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REVIEW ARTICLE **Open Access**

Population Census of Fire Caterpillars (*Setora Nitens* Walker) in Oil Palm Plantations (*Elaeis Guineensis* Jacq.) in the Begerpang Plantation of PT PP London Sumatera Indonesia TBK

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Abstract

The fire caterpillar Setora nitens Walker (Lepidoptera: Limacodidae) is a major pest of oil palm (*Elaeis guineensis* Jacq.) and causes significant economic losses through defoliation. This study aimed to analyze the population of S. nitens in two front observation schemes, PE1 (fronts 9, 17, 25) and PE2 (fronts 8, 16, 24), and to identify the dominant positions of larvae and the attack level as a basis for control. The study was conducted at Division 03 Naga Timbul, Begerpang Plantation of PT PP London Sumatra Indonesia Tbk., Deli Serdang Regency, North Sumatra Province, from February to April 2026. Sample trees were determined using purposive sampling based on classifications of light, moderate, and heavy attacks, with parameters including the number of eggs, live larvae, dead larvae, and pupae on the sample tree and six surrounding trees. The highest population of live larvae was found in the heavy attack category, with 469 individuals (PE1) and 177 individuals (PE2), averaging 21.4 individuals per tree. The highest number of pupae reached 394 individuals in the same category, indicating a potential risk of population explosion in the next generation. The dominant larvae were found in positions 1A and 1B at the tips of the 9th and 17th leaf sheaths, on the underside of the leaf, while no eggs were observed during the study. This is the first empirical comparison of the effectiveness of PE1 and PE2 in the field, as well as the establishment of the most representative anatomical positions of the leaf sheaths as a reference for standardizing pest censuses. It is recommended that control measures be prioritized in blocks with severe infestations, with monitoring focused on the 9th and 17th leaf sheaths at the tips of the underside of the leaf.

Keywords: Attack Level, Control Threshold, Defoliation, Population Explosion, Purposive Sampling

1. Introduction

Oil palm (*Elaeis guineensis* Jacq.) is a strategic commodity in the Indonesian economy. With a plantation area of 16.83 million hectares and a production of 46.82 million tons, Indonesia leads the world as the largest producer and exporter of *Crude Palm Oil (CPO), controlling more than 55% of the global palm oil supply* (Ministry of Agriculture, 2024). However, the sustainability of this commodity's productivity remains under pressure from attacks by plant pests (OPT), which can significantly reduce production (Himawan et al., 2026).

One of the pests that threaten oil palm productivity is *Setora nitens* Walker (*Lepidoptera: Limacodidae*), which is classified as the most detrimental defoliative pest. The larvae of this pest consume the leaf mesophyll until only the leaf veins remain, with the ability to damage a leaf surface area of 400 cm² per individual in one life cycle; the impact of its attack can reduce fresh fruit bunch (FFB) production by up to 70%. If it occurs twice a year, yield losses can reach 93% (Simanjuntak et al., 2020). This makes S. nitens a top priority in plantation pest management systems (Pradana et al., 2020).

Regular population monitoring is key to preventing undetected pest outbreaks. Without adequate population data, control decisions tend to be reactive and delayed, making control efforts cost-inefficient and risking negative

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environmental impacts from excessive pesticide use (Djiwanata et al., 2026). Furthermore, without control thresholds based on field census data, plantation managers lack an objective benchmark for when and where to implement control interventions, which can ultimately result in economic losses far greater than the cost of routine monitoring itself (Egonyu et al., 2022).

In general, pest censuses are conducted on the 9th, 17th, and 25th fronds as a representation of the canopy strata (Anggraini & Berutu, 2022). However, the effectiveness of this scheme, compared with alternative schemes on the 8th, 16th, and 24th fronds, has not been empirically studied. This study aims to analyze the *S. nitens population* in both schemes, compare the population distribution between sample trees and surrounding trees, and identify the most representative frond anatomical position as a reference for standardizing pest census methods in the field

2. Material and Methods

2.1. Place and Time

This research was conducted in Division 03 of Begerpang Plantation, PT PP London Sumatra Indonesia Tbk, in Naga Timbul Village, Tanjung Morawa District, Deli Serdang Regency, North Sumatra Province (3°29'16" N; 98°47'38" E; ±47 masl), for two months, from February to April 2026. In general, the stages of research implementation are presented in Figure 1.

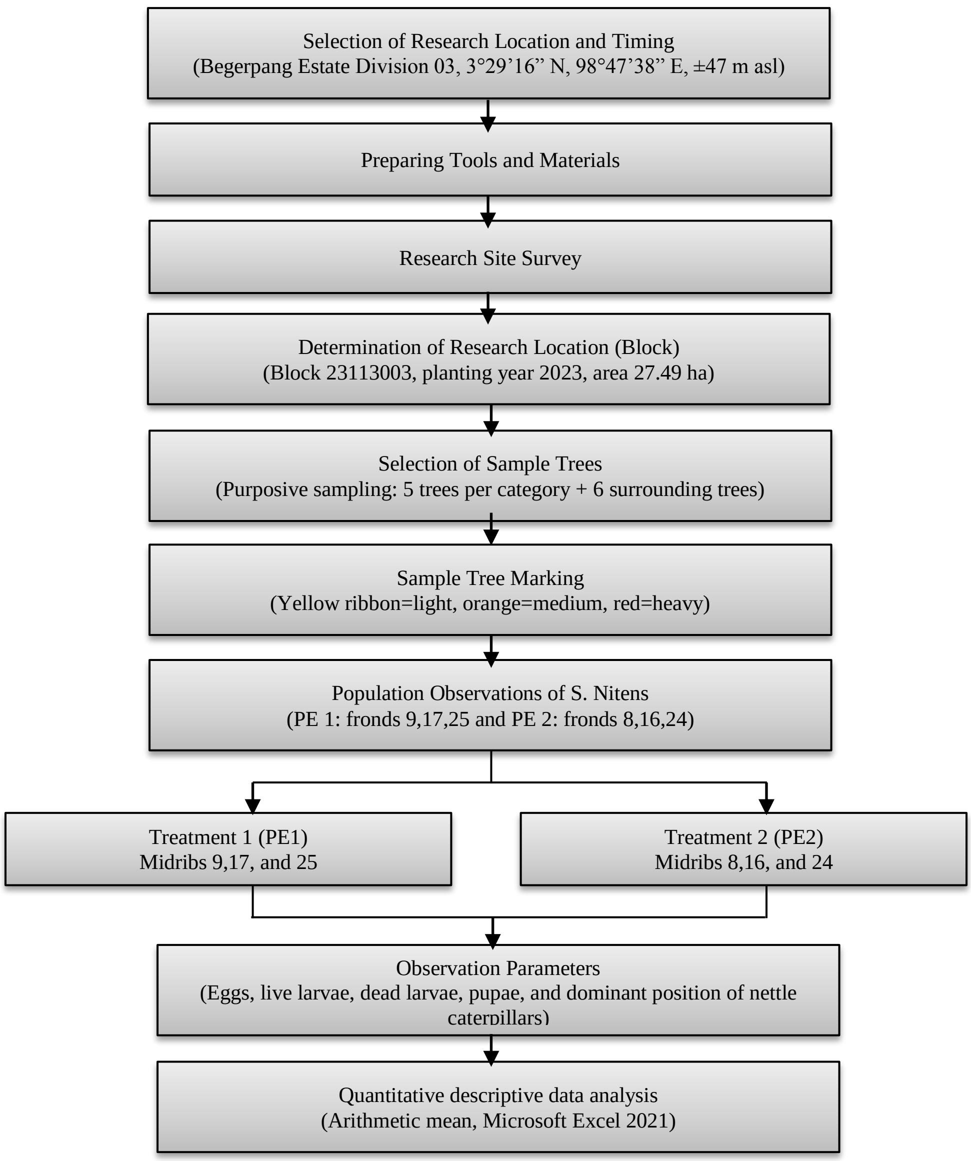


Figure 1. Research implementation diagram

2.2. Materials and Tools.

The research materials include oil palm plants planted in 2023, *S. nitens pests*, block maps, 12×17 cm plastic bags, and label paper. The equipment used is marking tape (red, orange, yellow), stationery, observation sheets, tweezers, iron hooks, cameras, and Microsoft Excel software.

2.3. Research Site Survey

The team conducts an initial survey of the research site before establishing observation blocks. This activity aims to verify the presence of the research objects in the field, ensuring that the S. nitens pest population is present and can be optimally observed at the selected location.

2.4. Determination of Research Locations (Blocks)

Determination of research locations (blocks) was carried out using field survey methods and global census data from the company's pest population. The blocks selected as research locations were blocks with a planting year of 2023 that were identified as experiencing active attacks by *S. nitens pests*, so that the availability of observation objects could be guaranteed during the research.

2.5. Determination of Sample Trees

Determination of sample trees was carried out using a *purposive sampling method* based on pest population census data that had been previously carried out in block 23113003 with an area of 27.49 ha. From each attack intensity category, 5 sample trees were taken, along with 6 surrounding trees, so that the total trees observed covered three categories at once, namely light, moderate, and severe attacks. Each sample tree was marked with a colored ribbon as a category marker, namely yellow for light attacks, orange for moderate attacks, and red for severe attacks. The classification of attack intensity was based on (Syed & Saleh, 1991), with the following criteria: light category if 1–5 pest individuals were found per tree, medium category if 6–10 individuals were found per tree, and heavy category if more than 10 individuals were found per tree.

2.6. Population Observation

A population census was conducted through direct visual observation of each sample tree and six surrounding trees. Parameters observed included the number of eggs, live larvae, dead larvae, and pupae, as well as the average population of the sample tree and six surrounding trees. Observations were conducted on two leaflet treatments: Treatment 1 (PE1), which included leaflets 9, 17, and 25, and Treatment 2 (PE2), which included leaflets 8, 16, and 24. Each observed leaflet was divided into three parts: the tip (position 1), the middle (position 2), and the base (position 3). Each part was distinguished based on the two sides of the leaf blade, namely the upper side (A) and the lower side (B). For pupae, observations were made on the ground surface around the base of the tree trunk and in the leaflet axils.

2.7. Data analysis

Data were analyzed descriptively and quantitatively using Microsoft Excel 2021 software. Data were tabulated and visualized in Microsoft Excel 2021, and the GMaps camera application (version 1.1.19) was used of verify the research location coordinates. The average population per tree was calculated using the arithmetic mean: x = Exi/n, where x is the average population, xi is the number of individuals in the i-th tree, and n is the number of trees observed (Büchse et al., 2007).

3. Results and Discussion

3.1. General Conditions of the Research Location.

The research was conducted in block 23113003, planting year 2023, Division 03 Naga Timbul, Begerpang Plantation, PT PP London Sumatra Indonesia Tbk. During the research, rainfall intensity peaked in March 2026 (121 mm), while it was lowest in April 2026 (2 mm). The high rainfall impacted the decline in the *S. nitens population*, especially the mortality of eggs and early instar larvae that are vulnerable to rainwater exposure. However, relatively high air humidity still supports larval development in the later phase (Egonyu et al., 2022).

Table 1. Rainfall data during the study (January–April 2026)

Month	Highest (mm)	Lowest (mm)	Intensity	Information
January	87	7	Currently	Rain in the morning, afternoon, and evening
February	112	6.4	Tall	The intensity of the rain is quite high
March	121	4.4	Highest	Rain predominantly day and night
April	43	2	Low	Rainfall is relatively low

Source: 2026 observation data

3.2. *S. nitens* Eggs

During the observation, *S. nitens eggs* were not found on any of the sample trees or and the six surrounding trees across the three attack categories (Table 2). This condition is thought to be caused by two main factors: first, the eggs had hatched into larvae before the observation was carried out; second, the relatively high rainfall during the observation has the potential to wash the eggs from the leaf surface, because *S. nitens eggs* are located on the underside of the leaf blade with a very small size so they are vulnerable to being carried away by rainwater flow (observation data, 2026).

3.3. Population of Live and Dead Larvae of *S. nitens*

Table 3 presents complete data on the population of live and dead larvae affected by predator attacks, and in also presents the mortality rate.

Observations showed the highest live larval population in the severe attack category (PE1 = 469 individuals; PE2 = 177 individuals), while the lowest was in the mild category

(PE1 = 15 individuals, PE2 = 3 individuals). The morphology of *S. nitens* larvae was observed in an active condition on oil palm fronds during the observation period (Figure 1). The larvae have a yellowish-green body color with poisonous spines (seta) covering the entire surface of their bodies. These morphological characteristics not only differentiate species but also act as an active defense mechanism against predators (Lubis et al., 2021).

Table 2. Number of *S. nitens eggs* based on attack category

Attack Level	Number of Eggs	Information
Light	0	Eggs not found
Currently	0	Eggs not found
Heavy	0	Eggs not found

Source: 2026 observation data

Table 3. Population of live larvae and dead larvae due to *S. nitens predators*

Attack Level	PE 1		PE 2	
	L. Life	L. Dead	L. Life	L. Dead
Light	15	15	3	4
Currently	293	8	103	2
Heavy	469	30	177	8
Amount	777	53	283	14

Source: 2026 observation data

Figure 2. Setora nitens larvae (personal documentation, 2026)

A total of 67 dead larvae were found spread across all attack categories, with the highest number in severe attacks (38 individuals; PE1 = 30, PE2 = 8), followed by mild attacks (19 individuals: PE1 = 15, PE2 = 4), and the lowest in moderate attacks (10 individuals; PE1 = 8, PE2 = 2), all of which are suspected to be due to predator activity. (Figure 3) shows that *S. nitens* larvae that died due to predator attacks exhibited typical characteristics in the form of a change in body color from yellow-orange to blackish brown and a hardened body with tangled or fallen spines. This symptom is caused by the suction of hemolymph fluid through the predator's stylet (Rustam et al., 2025). It is identical to the findings of Pratama (2021), who reported that *S. annulicornis* was able to suppress the larval population within 15 minutes of first contact, with mortality reaching 100% on the 4th day. The similarity of these symptoms confirms that the deaths of the 67 larvae found across all attack categories were the result of active predation *by Sycanus* sp. in the field.

The presence of predators was successfully documented directly on oil palm fronds in the same location as the habitat of *S. nitens larvae* (Figure 4), indicating that predators play an active role as biological control agents in the Division 03 Begerpang Plantation area (Hakiki et al., 2020). The highest number of dead larvae was found in the heavy attack category (38 individuals) along with the high population density.

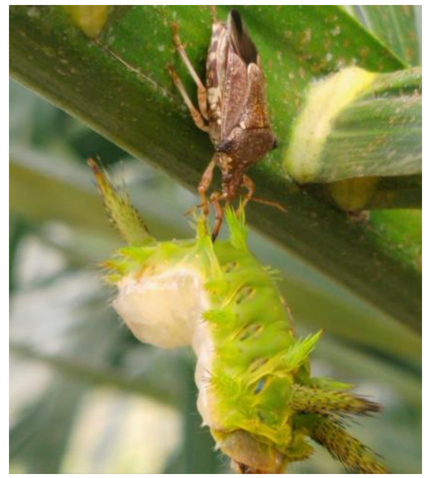
Figure 3. Setora nitens larvae that died due to predator attacks (personal documentation, 2026).

However, the proportion of deaths was actually greater in light attacks, indicating that predation pressure is more effective at low population densities. (Guntoro et al., 2024) reported that one *S. annulicornis* can prey on 3–12 larvae per session, with an average of 1–3 larvae per day. So that in conditions of heavy attacks, the presence of natural predators is not sufficient to keep up with the rate of larval population growth, and integrated control interventions are still needed.

3.4. *S. nitens* pupae.

Pupae were found on the soil surface around the base of the stem, with a total of 540 individuals in total. The highest distribution of pupae was in the severe attack category (73.0%; 394 individuals), followed by moderate attacks (27.0%; 146 individuals), and no pupae were found in light attacks. Quantitative comparative data on the number of pupae per attack category from previous studies are not yet available, so this finding is a contribution of initial data that can be used as a reference for further research. The high proportion of pupae in the severe attack category indicates that the pest population has the potential to produce the next generation in a short time if no immediate control measures are taken (Pradana et al., 2020).

(a)



(b)

Figure 4. (a) Predators found on oil palm fronds at the research location, (b) A predator preying on *Setora nitens larvae* in the field (personal documentation 2026).

Table 4. Number of *S. nitens* pupae in each attack category

Attack rate	Pupa	Percentage (%)
Light	0	0.0
Currently	146	27.0
Heavy	394	73.0
Amount	**540**	**100.0**

Source: 2026 observation data

3.5. Average population in sample trees.

Analysis of the average population of *S. nitens* per sample tree showed a consistent pattern by attack level. The highest average population was recorded in the heavy attack category (21.4 individuals/tree), followed by the moderate category (8.8 individuals/tree) and the light category (1.4 individuals/tree) (Table 5). The significant differences between the three categories are in line with the classification system of attack levels according to (Syed & Saleh, 1991), thus strengthening the validity of the categorization used in this study.

Table 5. Average population of *S.nitens* in sample trees

Attack Level	Total PE1	Mean ± SE	Total PE2	Mean ± SE
Light	7	1.4 ± 0.40	1	0.2 ± 0.20
Currently	44	8.8 ± 0.49	17	3.4 ± 0.40
Heavy	107	21.4 ± 1.66	36	7.2 ± 0.20
Amount	**158**		**54**	

Source: 2026 observation data

3.6. Comparison of Sample Tree Populations with Six Surrounding Trees.

The population in the sample tree was consistently higher than the average of the six surrounding trees in all attack categories (Table 6). The presence of a relatively high population in surrounding trees indicates that *S. nitens* can spread rapidly between plants (Rustam et al., 2025).

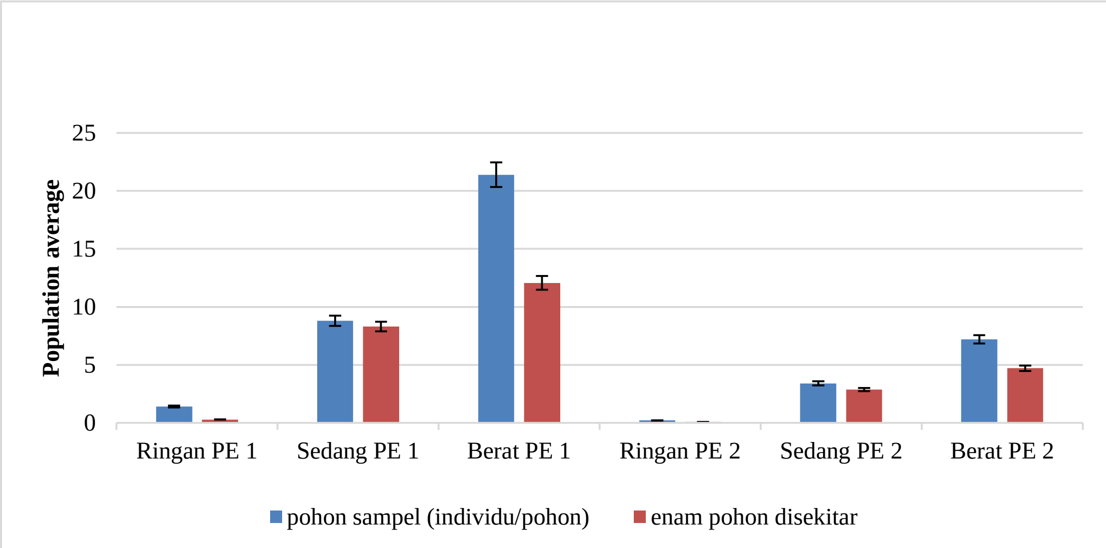


Figure 6. Comparison graph of the average population of *S. nitens* on the sample tree and six surrounding trees (personal source)

3.7. Dominant Positions of Fire Worms on Leaf Sheaths.

The highest number of larvae was found at positions 1A and 1B (the tip of the leaf sheath), while the lowest number was at positions 3A and 3B (the tip of the leaf sheath) (Table 6). Position 1B recorded the highest total with 325 individuals, followed by 1A with 321 individuals.

Table 6. Distribution of *S. nitens population* based on position on the leaf stem

Leaf Position	PE 1	%	PE 2	%	Total	percentage%
End (1A+1B)	485	45.8	161	15.2	646	60.9
Middle (2A+2B)	246	23.2	100	9.4	346	32.6
Base (3A+3B)	46	4.3	22	2.1	68	6.4
AMOUNT	**777**	**73.3**	**283**	**26.7**	**1060**	**100.0**

Source: 2026 observation data

The distribution of larvae based on leaf sheath position showed the highest density at the tip (positions 1A+1B) with a total of 646 individuals (60.9%), followed by the middle (positions 2A+2B) with 346 individuals (32.6%), and the base (positions 3A+3B) with 68 individuals (6.4%). This pattern is consistent with a report (Mula et al., 2020) that fire caterpillar larvae tend to colonize at the tip of the leaf sheath, accounting for 65–70% of the total population, because the young leaf tissue in this area is richer in Water and nutrients, making it a preferred feeding location. Similarly, Anggraini & Berutu (2022) stated that the highest attack intensity was consistently found from the tip to the middle of the leaf sheath. Leaf sheaths 9 and 17 showed higher larval densities than leaf sheath 25, presumably because the leaf tissue is softer and more nutritious (Lubis et al., 2021) . Therefore, monitoring should be prioritized at the tips and middle of the 9th and 17th leaf stalks, especially on the lower leaf blades.

4. Conclusion

Based on the results of the study, it was concluded that the population of S. nitens increased with the severity of the attack, with the highest number of live larvae in the severe attack category (PE1 = 469 individuals; PE2 = 177 individuals) and an average of 21.4 individuals per tree. The pest actively spread to six trees around the sample tree, especially in cases of severe attacks, indicating rapid inter-plant dispersion. Dead larvae found in all attack categories were caused by the activity of natural predators, indicating the potential for biological control that can be optimized.

The dominant position of larvae was concentrated on the top of the leaf sheath (1a/1b), especially on the 9th and 17th leaf sheaths, with the lower leaf sheath being the preferred location. These findings recommend that the S. nitens population census focus on the top of the 9th and 17th leaf sheaths to improve monitoring efficiency and accuracy. Control measures should be initiated as soon as spread to surrounding trees is detected, serving as a threshold for field action.

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