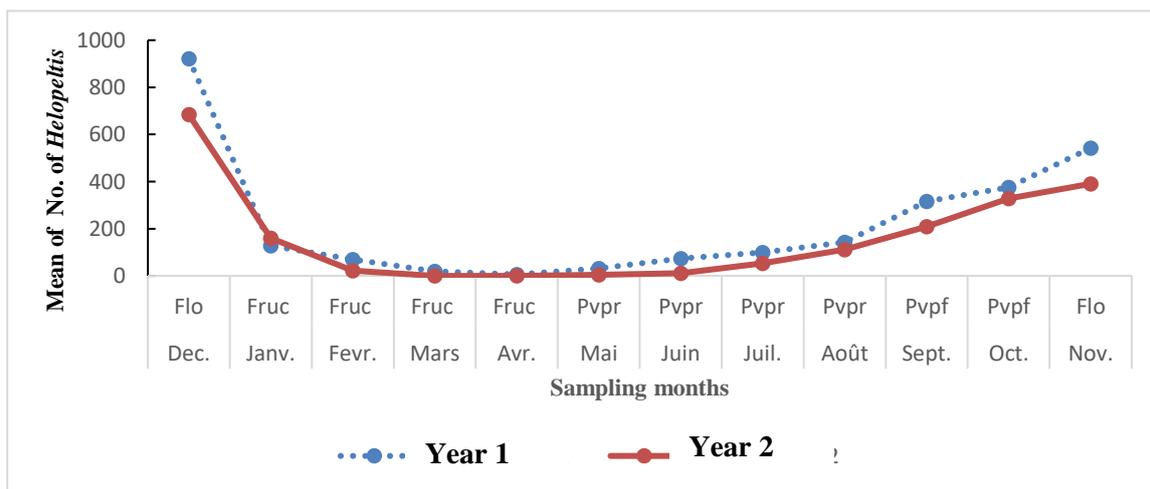


Fig. 8. Population fluctuation of *Helopeltis* spp. according to the phenological stages of the cashew tree

Flo: flowering; Fruc: fruiting; Pvpr: vegetative growth post-harvest; Pvpf: vegetative growth pre-floral

#### **4 DISCUSSION**

The variation in the average number of individuals captured depending on the site could be explained by the difference in tree size from one orchard to another due to differences in age, the level of attacks and the maintenance of the plots prior to the study. Site 1 is older and therefore has large cashew trees with closed crowns bearing more young leaf buds, which are the preferred food source of *Helopeltis* spp. The average temperatures of 27°C and average relative humidity of over 70% recorded in these orchards are factors that favour the development of the insect. Similar results were obtained by Akessé et al. [11] on *Diastocera trifasciata*, a major pest that feeds on cashew trees in the Gbêkê region in central Côte d'Ivoire. These results also corroborate those of Nyukuri et al. [12], who noted that in Kenya and on tea plants, *Helopeltis* spp. feed more on young leaves.

The reduction in *Helopeltis* spp. populations from the first to the second year is thought to be linked to the fact that collections significantly reduce the number of individuals that are likely to reproduce. Several authors have reported this. In Benin, Agboton et al. [13] reported that *Helopeltis* spp. population levels fluctuated from year to year in orchards in central and northern Benin.

The population peaks recorded at the end of the rainy season when rainfall is moderate are thought to be linked, on the one hand, to the morphology of the insect, namely its small size, which means that during heavy rainfall, some individuals are washed away, and, on the other hand, to the insect's development cycle, which is longer when humidity is very high. Similar observations have been made in Côte d'Ivoire, specifically in cocoa cultivation, by [14] in the Méagui region and [15] in the Haut-Sassandra region. According to these authors, this pest is observed throughout the year, with a peak recorded in July in Méagui and in September in Haut-Sassandra, a period marking the beginning of the short dry season.

The decline in population levels from December onwards, leading to their near disappearance, is thought to be due to the gradual rise in temperature, which is unfavourable to larvae and adults. This temperature level exceeds their activity and survival threshold. According to [9] and [15], in the Indénié-Djuablin and Haut-Sassandra regions, respectively, in cocoa farming, the population level of mirids decreased as the temperature increased. Reference [16] also mentioned that the influence of temperature on insect abundance is more noticeable when the lower and upper development thresholds are exceeded, causing insect mortality.

The abundance of adults during the flowering stage of the cashew tree is thought to be due, on the one hand, to the reproductive behaviour of the species, more specifically the availability of preferred egg-laying sites. Flowering provides more egg-laying sites, such as young flower buds and panicles. This could explain why population levels begin to rise from the onset of leafing, with the appearance of new tender leaves. These results corroborate those of [17]. According to these authors, female *Helopeltis schoutedeni* prefer to lay their eggs in young cashew fruits, young buds and panicles. This development can also be explained by physiological changes in the cashew tree, namely the composition of the sap, which is the primary food source for *Helopeltis* spp. at different stages of the host plant's development. According to [9], the population level of mirids increases just after the rainy season, when the sap of plants is rich in water.

#### **5 CONCLUSION**

The study of fluctuations in species of the genus *Helopeltis* revealed cyclical and seasonal patterns. The insects are present in orchards almost all year round, with a single period of high population density. This period extends from July to January, with the peak observed in December. From June onwards, numbers gradually increase until reaching their peak in December. From January onwards, a decline in numbers is observed, until they are virtually eliminated between February and April. A negative correlation was observed between temperature and the population level of *Helopeltis* spp. Relative humidity, on the other hand, was positively correlated with the population level of *Helopeltis* spp.

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#### **REFERENCES**

- [1] CCA (Conseil du Coton et de l'Anacarde), 2024, [Online] Available: <https://www.conseilcotonanacarde.ci/campagne-2023-2024>. (09 september 2025).
- [2] CCA (Conseil du Coton et de l'Anacarde) 2014, [Online] Available: <https://www.conseilcotonanacarde.ci/volume-commercialise>. (04 June 2021).

- [3] CCA (Conseil du Coton et de l'Anacarde), 2021, [Online] Available: [https://www.conseilcotonanacarde.ci/campagne\\_2020-2021](https://www.conseilcotonanacarde.ci/campagne_2020-2021). (15 June 2023).
- [4] Ouali-N. S.-W.M., Akessé E.N., Ouattara G.M. & Koné D., Process of Attack on Cashew Tree Branches by *Diastocera trifasciata* (Coleoptera: Cerambycidae) and the Relationship between These Attacks and the Phenological Stages in the Gbèkè Region (Central Côte d'Ivoire), *Insects*, 11 (8). pp. 456-466, 2020.
- [5] Kouadio K.F.S., Akessé E.N., Ouali N'goran S.-W.M. & Koné D., Distribution et dégâts de *Diastocera trifasciata* (Coleoptera: Cerambycidae) et de *Apate terebrans* (Coleoptera: Bostrichidae), insectes ravageurs de l'anacardier en Côte d'Ivoire, *Journal of Applied Biosciences*, (186), pp. 19588-19600, 2023.
- [6] Mandal, R. C., Cashew production and processing technology, India *Agrobios*, 195p, 2000.
- [7] Dwomoh E. A., Ackonor J. B. & Afun J. V. K., Survey of insect species associated with cashew (*Anacardium occidentale* Linn.) and their distribution in Ghana. *African Journal of Agricultural Research*, 3 (3), pp.205-214, 2008a.
- [8] Saroj P.L. Bhat, P. S. & Srikumar, K. K., Tea mosquito bug (*Helopeltis* spp.) - A devastating pest of cashew plantations in India: A review. *Indian Journal of Agricultural Sciences* 86 (2), pp.151-62, 2016.
- [9] Kouamé N. N., N'Guessan F. K., N'Guessan H. A., N'Guessan P. W. & Tano, Y., Variations saisonnières des populations de mirides du cacaoyer dans la région de l'Indénié-Djuablin en Côte d'Ivoire. *Journal of Applied Biosciences* (83), pp.7595-7605, 2014.
- [10] Ouédraogo S. N., Dynamique spatio-temporelle des mouches des fruits (Diptera, Tephritidae) en fonction des facteurs biotiques et abiotiques dans les vergers de manguiers de l'ouest du Burkina Faso, Thèse de Doctorat, Université Paris Est, 156p, 2011.
- [11] Akessé E. N., Ouali-N'Goran S.-W. M., N'Dépo O. R. & Tano D. K. C., Population fluctuation of *Diastocera trifasciata* (Fabricius, 1775) (Coleoptera: Cerambycidae), cashew branches girdler in the Brobo locality (Central Côte d'Ivoire). *Journal of Entomology and Zoology Studies*, 6 (5), pp.1064-1070, 2018.
- [12] Nyukuri R. W., Kirui S. C., Wanjala F. M. E., Ogema V. & Cheramgoi E., Effect of varying population and feeding preferences of *Helopeltis schoutedeni* Reuter (Hemiptera: Miridae) on parts of tea shoot (*Camellia sinensis* Kuntze) in Kenya, *Peak Journal of Food Science and Technology*, 1 (1), pp.1-5, 2013.
- [13] Agboton C., Onzo A., Ouessou I., Goergen G., Vidal S., Tamò M., Insect Fauna Associated With *Anacardium occidentale* (Sapindales: Anacardiaceae) in Benin, West Africa. *Journal of Insect Science*. 14 (229), pp.1-11, 2014.
- [14] Guessan-Bi T. K., Kouame K. L., Kwadjo K. É., Kra K. D. & Doumbia M., Abundance and Dynamics of the Main Heteroptera Pests of Cocoa Tree in the Orchards of the Department of Méagui (South-West, Côte d'Ivoire), *Journal of Agricultural Science*, 14 (8), pp. 40-48, 2022.
- [15] Kouamé, N. N., N'Guessan, F. K., N'Guessan, H. A., N'Guessan, P. W. & Tano, Y., Variations saisonnières des populations de mirides du cacaoyer dans la région du Haut-Sassandra en Côte d'Ivoire, *Journal of Animal & Plant Sciences*, 25 (1), pp.3787-3798. 2015.
- [16] Marchioro C. A. & Foerster L. A., Biotic factors are more important than abiotic factors in regulating the abundance of *Plutella xylostella* L. in Southern Brazil. *Revista Brasileira de Entomologia*, 60 (2016), pp.328-333, 2016.
- [17] Dwomoh EA, Afun JVK, Ackonor J.B., Laboratory studies of the biology of *Helopeltis schoutedeni* Reuter (Hemiptera: Miridae), a major sucking pest of cashew (*Anacardium occidentale* Linn.), *J. Cell Anim. Biol.* 2 (3), pp. 055-062, 2008 b.