INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 18, No. 6, p. 166-175, 2021

RESEARCH PAPER OPEN ACCESS

Influence of cashew farms age on the damage of *Zographus regalis* (Browning, 1776) (Coleoptera: Cerambycidae) and Termites in West of Côte d'Ivoire

Dohouonan Diabaté[1*], Tenon Coulibaly[2], Yao Tano[3]

[1]*Département Agronomie et foresterie, UFR Ingénierie Agronomique Forestière et Environnementale, Université de Man, BP 20 Man, Côte d'Ivoire*

[2]*Département de Biologie Animale, UFR Sciences Biologiques, Université Péléforo Gon Coulibaly Korhogo, BP 1328, Korhogo, Côte d'Ivoire*

[3]*Université Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire*

Key words: Cashew, insects attack, termite, *Zographus regalis*, Côte d'Ivoire.

http://dx.doi.org/10.12692/ijb/18.6.166-175 Article published on June 29, 2021

Abstract

Cashew is an important crop. This study was carried out to evaluate the influence of cashew trees age on the damage of *Zographus regalis* and termites in the west of Côte d'Ivoire. These insects damages were collected in cashew orchards (class 1:] 0, 5] years), class 2:] 5, 10] years and class 3:] 10, 15] years). Four plots of 1 ha per cashew orchards class were sampled monthly from 7 am to 11 am. The results showed that the damage rates were between 3% and 21%. The intensity attack on cashew trees was between 2 and 4 in the two regions of the west of Côte d'Ivoire. The damage rate and the intensity attack of *Zographus regalis* decrease progressively with the age of cashew orchards. However the intensity attack of termites increase progressively with the age of cashew orchards. A total of 08 species belonging to 5 genera and 5 sub-families were collected in all the study plot. In Duékoué cashew orchards, the damage rate was highest in class 3 orchards with a rate of 5.167. In the cashew orchards of Man, the highest damage rate was also observed in class 3 orchards with a rate of 2.66 in class 3 cashew orchards. The cashew trees protection with pesticides was recommended for increasing the yield and the qualities of cashew nuts.

* **Corresponding Author:** Dohouonan Diabaté ✉ dohouonan.diabate@univ-man.edu.ci

Introduction

The cashew tree, *Anacardium occidentale* (Sapindales: Anacardiaceae), is native to Brazil and was introduced into Africa by Portuguese traders in the 16th century (Johnson, 1973; Delgado and Couturier, 2014; Adeigbe *et al.*, 2015). In Côte d'Ivoire, cashew was initially introduced in 1951 for soil preservation and reforestation in the savannah (Delgado and Couturier, 2014; Kra *et al.*, 2017, Diabaté and Tano, 2020). Since 2000, cashew was become an important cash crop in Côte d'Ivoire. Cashew nut production was 875,000 tons (23.8% of world production) and was covering 16 million ha in 2018 (Bassett *et al.*, 2018; Ricau, 2019). The cashew nut production in Côte d'Ivoire increased from 60,000 tons in 2000 to 875,000 tons in 2018 (Djaha *et al.*, 2010; Ricau, 2019) and become the first Cashew producer in Africa (Diop, 2016). However, its production is threatened by several biotic factors, especially insects (Agboton *et al.*, 2014; Diabaté and Tano, 2020).

The cashew nut yield in Côte d'Ivoire farms were lowered and were 350 kg/ha (Ricau, 2019). Despite being considered a rustic plant and well adapted to tropical conditions (Topper *et al.*, 2001; Freire *et al.*, 2002; Bezerra *et al.*, 2007), significant damages have been observed on the cashew trees (Dwomoh *et al.*, 2008; Vasconcelos *et al.*, 2014; N'Depo *et al.*, 2017; Diabaté and Tano, 2020). Insect pests are a major source of crop losses in many cashew-growing areas (Asogwa *et al.*, 2009, 2011; Agboton *et al.*, 2014). Insect pests infest its various parts including roots, stem, branches, flowers, and the pseudo-apples (Asogwa *et al.*, 2009, 2011; Agboton *et al.*, 2018). Most of the insects damaged the cashew crop by sucking sap, defoliation, branch girdling, stem and twig boring, and fruit and nut boring (Dwomoh *et al.*, 2008; Vasconcelos *et al.*, 2014; Tchetangni *et al.*, 2019). In the west of Côte d'Ivoire, *Zographus regalis* and termite attacks were very important. Larvae of *Z. regalis* bores into tree trunks and twigs (Dwomoh *et al.*, 2008) and termite damages were observed on the roots and on cashew trees trunks. These insects' pests become a major pest on cashew trees in the west of Côte d'Ivoire. Moreover, very little data exists on the damage of these insect pests in these regions of Côte d'Ivoire. The study aimed to evaluate the influence of cashew trees age on the damage of *Zographus regalis* and termite in the west of Côte d'Ivoire.

Material and methods

Study area

The study was carried out in two regions of the West of Côte d'Ivoire (Tonkpi and Guémon regions). Tonkpi region is located at 7°24'N and 7°33'W and Guémon region is between 7°00' and 6°50 (Fig. 1).

The study area was influenced by the subequatorial climate. The mean of annual rainfall was 1632 mm and the average annual temperature was 25 °C.

The rainy season was seven-months from April to October (Saley, 2003; Brou, 2005; Ahoussi *et al.*, 2018). These regions were an agro-ecological area which showed climatic conditions favorable for cashew cultivation. The vegetation was forests marked in places by meadows (Brou, 2005).

Experimental design

The study was conducted from January, 5 to April, 5, 2021 to evaluate the influence of cashew orchards age on *Zographus regalis* and termites damages in Tonkpi and Guemon regions of Côte d'Ivoire. These insects damages were collected in cashew orchards (class 1:] 0, 5] years), class 2:] 5, 10] years and class 3:] 10, 15] years) (Table 1). Four plots of 1 ha (10 m x 100 m) per cashew orchards class were sampled monthly from 7 am to 11 am. In each of the cashew farm, four elementary plots were delimited. Cashew trees were spaced at 8 x 6 m. Some parts of cashew plants destroyed by the insects were also recorded. The attacked trunks, branches, and twigs were counted per tree and marked so that they were no longer recounted.

Evaluation of Z. regalis and termite damage

The damage estimate was obtained from the number of trees attacked, by the number of branches attacked and by the number of twigs attacked.

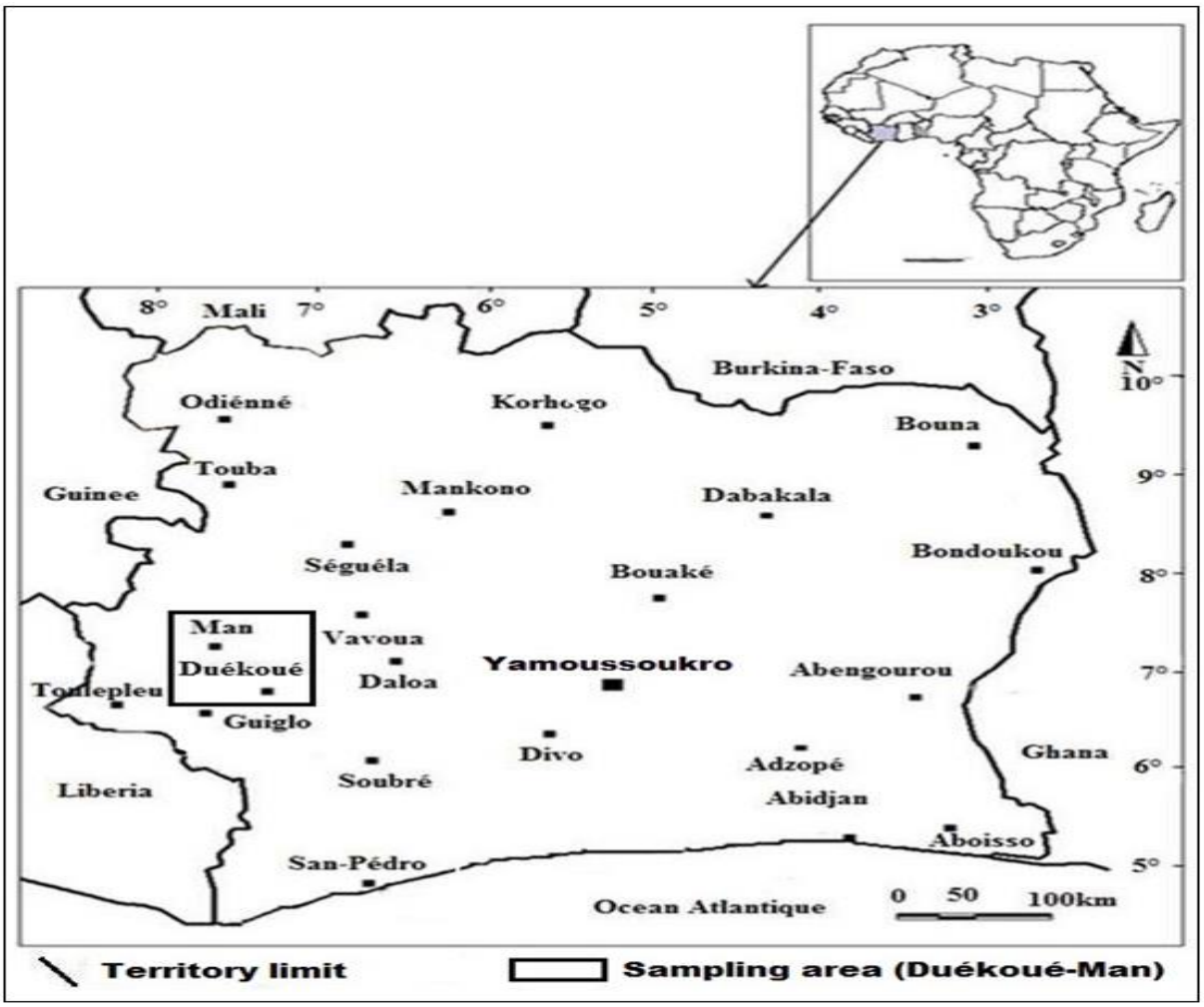

Fig. 1. Location of data collection sites in west of Côte d'Ivoire (Duékoué, Man).

The damage rates as the percentage of cashew trees attached by *Z. regalis* were calculated using the following formula:

$$Ta = \frac{Npax\,100}{Ntp} \quad (1)$$

with:

Ta = Damage rates of *Z. regalis* per plot (%)

Npa = Number of plants attacked by *Z. regalis*

Ntp = Total number of sampled plants per plot

The intensity of attack of cashew trunks per cashew tree sampled was evaluated by using the following formula:

$$I = \frac{Nta}{Ntpa} \quad (2)$$

Nta: Number of *Z. regalis* damage per cashew trunk attacked

Ntpa: Total number of sampled plants attacked by *Z. regalis* per plot

Identification of termites

Collected individuals were observed and identified down to the genus level in the laboratory under a binocular magnifying glass, using the identification keys of Sjöstedt (1926), Bouillon and Mathot (1965), Harris (1966a ; 1966b) ; Sands (1965), and Ruelle (1970). After identification, each genus was classified in its trophic group (fungus-growers, grass-feeders and wood-feeders).

Data analysis

Data of the damage rates of *Zographus regalis* and termite, and the intensity attacks of *Zographus regalis* on cashew trees were analyzed using SPSS software, version 22.0. Data of damage rate and of intensity attack were subjected to an analysis of

variance (ANOVA main effect) and the means discriminated with the Tukey test (HSD) with a probability of 5 %.

Results

Influence of cashew orchards age on the damage of Zographus regalis

Zographus regalis caused serious damage on cashew trees. The larva bores into tree trunks, branches, and twigs. The attack of Z. regalis causes a significant loss of the sap of the cashew trees (Fig. 2).

Damage rate of zographus regalis on cashew trees

The damage rate of *Z. regalis* on cashew orchards was between 10% and 21% in Duekoue cashew orchards. The damage rate of *Z. regalis* recorded in cashew orchards of class 1 (] 0, 5] years) was higher (20.118%). The damage rate decrease progressively with the age of cashew orchards.

It was 17.145 in cashew orchards of class 2 (] 5, 10] years) and was 10.967% in cashew orchards of class 3 (] 10, 15] years) (p= 0.034) (Table 2).

Table 1. Age of cashew orchards classes**.**

N° of class	Age of cashew farm	Number of farm sampling
Class 1	]0; 5]	4
Class 2	]5; 10]	4
Class 3	]10; 15]	4

In Man, The highest damage rate of *Z. regalis* on cashew trees was in cashew orchards of class 1 (8.3%) and the lowest damage was in cashew orchards of class 3. The damage rate decreases also progressively with the age cashew orchards. In cashew orchards of class 2, the damage of *Z. regalis* was 5.167%. There was a significant difference on *Z. regalis* damage in cashew orchads classes (p= 0.001). However the damage rates were lowed in Guémon region (Duékoué) than those of Tonkpi region (Table 2).

Table 2. Damage rate of *Zographus regalis* attack on cashew trees.

Habitat	Damage rate (%) ± SE	
	Duékoué	Man
Class 1	20.118 b ± 2.943	8.300 c ± 0.506
Class 2	17.145 ab ± 2.943	5.167 b ± 0.869
Class 3	10.967 a ± 000	3.100 a ± 0.363
p-value	*0.034*	0.001

SE. Standard error

The means assigned to the same letter within the same column are not significantly different for the 5% Tukey test (HSD).

Intensity attack of Z. regalis

The intensity attack of *Z. regalis* in Duekoue was between 2 to 4 damages per cashew tree attacked. The intensity attacks of *Z. regalis* decreases progressively with the age of cashew orchards. The intensity attack of *Z. regalis* values were 3.333, 2.667, 2.00 in cashew orchards of class 1, 2 and 3, respectively (Fig. 3). In Man, the intensity attack of *Z. regalis* decreases progressively with the age and were between 2 to 3. The intensity attack was higher on cashew orchards of class 1 (2.776) and was higher in cashew orchards of class 3 (2.045). The intensity attack of *Z. regalis* was 2.470 in cashew orchards of class 2 (Fig. 3).

Influence of cashew orchards age on the damage of termites

A total of 08 species of termites belonging to 08 genera and 5 sub-families were collected in all the

study plot. The Macrotermitinae family was the most diverse with 3 genera of termite pests (Table 3). Termites harvested at two trophic groups, fungus-growers and wood-feeders. The wood-feeders group present with 5 genera were the most diversified group (Table 3).

In Man (Tonkpi region), a total of 4 species of termites were collected in all 3 classes. Class 3 recorded the highest diversity with 3 genera of termites collected. Class 1 recorded only 1 termite genus (Table 3).

In Duékoué (Guémon region), a total of 6 species of termites were collected in all 3 classes. The Class 3 also recorded the greatest diversity with 5 species of termites. The Class 1 recorded 2 species of termites (Table 3).

Table 3. Genus of termite pests of cashew trees collected in the study areas.

Sub-Familly/ genera	FG	DUEKOUE			MAN		
		Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
Coptotermitinae							
Coptotermes intermedius (Silvestri)	w			*			
Rhinotermitinae							
Schedorhinotermes lamanianus (Sjöstedt)	w			*			
Macrotermitinae							
Ancistrotermes cavithorax (Sjöstedt)	f	*	*		*	*	
Macrotermes subhyalinus (Rambur)	f						*
Odontotermes pauperans (Silvestri)	f		*	*			
Nasutitermitinae							
Nasutitermes sp	w			*			
Termitinae							
Amitermes evuncifer (Silvestri)	w						*
Microcerotermes fuscotibialis (Sjöstedt)	w	*	*	*		*	*
Total		2	3	5	1	2	3

w : Wood-feeders, f : fungus-growers.

Termite's attack several parts of the cashew trees such as the roots, the stems and the branches and causes the death of cashew trees attacked (Fig. 4). The lowest damage rate of termite attacks occurred in Man cashew farms. The damage rate of termite attacks was higher in Duékoué cashew farms. In the two region, the damage of termite increase progressively with the age of cashew orchards.

Table 4. Damage rate of termites attack on cashew trees.

Habitat	Damage rate (%) ± SE	
	Duékoué	Man
Class 1	1.000 a ± 0.00	1.333 a ± 0.363
Class 2	4.133 b ± 1.637	2.000 b ± 0.000
Class 3	5.167 b ± 1.637	2.667 b ± 0.637
p-value	*0.0001*	*0.001*

SE. Standard error.

The means assigned to the same letter within the same column are not significantly different for the 5% Tukey test (HSD).

In Duékoué cashew orchards, the damage rate was 1, 4.133 and 5.167 in cashew orchards of class 1, class 2 and class 3, respectively (p=0001). In Man cashew orchards, the damage rate was 1.33, 2 and 2.667 in cashew orchards of class 1, class 2 and class 3, respectively (p=0.001) (Table 4).

Fig. 2. Impact of the damages of *Zographus regalis* on various organs of cashew tree (branch (a); Trunk (b)).

Discussion

In this study, damage of *Z. regalis* on the part of cashew trees was recorded in the cashew farms of Guémon (Duékoué) and Tonkpi (Man). Larvae of *Z. regalis* bore into cashew tree trunks, branches, and twigs caused serious damage on cashew trees. Similar results were reported by many authors such as Dwomoh *et al.* (2008), Asogwa *et al.* (2011), and N'Depo *et al.* (2017). The damage rate of *Z. regalis* recorded on cashew trees in the two regions of the west of Côte d'Ivoire were between 3% and 21%.

These damage rate decrease progressively with the age of cashew orchards.

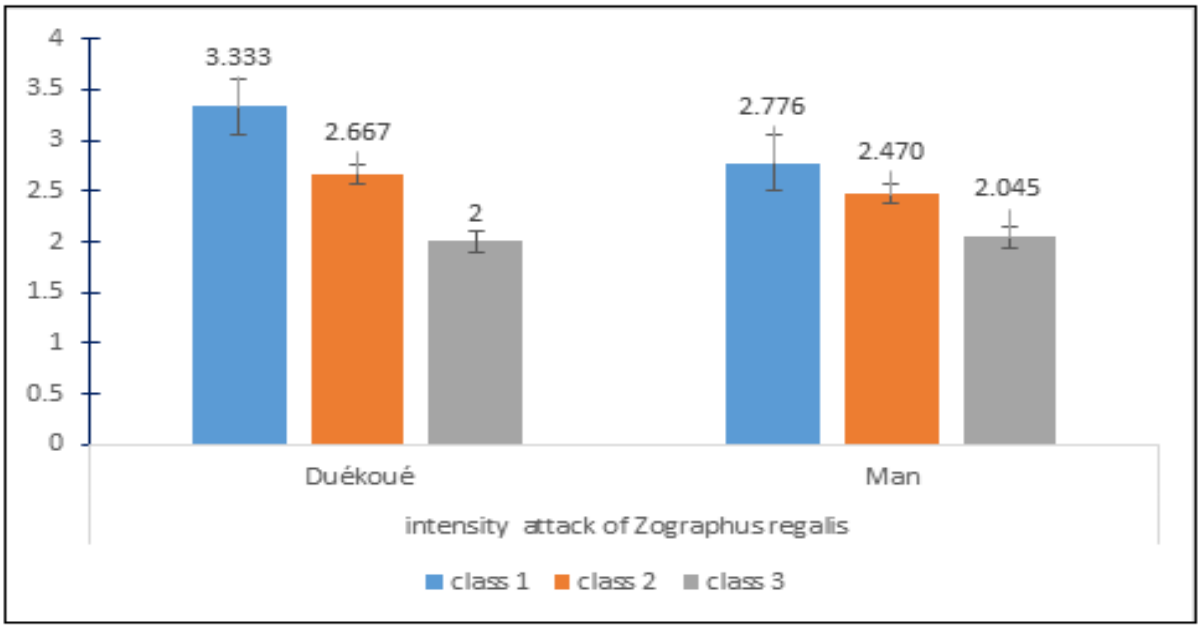

Fig. 3. Intensity attacks of *Zographus regalis* on cashew trees.

The highest damage rate on cashew were recorded in young cashew orchards and were lower in old cashew orchards. Furthermore, the intensity attack of *Z. regalis* was decreased progressively with the age of cashew orchards. Larvae of *Z. regalis* bore into cashew tree trunks, branches, and twigs caused serious damage on cashew trees. In fact, the perforation of the stems and branches of cashew trees causes a significant loss of sap. Thus, *Z. regalis* reduces photosynthesis. The mineral nutrition of the plant and the synthesis of organic matter accumulated in the fruits were distrubed. Consequently, the cashew nuts produced were small and consequently the yield of cashew orchards is reduced. Similar results were reported by Dwomoh *et al.* (2008) which showed that *Z. regalis* damage was higher on mature trees.

This insect pest greatly reduce both development and quality of the produce of cashew trees.

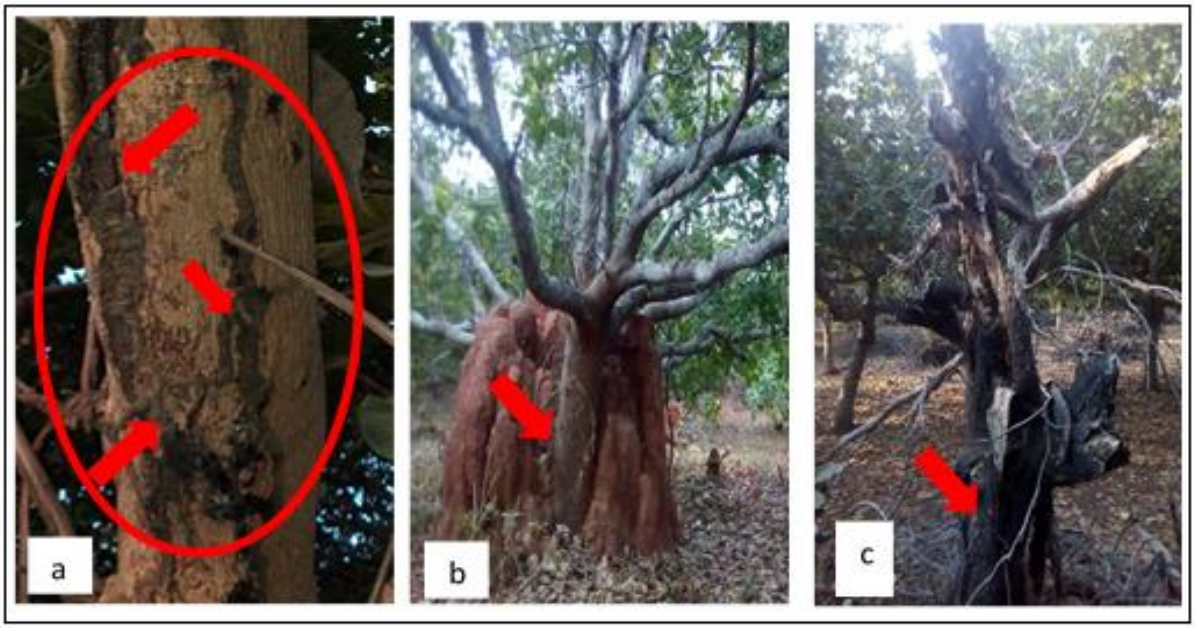

Fig. 4. Impact of termite attack on cashew trees (a. attack of *Microcerotermes* sp; b: attack of *Macrotermes* sp; c: Deep tree due to termite attack).

The results indicate that the damage of termite decrease progressively with the age of cashew orchards. Termites attack the roots, the stems and the branches of cashew trees and caused the death of cashew trees attacked. Consequently the yield of cashew orchards is reduced. The termite pest species harvested in this study belong to the fungus-growers and wood-feeders groups. These two trophic groups are recognized as the main pests of rubber trees (Apkesse *et al.*, 2019; Hidayat *et al.*, 2018) and mango trees (Coulibaly *et al.*, 2014). They attack trees because of their diet mainly based on cellulose and their need for water. Tra Bi *et al.*, 2019 also showed that Cocoa trees were most prone to termite attack. The observations of Gbenyedji *et al.*, (2016) also showed that most of the termite species responsible for tree damage on the Lomé campus belong to the wood-feeders and fungus-growers groups.

Conclusion

Zographus regalis and the termite caused serious damage on cashew trees. Their damage rates were between 3% and 21%. *Zographus regalis* larva bores into tree trunks and twigs of cashew trees. The intensity attacks of *Zographus regalis* on cashew trees were between 2 and 4 in the two regions of the west of Côte d'Ivoire. The damage and the intensity attack of *Zographus regalis* decrease progressively with the age of cashew orchards. The attack of termites increase progressively with the age of cashew orchards. A total of 8 species belonging to 5 genera and 5 sub-families were collected in all the study plot.

In Duekoue cashew orchards, the damage rate was highest in class 3 orchards with a rate of 5.167. In the cashew orchards of Man, the highest damage rate was also observed in class 3 orchards with a rate of 2.667 in class 3 cashew orchards. Plant's protection with pesticides was recommended for increasing the yield and the qualities of cashew nuts in cashew farms.

References

Ahoussi EK, Keumean NK, Kouassi MA, Koffi BY. 2018. Etude des caractéristiques hydrogéochimiques et microbiologiques des eaux de consommation de la zone périurbaine de la ville de Man: cas du village de Kpangouin (Côte d'Ivoire). International Journal of Biological and Chemical Sciences **11(6),** 3018-3033. https://dx.doi.org/10.4314/ijbcs.v11i6.37

Adeigbe OO, Olasupo FO, Adewale BD, Muyiwa AA. 2015. A review of cashew research and production in Nigeria in the last four decades. Science Research Essays **10(5)**, 196-209.

Agboton C, Onzo A, Akohou H, Goergen G, Vidal S, Tamo M. 2018. Population dynamics of the cashew leafminer, *Eteoryctis gemoniella* (Lepidoptera: Gracillariidae), and inventory of its parasitoids in cashew orchards of Northern Benin, West Africa. International Journal of Tropical Insect Science, 1- 13. https://dx.doi.org/10.1017/S1742758417000339

Agboton C, Onzo A, Ouessou FI, Goergen G, Vidal S, Tamo M. 2014. Insect Fauna Associated with *Anacardium occidentale* (Sapindales: Anacardiaceae) in Benin, West Africa. Journal of Insect Science **14 (229),** 1-11. https://dx.doi.org/10.1093/jisesa/ieu091

Akpesse AAM, Kissi TAP, Coulibaly T, Diby YKS, Kouassi KP, KOUA HK. 2019. Termite assemblages and infestation in rubber plantations of M'Brimbo in southern Côte d'Ivoire. International Journal of Advanced Research in Biological Sciences **6(4),** 21-29.

Asogwa EU, Anikwe JC, Ndubuaku TCN, Okelana FA. 2009. Distribution and damage characteristics of an emerging insect pest of cashew, *Plocaederus ferrugineus* L. (Coleoptera: Cerambycidae) in Nigeria: A preliminary report. African Journal of Biotechnology **8(1),** 053 - 058.

Asogwa EU, Ndubuaku TCN, Hassan T. 2011. Distribution and damage characteristics of *Analeptes trifasciata* Fabricius 1775 (Coleoptera: Cerambycidae) on cashew (*Anacardium occidentale* linnaeus 1753) in Nigeria. Agriculture And Biology Journal of North America **2(3),** 421-431. https://dx.doi.org/10.5251/abjna.2011.2.3.421.431

Bassett TJ, Kone M, Pavlovic NR. 2018. Power Relations and Upgrading in the Cashew Value Chain of Côte d'Ivoire. International Institute of Social Studies. Development and Change, 1-25. https://dx.doi.org/10.1111/dech.12400

Bezerra MA, De Lacerda CF, Filho EG, De Abreu CEB, Prisco JT. 2007. Physilogy of cashew plants grown under adverse conditions. Brazil Journal of Plant Physiology **19(4)**, 449-461.

Bouillon A, Mathot G. 1965. Quel est ce termite africain ? Zooleo **1,** 1-115

Brou YT. 2005. Climat, mutations socioéconomiques et paysages en Côte d'Ivoire. Mémoire de synthèse des activités scientifiques présenté en vue de l'obtention de l'Habilitation à Diriger des Recherches, Université des sciences et technologies de Lille, France, p 226.

Coulibaly T, Akpesse A AM, Yapi A, Zirihi GN, Kouassi KP. 2014. Dégâts des termites dans les pépinières de manguiers du nord de la Côte d'Ivoire (Korhogo) et essai de lutte par utilisation d'extraits aqueux de plantes. Journal of Animal & Plant Sciences **22(3),** 3455-3468.

Delgado C, Couturier G. 2014. Principaux insectes nuisibles à l'anacardier en Amazonie péruvienne.

Données préliminaires. Fruits **69**, 293-302. https://dx.doi.org/10.1051/fruits/2014018

Diabaté D, Tano Y. 2020. Attaque de *Analeptes trifasciata* Fabricius 1775.

(Coleoptera : Cerambycidae) en culture d'anacarde (*Anacardium occidentale* Linnaeus 1753) à l'ouest de la Côte d'Ivoire. Revue Ivoirienne des Sciences et Technologies **36**, 1-10.

Diop M. 2016. Côte d'Ivoire: Premier producteur mondial de noix de cajou, p 1.

Djaha J-BA, N'Guessan AK, Ballo CK, Aké S. 2010. Germination des semences de deux variétés d'anacardiers (*Anacardium occidentale* L.) élites destinées à servir de porte-greffe en Côte d'Ivoire. Journal of Applied Biosciences **32,** 1995-2001.

Dwomoh EA, Ackonor JB, Afun JVK. 2008. Survey of insect species associated with cashew (*Anacardium occidentale* Linn.) and their distribution in Ghana. African Journal of Agricultural Research **3(3)**, 205-214.

Freire FCO, Cardoso JE, Santos AA, Viana FMP. 2002. Diseases of cashew nut plants (*Anacardium occidentale* L.) in Brazil. Crop Protection **21**, 489-494.

Gbenyedji JNBK, Kasseney BD, Nyamador S, Sanbena BB, Kokutsè AD, Kokou K, Glitho I A. 2020. Evaluation des attaques de termites (Isoptera Brulle, 1832) sur quatre essences forestières d'importance économique au Togo (Afrique De l'ouest). European Scientific Journal **12(9)**, 332- 352. https://dx.doi.org/10.19044/esj.2016.v12n9p333

Harris WV. 1966a. On the genus *Coptotermes* in Africa. Proceedings of the Royal Entomological Society of London (B) **35,** 161-171.

Harris WV. 1966b. The Genus *Ancistrotermes* (Isoptera). Bulletin of the British Museum (Natural history) Entomology **18(1),** 1-20.

Hidayat MR, Endris WM, Dwiyantib Y. 2018. Effect of a rubber plantation on termite diversity in Melawi, West Kalimantan, Indonesia, Agriculture and Natural Resources **52,** (439-444).

Johnson D. 1973. Cashew cultivation in Brazil. Agron Mocamb. Laurenco Marques **7,** 119-129.

Kra KD, Kwadjo KE, Douan GE, Kouamé KL, Ouattara KV, Doumbia M. 2017. Évaluation des dégâts de *Analeptes trifasciata* (Coleoptera: Cerambycidae) sur les anacardiers dans les régions du Béré et de l'Iffou (Côte d'Ivoire). Journal of Applied Biosciences **112**, 10969-10977. https://dx.doi.org/10.4314/jab.v112i11.

N'Depo OS, Cherif M, Johnson F, Kassi FJ-M, N'guessan AC, Silue N, Akesse EN, Kone D, N'Goran OM. 2017. Inventaire des insectes ravageurs du verger anacardier dans les régions de Bounkani, Gontougo et Indénie-Djablun au Nord-Est en Côte d'Ivoire. Afrique Science **13(2)**, 333-343.

Ricau P. 2019. Analysis of cashew production, processing and trade in West Africa. Nitidae, 30 p.

Ruelle JE. 1970. A revision of the termites of the genus Macrotermes from the Ethiopian region (Isoptera: Termitidae). Bulletin of the British Museum **24,** 363-444.

Saley MB. 2003. Cartographie thématique des aquifères de fissures pour l'évaluation des ressources en eau. Mise en place d'une nouvelle méthode d'extraction des discontinuités images et d'un SIHRS pour la région semi-montagneuse de Man (Nord-Ouest de la Côte d'Ivoire). Thèse de Doctorat d'Université de Cocody-Abidjan, 209 p.

Sands WA. 1965. A revision of the termite family Nasutitermitinae (Isoptera, Termitidae) from the Ethiopian Region. Bulletin of the British Museum (Natural History) **4,** 1-172.

Sjöstedt Y. 1926. Revision der Termiten Afrikas. 3. Monographie. Kungliga Svenska Vetenskapsakademiens Handlingar, 1-415.

Tchetangni YA, Afouda LCA, Ouinsavi CAIN. 2019. Evaluation of the Damage of *Eteoryctis gemoniella* (Lepidoptera: Gracillariidae) in Cashew Plantations in Benin. European Scientific Journal, 286-299.
https://dx.doi.org/10.19044/esj.2019.v15n12p286

Topper CP, Caligari PDS, Camara M, Diaora S, Djaha A, Coulibay F, Asante AK, Boamah A, Ayodele EA, Adebola PO. 2001. West African Regional Cashew Survey Report (Guinea, Guinea Bissau, Côte d'Ivoire, Ghana and Nigeria). Sustainable Tree Crop Programme (STCP) and Biohybrids Agrisystem Ltd. U.K. **1,** p 110.

Tra Bi CS, Coulibaly T, Blei SH, Souleymane K, Kouassi KP, Tano Y. 2019**.** Attacks of termites (Insecta: isoptera) in cocoa farms (*Theobroma cacao* L.) in oumé (Côte d'Ivoire). International Journal of Current Research **11(09),** 6899-6905.

Vasconcelos S, Mendes LF, Beja P, Hodgson CJ, Catarino L. 2014. New records of insect pest species associated with cashew, *Anacardium occidentale* L. (Anacardiaceae), in Guinea Bissau. African Entomology **22(3),** 673-677.