

RESEARCH PAPER

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Perception of oil palm producers on infestations of *Trabanta rufisquamata* defoliating caterpillars in palm groves in southern Benin

Abilou Oloyiwola Olorounto^{*1,2}, Hervé Nonwegnon Sayimi Aholoukpe¹,
Micheline Vignon Hintenou², Houngan Judicaël Yelian Yan²,
Ladekpo Sylvain Ogoudjobi³, Antoine Badou¹, Aimé H. Bokonon-Ganta²

¹Centre de Recherches Agricoles Plantes Pérennes de l'Institut National des Recherches Agricoles du Bénin (CRA-PP/INRAB), 01 BP 884 Recette Principale Cotonou 01, Bénin

²Unité d'Entomologie Agricole (UEAg), Laboratoire d'Étude et de Gestion des Organismes Nuisibles des Végétaux (LaGON), Département de Production Végétale, Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, B.P. 526, Abomey-Calavi, République du Bénin

³Unité de Recherche en Sciences du Sol, Laboratoire des Sciences Végétales, Horticoles et Forestières, Université Nationale d'Agriculture (UNA), République du Bénin

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ABSTRACT

The oil palm (*Elaeis guineensis* Jacq.) is cultivated in Benin Republic for its economic importance. However, since 2016, it has been heavily attacked by *Trabanta rufisquamata* (Notodontidae Lepidoptera), a defoliating caterpillar. The present study aimed to study producers' perceptions on this new oil palm pest in Benin. Informations were provided on pest recognition, the damage caused and its impact as well as the control methods used by producers for its management. A survey was conducted in southern Benin in the agricultural development pole (PDA) 6 and 7 representing oil palm production areas in Benin. A total of 120 oil palm producers randomly selected from the municipalities of Adja-Ouère, Sakété and Pobè (PDA 6), and 110 producers from the municipalities of Allada, Toffo and Bonou (PDA 7), were individually surveyed. As results, 76% of the producers surveyed recognised the pest *T. rufisquamata* as the main defoliator of oil palms. An estimate of the oil palm plantations defoliated between 2016 and 2022 in Bonou and Adja-Ouère indicated a high presence of this pest with average defoliated areas of 23.21 ha and 11.33 ha respectively. Chemical control has been widely used by producers for the pest control. About 46.91% of producers used chemical products, compared to 48.14% of producers who have taken no action. Various registered and non authorised synthetic chemicals (pesticides) with main active ingredients are: Emamectin Benzoate, Lambda-Cyhalothrin, Acetamiprid and Lambda-Cyhalothrin were used with. This study has shown the need of improving producers' knowledge in the different development stages of *T. rufisquamata* in order to develop appropriate control methods while improving production in the oil palm sector in Benin.

***Corresponding author:** Abilou Oloyiwola Olorounto ✉ bilous84@yahoo.fr

INTRODUCTION

The oil palm, *Elaeis guineensis* (Arecaceae) is an oilseed plant native to the Gulf of Guinea in Africa (Jacquemard, 2011). It is cultivated for its palm oil, which is extracted from the fleshy fruit bunches with oily pulp (Jacquemard, 2011). Oil palm is one of the sectors included in Benin's Strategic Plan for the Revival of the Agricultural Sector (PSRSA, 2011) that is eligible for government funding. This sector plays an important economic, cultural, social and ecological role, particularly in the south of the country (Fournier *et al.*, 2001). Oil palm production in Benin is estimated at around 312,943 tonnes of bunches in 2015 (Konnon *et al.*, 2020). Oil palm plantain is now one of the main agricultural sectors in southern Benin and a pillar of agricultural development (MAEP, 2017). However, the productivity of this important oilseed crop is generally influenced by biotic and abiotic constraints that can drastically reduce yields and even affect the sustainability of the sector (Beaudoin-Ollivier *et al.*, 2011; Nouy *et al.*, 1999). The main abiotic constraint is the very high-water deficit, which severely limits yields (Aholoukpè, 2013; Nouy *et al.*, 1999). Among the biotic constraints, insects play an important role because they are very diverse and capable of attacking all parts of the plant.

In Benin, the attacks observed in recent years have been caused by various species of lepidoptera belonging to the Hesperidae, Limacodidae and Crambidae families, two species of Coleoptera belonging to the Chrysomelidae (*Coelanomenodera lamensis*) and Scarabaeidae (*Oryctes* sp.) families, and one Orthoptera (*Zonocerus variegatus*) (Olorounto, 2019; Coffi *et al.*, 2014). In addition to these insects commonly found in Benin's agro-ecosystem, since 2016, plantations in the south have been under attack from the defoliating caterpillar *T. rufisquamata* (Notodontidae Lepidoptera) (Hampson, 1910). The arrival of this new oil palm pest in Benin caused several waves of damage between 2016 and 2020 in plantations in the Plateau and Ouémé regions (Olorounto *et al.*, 2019). In order to identify this new oil palm pest in Benin's palm plantations, initial studies conducted by Olorounto *et al.* (2020) described the species and its characteristic damages,

determined its systematics and studied some of its biological parameters.

Since its appearance in Benin in 2016, *T. rufisquamata* has remained present in palm plantations and poses a real threat to the development of the sector, with outbreaks observed in 2019 and then in 2020, particularly in the departments of Plateau and Ouémé (southern Benin), where significant damage has been estimated at several dozen hectares (Olorounto *et al.*, 2020). For effective and sustainable management of this new oil palm defoliating caterpillar, it is essential to carry out a diagnosis of pest attacks in rural areas in order to assess producers' level of knowledge about *T. rufisquamata* and, above all, to evaluate the effectiveness of the control strategies adopted by producers to mitigate the damage and associated yield losses. The present study, which assesses oil palm producers' perceptions of the manifestations of the *T. rufisquamata* pest, aims to strengthen producers' capacity to manage it based on their prerequisites for effective control.

MATERIALS AND METHODS

Study area

The study was conducted in southern Benin, areas reported to be infested with *T. rufisquamata* (Olorounto, 2019), specifically within Agricultural Development Pole (PDA) 6 and 7. In the municipalities of Adja-Ouèrè (7°00'00 N, 2°37'00 E), Sakété (6°44'11 N, 2°39'29 E), and Pobè (6°58'59 N, 2°39'48 E) were selected for the surveys in PDA 6. While in PDA 7, the surveys were conducted in the municipalities of Allada (6°39'54 N, 2°09'08 E), Toffo (6°50'59.99 N, 2°04'60 E), and Bonou (6°54 N, 2°27' E) (Fig. 1). These municipalities located in the main oil palm production areas of Benin (SNV, 2009) are characterized by a sub-equatorial climate with two rainy seasons and two dry seasons (Aholoukpè *et al.*, 2020).

The surveyed areas exhibit diverse soil types, including vertisols, ferruginous soils, ferralitic soils, and hydromorphic soils, with annual rainfall ranging between 900 mm and 1300 mm (Aholoukpè *et al.*, 2020).

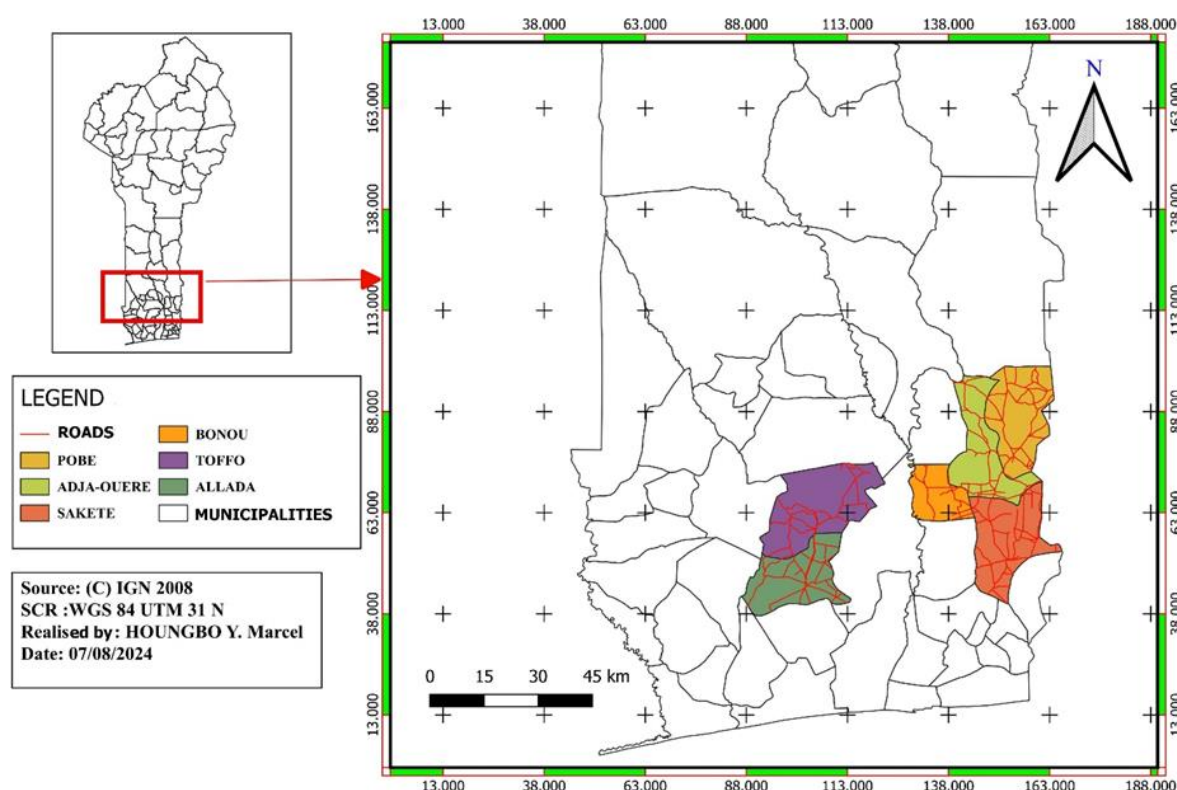


Fig. 1. Map of the survey area

Sampling method

The sample size was determined based on a preliminary survey conducted among 50 palm oils' producers selected at random in each PDA using the method described by Dagnelie (1998). The proportion of producers who recognized the defoliating caterpillars as a major phytosanitary problem was assessed in PDAs 6 and 7, 81% and 83% of producers, respectively, acknowledged this issue. These percentages were then used to calculate the required sample size in each PDA using the following formula (Dagnelie, 1998) :

$$N = \mu^2 1 - \alpha / 2 \times \pi_i (1 - \pi_i) / d^2$$

Where, N = sample size for each municipality

$\mu^2 1 - \alpha / 2 = 1.96$, represents the value of the normal random variable for a risk α equal to 0.05

π_i = proportion of producers who stated that defoliating caterpillars are a significant plant health problem in oil palm production

d = margin of error (5%).

A total number of 120 producers were surveyed in PDA 6 and 110 in PDA 7. The number of respondents

per municipality was determined proportionally to the population size of each locality (INSAE, 2013) (Table 1).

Table 1. Distribution of producers surveyed

Poles	Size/Pole	Municipalities	Size/Municipality
Pole 6	120	Adja Ouèrè	40
		Sakété	38
		Pobè	42
Pole 7	110	Bonou	33
		Allada	38
		Tofo	39

Field survey and data collection

The survey was conducted from January to April 2022, and consisted of individual interview with producers using a structured and pre-established questionnaire. The latter focused on knowledge of oil palm pests with an emphasis on *T. rufisquamata*, its distribution, its host plants, the characteristics of the damage it causes, and the control methods used by producers for its management. The estimate of defoliated areas took into account damage recorded from 2016, the year *T. rufisquamata* was first reported, up to the survey period.

Data processing and statistical analysis

The survey data were analyzed using R software (version 4.4.2). Descriptive statistics (frequency and mean) and logistic regression were used to present the results in forms of graphs and tables. The analysis of variance (ANOVA) test was applied to compare means. The Wilcoxon–Mann–Whitney test, the chi-square test of independence and, Fisher's exact test were performed to assess dependence among factors. Odds ratio (OR) analysis was performed to assess the effect of areas on the occurrence of caterpillar attacks in each PDA.

RESULTS

Characteristics of oil palm producers surveyed in the three municipalities

Respondents characteristics by gender

The distribution of oil palm producers showed that there were 192 men (92.31%) and 16 women (7.69%) out of a total of 208 surveyed (Table 2). In PDA 6, 99 producers were interviewed out of which 8 (8.08%) were women while 91 (91.92%) were men. The same number of women, 8 (7.34%) were recorded in PDA 7 out of 109 producers surveyed with 101 men (92.66%).

Table 2. Respondents characteristics by gender

Characteristics	Total number	Proportion of producers (%)	
		Female	Male
	N = 208	N = 16	N = 192
PDA			
PDA 6	99	8.08	91.92
PDA 7	109	7.34	92.66
Municipalities			
Adja-Ouèrè	30	6.67	93.33
Allada	39	10.26	89.74
Bonou	30	3.33	96.67
Pobè	43	13.95	86.05
Sakété	26	0.00	100.00
Toffo	40	7.50	92.50

N= total number of producers surveyed

Producers are spread across several municipalities, with varying proportions depending on gender. The municipality of Sakété has recorded no women producers among its 26 producers (100% men) surveyed. In contrast, Pobè recorded the highest proportion of women producers, with 12.20% of women out of a total 41 producers. In the other

municipalities, the gender distribution is relatively homogeneous, with female participation rates ranging from 3.33% in Bonou to 10.26% in Allada.

Respondents characteristics by age

The distribution of oil palm producers by age (Fig. 2) revealed a predominance of those aged between 30–50 years, accounting for 54.33% of producers. Producers aged 50 years and above represented 29.81%, while the proportion of those under 30 years old remains relatively low (15.87%).

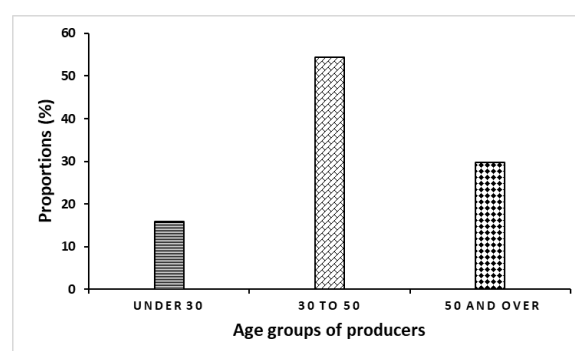


Fig. 2. Distribution of oil palm producers by age group

Characteristics of respondents by level of education

Fig. 3 showed the level of educational among producers. It highlighted a predominance of uneducated individuals, representing 74.52% of the total number of producers surveyed.

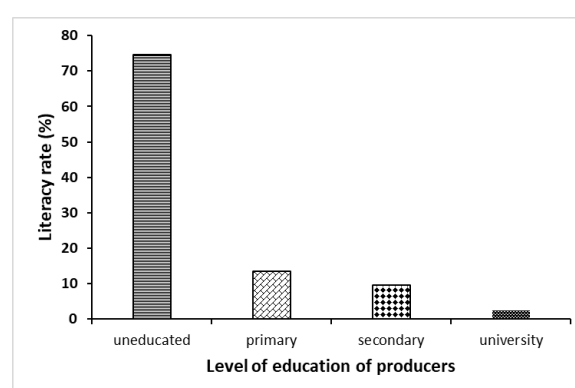


Fig. 3. Distribution of oil palm producers by level of education

Producers with a primary education level accounted for only 13.46%, while those with secondary education level were fewer (9.62%). Only 2.40% of producers have a university education level, reflecting

the overall low level of academic training among producers in the sector.

Knowledge on the existence of attacks by the defoliating caterpillar *T. rufisquamata* in oil palm plantations

General knowledge

The Fig. 4 below shows that 81.25% of oil palm producers surveyed reported being aware of the *T. rufisquamata* and its damages, while 18.75% have no idea of it.

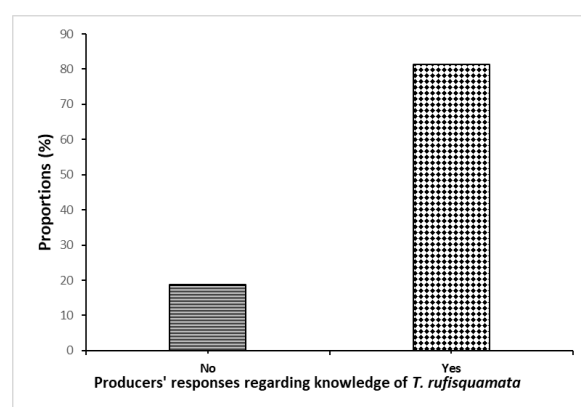


Fig. 4. Distribution of producers according to their knowledge or lack of *Trabanta rufisquamata*

Knowledge of the existence of *T. rufisquamata* according to socio-demographic characteristics

Knowledge of the defoliator *T. rufisquamata* among oil palm producers significantly varied by PDA, municipality, gender, age, and level of education. The analysis revealed a significant difference between the two PDAs. In PDA 6, all producers (100%) were aware of the existence of *T. rufisquamata*, whereas in PDA 7 735.78% of producers were not. All the producers in Adja-Ouèrè, Bonou, Pobè, and Sakété knew about the existence of the pest (100%). In Toffo and Allada, 52.50% and 46.15% of producers respectively were knew nothing about the present pest. Producers aged 50 years and above are the most aware of the present of the pest (83.87%), followed by those aged 30–50 (80.53%). However, producers under 30 were less informed (78.79%) (Table 3).

Educational level further influenced knowledge of *T. rufisquamata*. All producers with university

education level reported to know the pest (100%). In contrast, lack of awareness was reported by primary education level producers (21.43%) followed by those with secondary education level (20%) and uneducated producers (18.71%).

Table 3. Knowledge of *Trabanta rufisquamata* as a pest of oil palms according to socio-demographic characteristics

Characteristics	Total number N = 208	Proportion of respondents (%)	
		No	Yes
PDA			
PDA 6	99	0	100
PDA 7	109	35.78	64.22
Communes			
Adja-Ouèrè	30	0.00	100.00
Allada	39	46.15	53.85
Bonou	30	0.00	100.00
Pobè	2	0.00	100
Pobè	41	0	100
Sakété	26	0.00	100
Toffo	40	52.50	47.50
Gender			
Female	16	18.75	81.25
Male	192	18.75	81.25
Age group			
30 to 50	113	19.47	80.53
50 and above	62	16.13	83.87
Under 30	33	21.21	78.79
Level of education			
No education	155	18.71	81.29
Primary	28	21.43	78.57
Secondary	20	20.00	80.00
University	5	0	100

N= Total number of respondents

Producers' knowledge of *T. rufisquamata* according to its developmental stages

Analysis of Fig. 5 indicates that over 76% of surveyed producers recognized *T. rufisquamata* as a serious pest of oil palm. However, more than 95% of respondents across the six municipalities had no knowledge of its eggs or adult stage. The larval stage (caterpillar) were the most familiar to producers, particularly in the municipalities of Adja-Ouèrè (100%), Pobè (75.42%), and Sakété (80.33%) in PDA 6, as well as Bonou (64.51%) in PDA 7. In contrast, producers in Toffo and Allada (PDA 7) reported not knowing the caterpillar stage (39.02% and 23.07%, respectively).

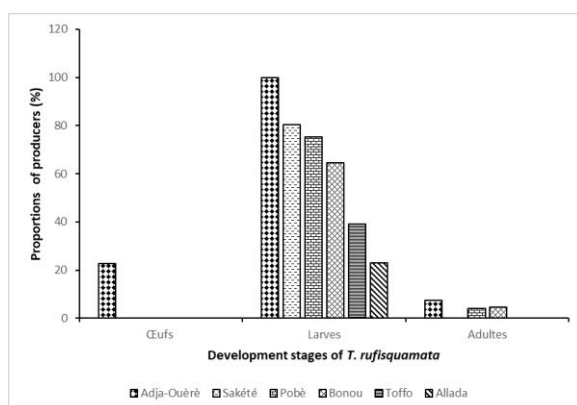


Fig. 5. Producers' knowledge of the *T. rufisquamata* different development stages

Presence of *T. rufisquamata* attacks in oil palm growers' plantations

Our study reveals that 65.38% of oil palm producers observed damages by defoliator catapillar in their plantations (Fig. 6).

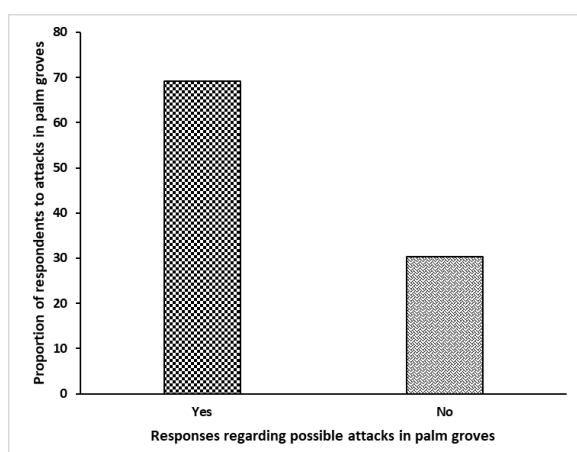


Fig. 6. Distribution of oil palm producers who have experienced attacks or not

Analysis of the results in Table 4, on the occurrence of defoliation according to the socio-demographic characteristics of oil palm producers, reveals significant variations by PDA and municipality.

Producers in both PDAs 6 and 7 reported attacks from defoliator, though at different levels of severity. About 69.72% of producers in PDA 7 compared to 60.61% in PDA 6 were affected by caterpillar defoliation cases.

The prevalence of defoliation varied considerably at the municipal level. The most affected municipalities

were Adja-Ouèrè (86.67%) followed by Toffo (72.50%), and Allada (71.79%), indicating a high incidence of the phenomenon in these areas. By contrast, Sakété recorded the lowest infestation rate, with only 42.31% of producers reporting cases of defoliation.

Table 4. Cases of defoliation according to socio-demographic characteristics

Study areas	Number Observations of defoliation cases in palm plantation by producers		p-value
	N = 208	No Yes	
PDA			0.015
PDA 6	99	38.38	61.62%
PDA 7	109	22.94	77.06%
Municipalities			<0.001
Adja-Ouèrè	30	13.33	86.67
Allada	39	25.64	74.36
Bonou	30	16.67	83.33
Pobé	43	44.19	55.81
Sakété	26	57.69	42.31
Toffo	40	25.00	75.00
Gender			0.6
Female	16	37.50	62.50
Male	192	29.69	70.31
Age group			0.4
30 to 50 years	113	26.55	73.45
50 years and over	62	35.48	64.52
Under 30	33	33.33	66.67
Level of education			0.8
No education	155	31.61	68.39
Primary	28	25.00	75.00
Secondary	20	25.00	75.00
Higher	5	40.00	60.00

Defoliation appeared to affect male-managed plantations (66.15%) slightly more than female-managed ones (56.25%). Reported cases varied little by age group: producers aged 30–50 years were the most likely to report defoliation (67.26%), followed by those under 30 (63.64%) and those over 50 (62.90%).

Producers with primary (71.43%) and secondary (70%) education were the most likely to report defoliation, whereas those with higher education were the least affected, with only 40% reporting cases. Nevertheless, statistical analysis confirmed that the differences by gender, age, and educational level were not significant.

Table 5. Areas impacting defoliation cases

Characteristics	OR	95% CI	p-value
PDA			
PDA 6	-	-	
PDA 7	0.46	0.12 - 1.56	0.2
Municipalities			
Adja-Ouèrè	-	-	
Allada	0.97	0.35 - 2.69	>0.9
Bonou	1.67	0.52 - 5.94	0.4
Pobè	0.19	0.05 - 0.60	0.008
Sakété	0.11	0.03 - 0.39	0.001
Toffo			

OR = odds ratio, CI = confidence interval

The data in Table 5 illustrate the influence of study areas on the occurrence of defoliation among oil palm producers. Analysis of the odds ratio (OR), with PDA 6 as the reference for PDAs and Adja-Ouèrè for municipalities, yielded an OR of 0.46 (CI: 0.12–1.56), suggesting a lower probability of defoliation compared to PDA 6; however, this effect was not significantly different ($p = 0.2$).

At the municipal level, two areas showed a significant reduction in defoliation risk:

Pobè had an OR of 0.19 (CI: 0.05–0.60), with a p -value of 0.008, indicating a significant reduction in risk compared to Adja-Ouèrè.

Sakété presented an even lower OR of 0.11 (CI: 0.03–0.39), with a p -value of 0.001, indicating a very strong reduction in risk compared to both Pobè and Adja-Ouèrè.

By contrast, the municipalities of Allada (OR= 0.97, $p > 0.9$) and Bonou (OR= 1.67, $p = 0.4$) showed no significant association with defoliation risk. Overall, the analysis highlighted Pobè and Sakété as municipalities and is significantly lower risk, while no significant differences were observed between PDA 6 and PDA 7, or for the other municipalities.

Extent of defoliation damage since the first appearance of *T. rufisquamata*

Tables 6 and 7 summarize the extent of defoliation damage observed between 2016 and 2022 by PDA and municipality. Among the 145 producers who reported defoliation, 61 cases occurred in PDA 6 and 84 in PDA 7.

Table 6. Years of observation of PDA defoliation cases

Years	Total number	Proportion of producers affected according to the Agricultural Development Pole/PDA (%)	
	N = 145	PDA 6	PDA 7
2016	14.89	14.75	15.00
2017	5.67	6.56	5.00
2018	14.18	22.95	7.50
2019	3.55	6.56	1.25
2020	21.99	29.51	16.25
2021	19.15	9.84	26.25
2022	20.57	9.84	28.75

Temporal analysis showed contrasting trends' between the two PDAs. PDA 6 experienced peaks in 2018 (22.95%) and 2020 (29.51%), followed by a decline sharp in 2021 and 2022 (9.84% each). In contrast, PDA 7 displayed an upward trend, with marked peaks in 2021 (26.25%) and 2022 (28.75%).

At the municipal level, producers affected by defoliation were spread across all six municipalities, with strong year-to-year variation. In 2016, Sakété recorded the highest incidence level of 54.55%, while the other municipalities were less affected and no attack declared at Pobè. Between 2018 and 2020, infestation rates increased substantially in Adja-Ouèrè (26.92%) and Pobè (29.17%). Bonou experienced a highest infestation in 2021 (43.48%), and in 2022, Allada (37.93%) and Toffo (32.14%) recorded the highest levels of infestation. Besides, the year 2019 was marked by a low level of infestation. Only the municipalities of Pobè, Sakété, and Toffo reported cases of defoliation and these were at a very low proportion. Furthermore, no attacks were reported in Toffo in 2017 and in Sakété in 2018 and in 2021.

Extent of defoliation damage caused by *Trabanta rufisquamata*

Tables 8 and 9 show the average defoliated areas reported by PDA and municipality. Significant differences were observed between PDAs ($p < 0.001$). PDA 6 recorded an average defoliated area of 5.51 ± 23.99 ha, while PDA 7 recorded 6.01 ± 28.82 ha. However, the overall mean defoliated area was 5.79 ± 26.67 ha considering all observations.

Table 7. Years of observation of defoliation cases by municipality

Years	Total number	Proportion of producers affected by defoliation by municipality (%)					
	N = 145	Adja-Ouèrè	Allada	Bonou	Pobè	Sakété	Toffo
2016	14.89	11.54	10.34	13.04	0.00	54.55	21.43
2017	5.67	3.85	6.90	8.70	8.33	9.09	0.00
2018	14.18	26.92	6.90	13.04	29.17	0.00	3.57
2019	3.55	0.00	0.00	0.00	12.50	9.09	3.57
2020	21.99	46.15	20.69	8.70	16.67	18.18	17.86
2021	19.15	7.69	17.24	43.48	16.67	0.00	6
2022	20.57	3.85	37.93	13.04	16.67	9.09	32.14

Table 8. Average area affected by defoliation according to PDAs

Characteristics	Total	Agricultural Development Pole(PDA)		p-value
	N = 145	PDA 6	PDA 7	
Average area affected/producer (ha)	5.79 ±26.67	5.51± 23.99	6.01 ± 28.82	<0.001
Wilcoxon-Mann-Whitney test				

Table 9. Average areas affected by defoliation by municipality

Characteristics	Municipalities					
	Adja-Ouèrè	Allada	Bonou	Pobè	Sakété	Toffo
	N = 26	N = 29	N = 25	N = 24	N = 11	N = 30
Average areas affected	11.33 (36.31)	0.64 (2.07)	23.21 (58.43)	1.17 (0.97)	1.20 (1.19)	1.29 (2.67)
N= number surveyed; Values in brackets represent proportions						

Table 10. Importance of insects responsible for defoliation of oil palm plantations according to PDA

Defoliators	Total number	Responsibility for damage attributed or not to oil palm defoliators (%)	
	N = 145	PDA 6	PDA 7
<i>Limacodidae</i>			
No	70.80	62.71	76.92
Yes	29.20	37.29	23.08
<i>T. rufisquamata</i>			
No	54.01	22.03	78.21
Yes	45.99	77.97	21.79
<i>Oryctes</i> sp.			
No	52.55	96.61	19.23
Yes	47.45	3.39	80.77
<i>Z. variegatus</i>			
No	92.70	98.31	88.46
Yes	7.30	1.69	11.54

Yes = agent responsible for defoliation; No: agent not responsible for defoliation, N = number of respondents

Table 11. Producers' assessment of the impact of *Trabanta rufisquamata* attacks

Communes	Proportion (in %) of producers by type of impact declared	
	Severe defoliation	Increase in yields 1 to 2 years after attack
Adja-Ouèrè	100	57
Pobé	92.15	28.78
Sakété	87.41	19.05
Bonou	100	49
Allada	55	0
Toffo	83.62	2.55

Analysis of defoliated areas by municipality revealed disparities in the risk of *T. rufisquamata* attacks. Bonou and Adja-Ouèrè were the most affected, with an average defoliated areas of 23.21

ha and 11.33 ha, respectively. In contrast, Allada, Pobè, Sakété, and Toffo were significantly less affected (0.64–1.29 ha), suggesting lower exposure or greater resilience of palm groves in these

municipalities to defoliation by *T. rufisquamata* caterpillars.

Significance of *T. rufisquamata* attacks among common defoliators in oil palm plantations

Analysis of attacks by common defoliators in Benin's oil palm plantations revealed significant differences between PDAs. Limacodidae were reported by 29.20% of affected producers, with higher prevalence in PDA 6 (37.29%) than in PDA 7 (23.08%). *Trabanta rufisquamata* emerged as a major defoliator, particularly in PDA 6 (77.97%), but was less frequent in PDA 7 (21.79%). In contrast, *Oryctes* sp. (Scarabaeidae) was much more prevalent in PDA 7 (80.77%) than in PDA 6 (3.39%). *Zonocerus variegatus* were less frequently cited, with an overall prevalence of 7.30%, slightly higher in PDA 7 (11.54%) than in PDA 6 (1.69%) (Table 10).

Impact of *Trabanta rufisquamata* attacks

Table 11 highlights two types of impacts of *Trabantarufisquamata* attacks reported by producers Negative impact: severe defoliation of plantations.

Positive impact: increased palm yield, reported by some producers 1–2 years after attacks.

Yield increases were reported by 57% and 49% of producers in Adja-Ouère and Bonou respectively. Same trend was observed in Pobè (28.78%) and Sakété (19.05%), but were almost absent in Toffo (0%) and Allada (2.55%).

Control methods for the control of *Trabanta rufisquamata*

Control methods adopted by producers

Analysis of control strategies against *T. rufisquamata* shown that nearly half of producers across the study area (48.97%) do not apply any control measures, with a higher proportion in PDA 6 (62.30%) than in PDA 7 (39.29%). Among active control methods, chemical control was the most common (46.90%), more widely adopted in PDA 7 (55.95%) than in PDA 6 (34.43%). Biochemical and mechanical methods were marginal, representing 2.76% and 1.38% of practices, respectively. There were a significant difference between the two PDAs in terms of control method used ($p=0.021$) (Table 12).

Table 12. Methods of controlling *Trabanta rufisquamata*

Control methods used	Number	Proportion of producers using each method (%)		<i>p</i> -value
	N = 145	PDA 6	PDA 7	
None	48.97	62.30	39.29	0.021
Biochemical	2.76	1.64	3.57	
Chemical	46.90	34.43	55.95	
Mechanical	1.38	1.64	1.19	
Fisher's exact test				

Table 13. Different types of insecticides used by the producers surveyed

Chemical insecticides	Trade name	Active ingredients	Mode of action	Percentage of users (%)
Registered	Gbayedo	Emamectin benzoate + Acetamiprid	Contact	17.91
	Marel	Emamectin benzoate		11.94
	Pacha	Lambda-Cyhalothrin + Acetamiprid		14.92
Non-registered	Lara Force	Lambda-Cyhalothrin	Contact	8.95
	Lambda Plus	Lambda-Cyhalothrin		49.25
	Sniper DDVP	Dichlorovinyl dimethyl phosphate		13.43

Synthetic insecticides used

The lists of the commonly used chemicals pesticides by respondents to manage defoliator attacks in their plantations is presented in Table 13. These include

both approved and unapproved products, although approved insecticides were the most widely used nationwide. Four main active substances were reported : emamectin benzoate, lambda-cyhalothrin,

and acetamiprid (with lambda-cyhalothrin appearing twice in the list). Table 13 shows that insecticides based on lambda-cyhalothrin (Lara force and Lambda plus) were the most widely used (58.2%).

DISCUSSION

Characteristics of the producers surveyed

The very low representation of women in oil palm production in Benin has also been reported by several authors in the sub-region (Ogoudjobi *et al.*, 2024; Doss and Meinzen-Dick, 2015).

This significant disparity can be explained by several factors, including the limited access of women to freehold land, which prevents them from investing in cash crops such as oil palm (Gbaguidi *et al.*, 2019). Similarly, rural women in Benin have limited access (less than 20%) to agricultural loans from financial institutions (Adéoti, 2019), even though oil palm cultivation requires substantial investment in the early years.

The results also showed a strong representation of producers aged 30-50, with younger producers (under 30) showing less interest. This age group is undoubtedly the most active in the sector, owing to their experience and physical capacity, which remain suited to agricultural work. Similar observations were reported by Ogoudjobi *et al.* (2024).

According to Adje *et al.* (2015), age is a determining factor in the adoption of agricultural technologies and the effective management of perennial crops. This is because managing palm plantations requires knowledge and technical skills acquired over time. In addition, farmers aged between 30-50 generally have the financial capacity and medium-term vision necessary to invest in cash crops such as oil palm (Yabi and Afouda, 2012). Conversely, according to FAO (2014), many young people in sub-Saharan Africa are excluded from agriculture due to a lack of resources and opportunities, as well as the low social prestige associated with farming.

Producers perception and knowledge of *Trabanta rufisquamata*

Oil palm is an economically important crop in Benin, mainly cultivated by smallholders for whom intensification remains a priority despite unfavorable climatic conditions (Aholoukpè, 2013). The Plateau Department is the leading production area. However, expansion of cultivation has led to the proliferation of pests (Kumar, 1991), creating new constraints. Oil palms are susceptible to numerous insect pests at all stages of their phenological development (Mariau, 1982). Among them, lepidopteran caterpillars are particularly fearsome because of their rapid proliferation and the extent of damage caused to foliage (Mariau, 1982).

According to producers surveyed, caterpillars have been their main pest problem since 2016. Attacks by *T. rufisquamata* were unknown before that year, confirming the findings of Olorounto *et al.* (2020), who reported the first occurrence of this pest in the Ouémé-Plateau palm plantations in 2016. Its emergence coincided with that of the fall armyworm (*Spodoptera frugiperda*) on maize (Goergen *et al.*, 2016), leading to confusion among producers in identifying the new pest and influencing their choice of control chemicals. Both phenomena are thought to be linked to climate conditions favorable to pest outbreaks, possibly associated with climate change (Cilas *et al.*, 2015).

Although awareness of *T. rufisquamata* is now widespread, producers' knowledge on its biology and developmental stages remains limited and varies across regions, likely due to differences in access to agricultural information and extension services. Education level also affected knowledge, although experience plays a significant role.

Producers are most familiar with the larval stage and its damage, largely because information has been disseminated through social media, producer groups, and extension services.

Nevertheless, early detection remains difficult due to the fact that caterpillars are greenish and blend into palm foliage, while the nocturnal moths lay eggs on

the underside of leaves, making them hard to detect (Olorounto *et al.*, 2020). Major infestations have so far been concentrated in Adja-Ouèrè and Bonou, although smaller outbreaks have occurred elsewhere.

This confirms Mariau's (2000) observation whereby attacks are sporadic and highly localized. However, since 2016, the pest has established itself in Benin, typically proliferating after the first rains of the main rainy season, and now represents a permanent threat to the sector.

Importance of defoliators in palm plantations

The present study revealed the presence of several defoliating insects in palm plantations, but the extent of their damage varies across time and space, and is influenced by environmental conditions (Hill, 2008). Zalucki *et al.* (2004) noted that high temperatures can accelerate pest life cycles, increasing their impact. *Trabanta rufisquamata* appears to be the most significant defoliator in PDA 6 (77.97%), but is less in PDA 7 (21.79%). In addition, agricultural practices likely play a major role in determining which pests thrive (Savary *et al.*, 2012).

Impact of caterpillar attacks in palm plantations

The regular occurrence of *T. rufisquamata* since 2016 indicates that the pest is now well established. The high proportion of producers reporting defoliation confirms the widespread nature of the problem. However, outbreaks are sporadic and localized, with the most severe damage recorded in Adja-Ouèrè, Sakété, and Bonou. These observations align with Mariau (2001), who described *T. rufisquamata* attacks as sporadic and localized. Local differences may be linked to environmental conditions or specific farming practices. Temperature, in particular, has been shown to influence pest population dynamics (Deutsch *et al.*, 2008; Bale *et al.*, 2002).

Defoliation disrupts photosynthesis, reducing productivity (Haile *et al.*, 1988). Kalidas (2012) reported yield losses up to 50% within 4–6 months of severe defoliation. However, some producers observed yield improvements following infestations. This may be

explained by the large amounts of caterpillar frass deposited at the base of palms, which enriches soils with organic matter. Similarly, compensatory growths after defoliation have been documented in cotton (Harris, 1973; Eaton, 1931).

Control strategies used by producers

In response to *T. rufisquamata*, most producers resorted to chemical control, reflecting the widespread tendency to react to pests with pesticides (Ouedraogo *et al.*, 2022; Kpadenou *et al.*, 2020). Nevertheless, 48.12% of surveyed producers reported taking no action, reflecting both the novelty of the pest and the lack of phytosanitary monitoring systems that would enable timely interventions.

Only a small proportion (1.23%) relied on biological control through natural mortality of caterpillars, possibly caused by epizootics or natural enemies, as also noted by Olorounto *et al.* (2020). Both registered and unregistered insecticides were used, but 20.76% of producers applied unregistered products. Such practices cause pesticide resistance and ecological imbalance by reducing natural enemies (Brevault *et al.*, 2007; Martin *et al.*, 2000).

Future management should prioritize safer alternatives. Promising options include low-dose applications of synthetic insecticides and botanical extracts. Studies have shown neem seed, leaf, and other plant extracts to be effective against various crop pests (Yao *et al.*, 2022; Sane, 2021; Ganda *et al.*, 2018). Other approaches, such as resistant planting material, should also be explored. As emphasized by Altieri (1995), *T. rufisquamata* is part of the agroecosystem and contributes to biodiversity; the objective should not be eradication but rather integrated pest management to keep populations below damaging thresholds.

CONCLUSION

Trabanta rufisquamata is now recognized throughout the study area as one of the most serious pests of oil palm in Benin. Its establishment in the agroecosystem poses a permanent threat to the sector. Detection remains difficult due to its cryptic biology, and

producers, lacking information on appropriate management, have lead to a heavily reliance on pesticides, often unregulated, with potentially harmful environmental consequences.

Training producers in pest identification and early detection is therefore essential to prevent severe outbreaks. Research trials are also needed to assess the short-, medium-, and long-term impacts of defoliation on palm yield, as well as the effectiveness of safer alternatives such as low-dose synthetic insecticides and biopesticides. Developing integrated strategies tailored to local conditions will be crucial to manage *T. rufisquamata* sustainably while safeguarding both productivity and ecosystem health.

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