

Assessment of population density of *Prosoestus* spp. (Coleoptera: Curculionidae), the main pests of female oil palm inflorescences in palm groves of La Mé

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Abstract

Improvements in the oil palm sector through government support have enabled Côte d'Ivoire to become the world's ninth largest producer, with a national production of 2.7 million tons of fruit bunches per year and 600,000 tons of crude palm oil per year, and occupy the 2nd place in Africa behind Nigeria. Despite this, oil palm cultivation is exposed to numerous phytosanitary problems that negatively impact its productivity. Among these constraints, there are *Prosoestus* spp. (Coleoptera: Curculionidae), pests of female oil palm inflorescences whose damage can lead to a decrease in the nouaison rate of more than 60% during heavy infestations. The studies carried out at the National Center for Agricultural Research, station in La Mé aimed to investigate the population density of *Prosoestus* spp (Coleoptera: Curculionidae) in palm groves of La Mé. The inventory of female inflorescence pests revealed three main insects causing damage to oil palm inflorescences: *Prosoestus sculptilis* and *Prosoestus minor* of the Curculionidae beetles and *Elaeidiphylos adustalis* of the Pyralidae lepidopterans. The population of *P. sculptilis* was also higher on male inflorescences. However, the converse was observed on female inflorescences, where population of *P. minor* was higher than that of *P. sculptilis*. These pests are most active during the daytime, mainly at full anthesis, with an abundance on male inflorescences. *P. sculptilis* was the most frequently observed on both types of inflorescences. It is therefore important to study the interaction between *Prosoestus* spp. and pollinating insects.

Keywords: Population density, Inflorescence, *prosoestus* spp, pest, oil palm

Introduction

After its independence, Côte d'Ivoire chose agriculture as the pillar of its economy. This economy is mainly based on the resources generated by coffee and cocoa. These crops have been encouraged by the political authorities, with the result that Côte d'Ivoire has been the world's leading cocoa producer for several years (JNCC, 2020) [4]. To diversify these resources, Ivorian government has adopted a crop diversification policy with the introduction of new crops such as oil palm, which has quickly become an important part of the country's economy.

Improvements to the oil palm sector through government support have enabled Côte d'Ivoire to become the world's ninth largest producer, with gross national production of 2.7 million tons of fruit bunches per year and 600,000 tons of crude palm oil per year, ranking second in Africa behind Nigeria (USDA, 2024) [14]. Côte d'Ivoire is also Africa's leading exporter of palm oil (D'Avignon, 2013) [2]. Palm oil production represents 3.13% of Côte d'Ivoire's GDP. These economic data show the importance of oil palms in the Ivorian economy and its value chain, which covers a long list of professions ranging from cultivation to the processing of crude oil or final products. Thus, oil palms contribute to poverty reduction and ensure food security for the Ivorian population (Cumunel, 2020) [1]. Due to the performance of its vegetal material, recognized as a mark of quality and genetic progress, not to mention the vast expanses of arable land, Ivorian government has set itself the objective, through its third "Palm Tree" plan set up by the national

agricultural investment program, of increasing crude palm oil production (Ricardo, 2010) [12].

Unfortunately, despite the role played by this plant in the Ivorian economy, this crop, like all cash crops, is faced with major difficulties. Indeed, it is exposed to numerous phytosanitary problems. These difficulties are due to many factors, such as soil depletion, the effect of chemical applications on pollinators, and the impact of harmful insects (Jacquemard, 2013; N'Guessan *et al.*, 2020) [3, 6], including *Prosoestus* spp., the main insect pests of female oil palm inflorescences. A more in-depth knowledge of these insects could be beneficial for good management of oil palm plantations. It is with this perspective that this study was conducted, with the overall objective of studying the population density of *Prosoestus* spp (Coleoptera: Curculionidae) in the palm groves of La Mé. Specifically, the study aimed to:

- Assess the population density of *Prosoestus* spp (Coleoptera: Curculionidae) pests in the palm groves of La Mé;
- Study the temporal dynamics of *Prosoestus* spp in the palm groves of La Mé.

Materials and methods

Study site

The studies were conducted at the research station of National Center for Agricultural Research of La Mé. The geographical coordinates of this station are: Latitude 5°26' N, Longitude 3°50' W). The site is surrounded by the village

of Kongofon to the north, the village of Aghien to the south, the village of Ahoutoué to the east, and the Mé River. The site is characterized by a hot and humid climate. The landscape consists of a low plateau and lowlands. The soil of La Mé is ferralitic, deep, and crumbly with fine particles. The vegetation consists of dense evergreen rainforest, which has been gradually replaced by oil palm plantations, with a hydrographic system composed of the Mé River and the Aghien Lagoon. The climate is characterized by an average relative humidity of 85%, an average annual temperature of 25.7°C, and annual rainfall of approximately 1,500 to 2,000 mm (Traoré & Mangara, 2009) [13].

The vegetative material used was oil palm *Elaeis guineensis* Jacq. (Palmaceae), variety Tenera of category C1001F, currently vulgarized in Côte d'Ivoire. The main organs used were female and male inflorescences at different phenological stages. The plants used were seven years old. Main insect pests of female oil palm inflorescences were collected in plots H05, H25, H24, and A62 of La Mé.

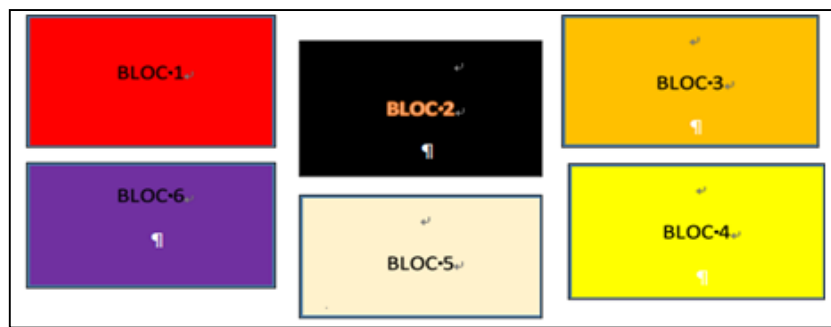


Fig 1: Experimental setup

Inventory of oil palm inflorescence pests

▪ Sampling

One (1) male inflorescence and one (1) female inflorescence were randomly selected from each of the six selected blocks. The selected inflorescences were monitored daily at each phenological stage (beginning of anthesis, full anthesis, and end of anthesis). Each inflorescence was stripped of spathes and intrusive palms to facilitate the sectioning of five male and five female spikelets using pruning shears. Each different batch of 5 spikelets was placed in plastic sachets and then sprayed with a chemical insecticide. These samples were then sent to the laboratory to identify the insect pests they contained.

▪ Observations

Various spikelets collected and stored in sachets were taken to the laboratory to be stripped for better visibility of the hidden insects. To this end, they were shaken onto filter paper using tweezers. The insects that fell onto the filter paper were grouped according to inflorescence and flowering stage, then stored in pill bottles containing 70°C alcohol to remove pollen debris. They were observed under a portable LCD microscope and identified using the insect collection from the oil palm inflorescences at the La Mé station.

Assessment of population density of *Prosoestus* spp, pests of oil palms

The individuals of *Prosoestus* spp were counted from the spikelets collected. This enabled the population density to be assessed using the following formula

Methods

Experimental design

The method used was a completely randomized design (CRD). Four plots (H05, H25, H24, A62) of 7 ha in production were selected for this study. Each plot constitutes a block. Each block or plot was subdivided into 6 sub-blocks (Fig 1). In each sub-block, one (1) male inflorescence and one (1) female inflorescence were randomly selected and then monitored at each phenological stage (beginning of anthesis, full anthesis, and end of anthesis). Thus, in each block (or plot), there were 36 inflorescences per plot. This equates to 18 male inflorescences and 18 female inflorescences per plot. Thus, three male and female inflorescences were selected per sub-block. A total of 144 inflorescences were used for this study across the four plots. The trials were conducted over a period of four (4) months, from November 2024 to February 2025.

$$\text{Population density} = \frac{\text{Total number of individuals}}{\text{Number of inflorescences}}$$

Study of the temporal dynamics of *Prosoestus* spp.

In these same blocks and on the same male and female inflorescences, stripped of their troublesome palms and spathes, mosquito net sleeves were installed. After covering, the inflorescence entered anthesis and the aniseed odor attracted pollinating insects and inflorescence pests, which were captured at different phenological stages using an aspirator between 8 a.m. and 10 a.m. and between 4 p.m. and 6 p.m. during seven days. The tests were carried out over a period of two months.

Results

Pests of oil palm inflorescences recorded

The inventory of female inflorescence pests showed that several insect species are present on both female and male oil palm inflorescences. These species include *Prosoestus sculptilis* and *Prosoestus minor* of Curculionidae beetle family and *Elaeidiphylos adustalis*, a Pyralidae lepidopteran.

On female inflorescences, *P. minor* was more frequently encountered, with an average of 7.11 individuals per inflorescence. *P. sculptilis* was moderately represented with an average of 3.53 individuals. As for *E. adustalis*, it was less present on the female inflorescences of the oil palm, with an average of 0.08 individuals. Analysis of variance showed significant differences between the average number of pests with regard to female inflorescences ($p < 0.05$) (Fig 2A).

On male inflorescences, *P. sculptilis* was present with an average of 17.16 individuals. While *P. minor* was moderately encountered with an average number of 7.03 individuals. The species *E. adustalis* was less present there. The average number of individuals recorded was 0.18 (Fig 2B).

Population density of *Prosoestus* spp, pests of female inflorescences of oil palm

The population density of pests based on the level of flowering has been assessed for *P. sculptilis* and *P. minor*, which have been more widespread on oil palm inflorescences.

▪ **Start of anthesis**

At the beginning of anthesis, the population density of *P. sculptilis* and *P. minor* was statistically similar on male inflorescences ($p > 0.05$) as well as on female inflorescences ($p > 0.05$). It was respectively 8.08 individuals per inflorescence and 5.29 individuals per inflorescence for *P. sculptilis* on male inflorescences and respectively 5.94 individuals per inflorescence and 10.14 individuals per inflorescence for *P. minor* on female inflorescences (Table I).

Table I: Population density of pests on male and female inflorescences at the beginning of anthesis

Inflorescences	Population density (individuals/inflorescence)		Probability (P)
	<i>P. sculptilis</i>	<i>P. minor</i>	
Male inflorescence	8.08 ± 1.89 ^a	5.29 ± 0.84 ^a	0.18 > 0.05
Female inflorescence	5.94 ± 1.26 ^a	10.14 ± 2.08 ^a	0.09 > 0.05

The means with the same letter on the same line are not statistically different.

▪ **Full anthesis**

In full anthesis, the population density was higher for *P. sculptilis* with 26.38 individuals per inflorescence than for *P. minor* (7.5 individuals per inflorescence) on male inflorescences. Contrarily, on the female inflorescences, *P. sculptilis* was less abundant with an average of 0.54 individuals per inflorescence, while the population density of *P. minor* was higher with an average of 3.17 individuals per inflorescence (Table II).

Table 2: Population density of pests on male and female inflorescences in full anthesis

Inflorescences	Population density (individuals/inflorescence)		Probability (P)
	<i>P. Sculptilis</i>	<i>P. minor</i>	
Male inflorescence	26.38 ± 7.85 ^a	7.5 ± 1.51 ^b	0.0203 < 0.05
Female inflorescence	0.54 ± 0.14 ^b	3.17 ± 0.59 ^a	0.0001 < 0.05

The means with the same letter on the same line are not statistically different.

▪ **End of anthesis**

At the end of anthesis, population density was higher for *P. sculptilis* with an average of 17.02 individuals per inflorescence than for *P. minor* (8.29 individuals per inflorescence) on the male inflorescences. Conversely, on the female inflorescences, the population density of *P. sculptilis* was lower with an average of 4.13 individuals per inflorescence, while population density of *P. minor* was higher with an average of 8.02 individuals per inflorescence (Table 3).

Table 3: Population density of pests on male and female inflorescences at the end of anthesis

Inflorescences	Population density (individuals/inflorescence)		Probability (P)
	<i>P. sculptilis</i>	<i>P. minor</i>	
Inflorescence mâle	17.02 ± 4.07 ^a	8.29 ± 1.56 ^b	0.0481 < 0.05
Inflorescence femelle	4.13 ± 1.06 ^b	8.02 ± 1.57 ^a	0.0421 < 0.05

The means with the same letter on the same line are not statistically different.

**Temporal dynamics of *Prosoestus* spp
Male inflorescence**

On the male inflorescences, in the morning, at the beginning of anthesis, the number of *P. sculptilis* was almost equivalent to that of *P. minor*. The average number of *P. sculptilis* was 13.75 ± 16.68, and for *P. minor*, it was 7.46 ± 7.18. No statistical difference was observed ($p (0.09) > 0.05$). At full anthesis, the average number of *P. sculptilis* was 30.29 ± 35.02 individuals, higher than that of *P. minor* which was 12.75 ± 13.43 individuals. These results are statistically different ($p (0.02) < 0.05$). At the end of anthesis, the average number of *P. sculptilis* was higher (51.25 ± 68.97 individuals) than that of *P. minor* (10.54 ± 13.40 individuals). These results are statistically different ($p (0.006) < 0.05$) (Fig 3A).

In the evening, at the beginning of anthesis, the number of insects observed was 2.42 ± 2.93 individuals for *P. sculptilis* and 3.12 ± 2.87 individuals for *P. minor*. No significant difference was observed between these pests at this stage of flowering ($p (0.40) > 0.05$). At full anthesis, this number varied from 3.75 ± 5.47 individuals for *P. sculptilis* and from 3.83 ± 4.05 individuals for *P. minor*. However, no significant difference was observed ($p (0.95) > 0.05$). At the end of anthesis, the number of *P. sculptilis* was 1.5 ± 1.66 individuals and 4.46 ± 4.26 for *P. minor* individuals. A significant difference ($p (0.002) < 0.05$) was observed between these pests at this stage of flowering (Fig 3B).

Female inflorescence

In the morning, the average number of individuals was 9.17 ± 10.79 individuals for *P. sculptilis* and 8.79 ± 8.72 individuals for *P. minor* at the beginning of anthesis. While in full anthesis, an average number of 6.54 ± 9.39 individuals of *P. sculptilis* and 8.08 ± 10.83 individuals of *P. minor* was observed. These results do not differ statistically ($p > 0.05$) for these insects at these two flowering stages. However, at the end of anthesis, an average number of 0.50 ± 0.78 individuals of *P. sculptilis* and 3.21 ± 4.68 individuals of *P. minor* was observed. The statistical analysis revealed a significant difference ($p < 0.05$) for this flowering stage (Fig 4A).

In the evening, the number of *P. minor* was higher than that of *P. sculptilis* at all stages of flowering. The average number of individuals was 2.71 ± 4.31 for *P. sculptilis*, lower than 11.50 ± 18.58 individuals for *P. minor* at the beginning of anthesis. At full anthesis, the average number of individuals was 1.71 ± 3.16 for *P. sculptilis*, also lower than 7.96 ± 11.08 individuals for *P. minor*. At the end of anthesis, the average number of *P. sculptilis* (0.58 ± 1.17 individuals) was lower than that of *P. minor* (3.13 ± 3.50 individuals). The statistical analysis showed a significant difference ($p < 0.05$) between the average number of individuals of each species with respect to the different flowering stages (Fig 4B).

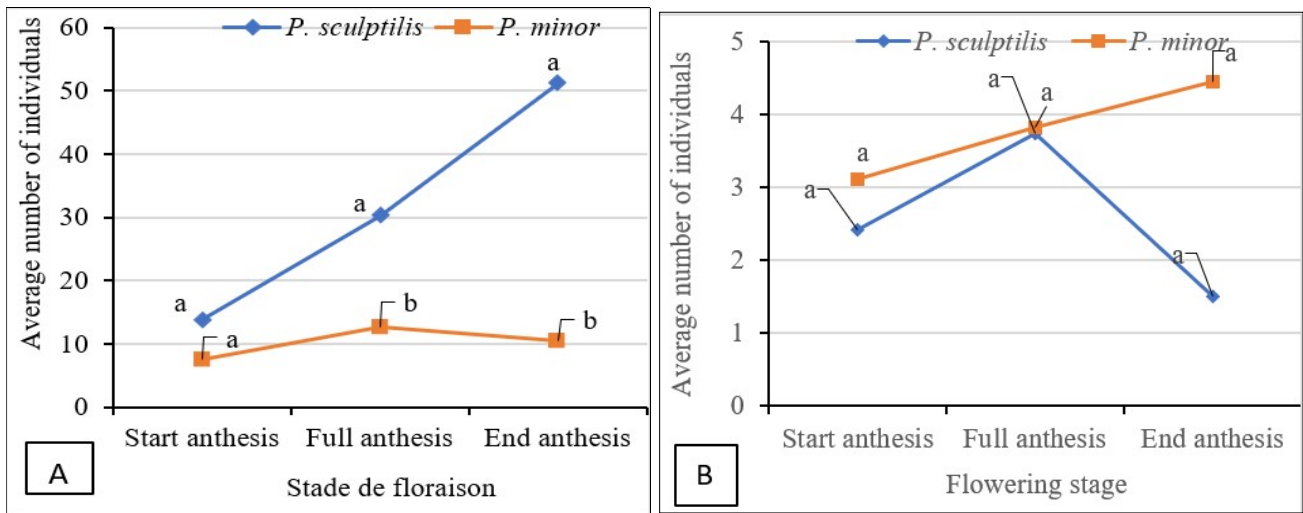


Fig 3: Temporal dynamics of *Prosoestus* spp. on male inflorescences, A: Morning, B: Evening

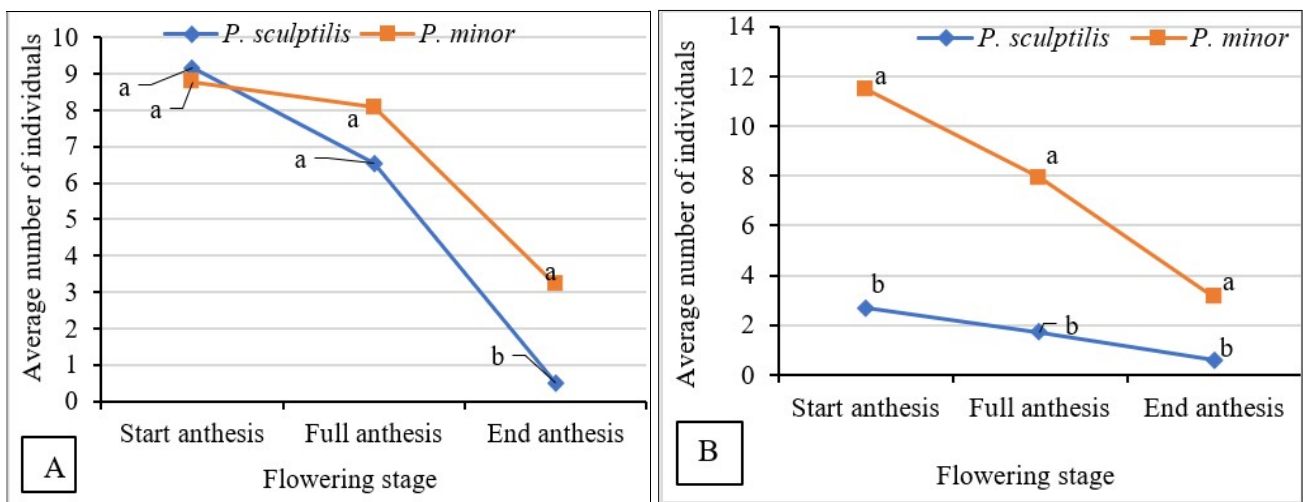


Fig 4: Temporal dynamics of *Prosoestus* spp. on female inflorescences, A: Morning, B: Evening

Discussion

The inventory of female inflorescence pests revealed the presence of three main pests affecting oil palm inflorescences in La Mé. These are *Prosoestus minor* (Coleoptera: Curculionidae), *Prosoestus sculptilis* (Coleoptera: Curculionidae), and *Elaeidiphylos adustalis* (Lepidoptera: Pyralidae). However, our research indicated that *P. minor* and *P. sculptilis* are the most numerous insects on oil palm inflorescences compared to *E. adustalis*. These results are similar to those of Philippe (1993) [10] and N'Guessan *et al.* (2022) [7], who mentioned that female oil palm inflorescences are subjected to attacks by several insects, the most important of which are *Prosoestus sculptilis* and *P. minor* (Coleoptera: Curculionidae). They also highlighted that the moth *Elaeidiphylos adustalis* causes insignificant damage to these female inflorescences of oil palms. Moreover, *P. sculptilis* was mainly present in large numbers on male inflorescences, while *P. minor* was more abundant on female inflorescences at all stages of flowering, except at the beginning of anthesis, when there was no significant difference between the average number of individuals of these two insects on male and female inflorescences. These results differ from those of Kouakou *et al.* (2018) [5], who showed that *P. sculptilis* and *P. minor* are more abundant on female inflorescences. Our results could be explained by the

duration of the study. Indeed, our work took place over only four months, from November 2024 to February 2025, while that of Kouakou *et al.* (2018) [5] lasted throughout the year. The study of the temporal dynamics of these two main inflorescence pests has provided a better understanding of the activity paces of these insects and their interactions on inflorescences. The study showed that during the daytime, *P. sculptilis* is much more active than *P. minor*, with peak activity occurring during full and end anthesis, particularly on the male inflorescence. This pace of activity can also be observed on the female inflorescence, with a slight decrease in activity for both types of insects. However, the activity of *P. sculptilis* and *P. minor* is almost identical for each stage of flowering, with a peak at the beginning and full anthesis. According to N'Guessan *et al.* (2022) [7], *P. minor* and *P. sculptilis* were more numerous at full anthesis than at the beginning and end of anthesis on female inflorescences. The heavy presence of these pests at the beginning of anthesis and mainly at full anthesis on the inflorescences can be explained by the very intense aniseed smell given off by the flowers. The volatile odorous compounds emitted by these oil palm inflorescences are thought to make them more attractive to insects during humid periods (Petit, 2010). This statement could explain the large numbers of *P. sculptilis* and *P. minor* seen during the day. Indeed, rising temperatures would have a negative impact on crops by

favoring pest populations (Wang *et al.*, 2021) [15]. Although both pests were observed on both types of inflorescences, the male inflorescence hosted a higher number of these pests. According to Porter *et al.* (1991) [11], pests can be present in large numbers in a crop without causing major impact only if they are not abundant during the vulnerable stages of crop growth.

Conclusion

Three (3) pests affecting oil palm inflorescences were identified in the palm groves of La Mé. These are *Prosoestus minor* Faust (Coleoptera: Curculionidae), *Prosoestus sculptilis* (Coleoptera: Curculionidae), and *Elaeidiphylos adustalis* Hampson (Lepidoptera: Pyralidae). The population density of *Prosoestus sculptilis* was higher on male inflorescences than *Prosoestus minor*. On female inflorescences, however, the population of *P. minor* was higher than that of *P. sculptilis*, probably due to the short duration of the study. These pests are most active during the daytime, mainly at full anthesis, with an abundance on male inflorescences. However, *Prosoestus sculptilis* was the most commonly observed species on both types of inflorescences. Nevertheless, it would be important to study the interaction between *Prosoestus* spp. and pollinating insects and to propose selective control methods against these pests.

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