

Analysis of The Effect of Pollinating Insects (*Elaeidobius Kameronicus*) on Oil Palm Average Bunch Weight in Sei Silau Plantation of PT Perkebunan Nusantara IV Regional I

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Article History: Received: 29 Mei 2026, Final Revision: 20 June 2026, Accepted: 20 July, Online Publication: 30 July 2026

ABSTRACT

Oil palm (*Elaeis guineensis* Jacq.) is an important plantation commodity whose productivity is closely related to the quality and yield of fresh fruit bunches (FFB). One of the main indicators of production performance is average bunch weight, which is strongly influenced by the success of pollination. This study aimed to evaluate the differences in average bunch weight before and after the introduction of the pollinating insect *Elaeidobius kameronicus*. A quantitative comparative method with paired observations on the same plantation blocks was applied in this study. The data were obtained from production records in Afdeling II of Sei Silau Plantation, covering the periods of July–August 2025 (before insect introduction) and January–February 2026 (after introduction). Data analysis was conducted using the Shapiro–Wilk normality test, followed by the Wilcoxon Signed Rank Test because the data were not normally distributed. The results showed that the average bunch weight after the release of pollinating insects was consistently higher than before the introduction. Statistical analysis also revealed significant differences, with p-values of 0.001 and 0.008 ($p < 0.05$). These findings indicate that the presence of *Elaeidobius kameronicus* improves pollination efficiency, thereby enhancing fruit formation and bunch weight. This study highlights the importance of effective pollinator management as a strategy to improve oil palm productivity in plantation systems.

Keywords: Average bunch weight, fruit set, oil palm, pollination, *Elaeidobius kameronicus*

INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is one of the strategic plantation commodities in Indonesia and plays an important role in the national economy. This commodity not only contributes significantly to national foreign exchange earnings through palm oil exports, but also serves as a source of livelihood for millions of workers in the

plantation sector and its downstream industries [1]. Along with the increasing global demand for palm oil, efforts to improve crop productivity need to be carried out sustainably through optimal cultivation management.

The productivity of oil palm is strongly influenced by the quantity and quality of fresh fruit

bunches (FFB) produced. One of the main indicators used in evaluating FFB production is Average Bunch Weight (ABW). ABW is a parameter that describes the average weight of harvested fruit bunches within a certain period and is commonly used as a basis for production estimation and plantation performance evaluation [2]. The higher the ABW value, the greater the production potential that can be generated by oil palm plants.

ABW values are influenced by various internal and external factors. Internal factors include plant age, genetic potential, and physiological conditions, while external factors include environmental conditions, nutrient availability, and cultivation management practices applied in the plantation. One of the most important factors affecting ABW is the success of the pollination process. Optimal pollination results in perfect and uniform fruit formation within a bunch, thereby increasing the overall bunch weight [3].

In the reproductive system of oil palm, pollination plays a crucial role because this plant is monoecious, meaning that male and female flowers are found on the same plant but in different bunches [4]. The success of pollination greatly determines the fruit set rate, which refers to the percentage of female flowers that develop into normal fruits. The higher the fruit set value, the more fruits are formed in a bunch, which directly contributes to an increase in ABW values [5].

Naturally, the pollination process in oil palm is largely assisted by pollinating insects. One of the most important pollinating insects is *Elaeidobius kamerunicus*, a small weevil that lives and reproduces on male flowers after anthesis. This insect is highly effective in distributing pollen from male flowers to female flowers due to its high activity and strong specificity to oil palm plants [6]. The presence of *Elaeidobius kamerunicus* has been proven to significantly improve pollination efficiency compared to natural pollination by wind or other pollinating agents.

Various studies have shown that the presence and population of *Elaeidobius kamerunicus* are closely related to increased oil palm productivity. This insect can increase fruit set values by 15–20%, which ultimately affects the

number of fruits in a bunch and the overall bunch weight [7]. Therefore, the management of pollinating insect populations has become an important aspect of oil palm cultivation management.

However, the population of *Elaeidobius kamerunicus* in the field is not always stable. Several factors, such as environmental conditions, pesticide use, and the presence of natural enemies, may affect the survival and activity of these insects. Improper pesticide use may reduce pollinator populations and negatively affect the pollination process in oil palm plantations [8]. Therefore, appropriate management strategies are needed to maintain and increase pollinator populations in plantation areas.

One effort that can be implemented is the dissemination or introduction of *Elaeidobius kamerunicus* in plantation blocks with low pollinator populations. This dissemination aims to increase the number of active insects involved in the pollination process, thereby improving pollination effectiveness and ultimately increasing ABW values. Theoretically, an increase in pollinator populations will increase the frequency of visits to receptive female flowers, thus increasing the chances of successful fertilization [9].

Sei Silau Plantation of PT Perkebunan Nusantara IV Regional I is one of the plantation companies that has implemented the dissemination of *Elaeidobius kamerunicus* as an effort to improve oil palm productivity. Although theoretically the dissemination of pollinating insects can increase ABW values, empirical evidence through field production data analysis is still required. This evaluation is important to determine the effectiveness of pollinating insect dissemination in improving plantation productivity.

In addition, comparative analysis of ABW values before and after the dissemination of pollinating insects can provide a clearer understanding of the relationship between pollination activity and crop production. By using a statistical approach, such as the Wilcoxon Signed Rank Test, it can be determined whether the observed differences are statistically significant. The results of this analysis are expected to serve as

a basis for plantation management decision-making related to effective and sustainable pollinator management. Based on the description above, the objective of this study was to analyze the differences in oil palm Average Bunch Weight (ABW) before and after the dissemination of *Elaeidobius kamerunicus* at Sei Silau Plantation of

PT Perkebunan Nusantara IV Regional I. This study is expected to provide scientific contributions in the field of plantation management, particularly regarding the optimization of natural pollination as an effort to increase oil palm productivity.

MATERIALS AND METHODS

Research Location and Time

This research was conducted in Afdeling II of Sei Silau Plantation, PT Perkebunan Nusantara IV Regional I, North Sumatra. Data collection was carried out during two observation periods, namely July–August 2025 as the data before the dissemination of pollinating insects and January–February 2026 as the data after the dissemination of *Elaeidobius kamerunicus*. This study was a field research using a quantitative approach with a comparative method. The research design involved observations of the same objects under two different conditions, namely before and after the dissemination of pollinating insects, in order to determine changes in Average Bunch Weight (ABW) resulting from the applied treatment.

Research Variables

The variables observed in this study consisted of independent variables, dependent variables, and control variables. The independent variable (X) was the dissemination of *Elaeidobius kamerunicus*, which was divided into two conditions, namely before and after dissemination. The dependent variable (Y) was the Average Bunch Weight (ABW) of oil palm expressed in kilograms (kg). The control variables included plant age, observation blocks, fertilization systems, harvesting techniques, and harvesting intervals, which were standardized to minimize the influence of other factors on the research result.

Data Collection Technique

The data used in this study were secondary data obtained from plantation production reports. Data collection was conducted through documentation of production reports and recapitulation of Average Bunch Weight (ABW) data before and after the dissemination of *Elaeidobius kamerunicus* in 15 plantation blocks with a planting year of 2015. The collected data were then organized and grouped according to the observation periods to facilitate the statistical analysis process.

Data Analysis

Data analysis was conducted in several stages to obtain accurate results. The first stage was a normality test using the Shapiro–Wilk method because the number of samples was less than 50 ($n = 15$) at a significance level of $\alpha = 0.05$. If the data were normally distributed, the analysis was continued using a paired sample t-test. However, if the data were not normally distributed, the non-parametric Wilcoxon Signed Rank Test was applied to determine the differences in ABW values before and after the dissemination of pollinating insects. The testing criteria were based on the significance value (p-value), where p-value < 0.05 indicated that H_0 was rejected, meaning there was a significant difference, whereas p-value ≥ 0.05 indicated that H_0 was accepted. All data analyses were performed using IBM SPSS Statistics software

RESULTS AND DISCUSSION

Average Bunch Weight Data

Average Bunch Weight (ABW) data were obtained from observations conducted on several oil palm plantation blocks before and after the dissemination of *Elaeidobius kamerunicus*. Observations were carried out on 15 plantation blocks with a planting year of 2015. The effect of *Elaeidobius kamerunicus* dissemination could only be observed after approximately six months

because the development process of oil palm fruit bunches, from pollination to harvest, requires about 5–6 months. Therefore, ABW data before dissemination were collected in July and August 2025, while the data after dissemination were collected in January and February 2026 to optimally represent the treatment effects.

Table 1. Average Bunch Weight Data

Planting Year	Block No.	Area (Ha)	Palm Inventory	Before Dissemination July 2025 (Kg)	After Dissemination January 2026 (Kg)	Before Dissemination August 2025 (Kg)	After Dissemination February 2026 (Kg)
2015	211	14.99	1,873	10.18	10.64	10.82	13.25
	270	8.38	1,041	10.72	11.42	11.41	11.59
	271	30.74	3,902	10.57	11.08	10.88	11.14
	272	28.99	3,657	9.79	9.96	10.22	10.57
	289	8.13	1,027	10.85	11.88	10.78	12.28
	290	26.32	3,334	10.80	11.59	11.20	12.05
	291	29.81	3,736	10.67	11.05	11.12	10.48
	292	29.24	3,494	9.45	9.98	9.94	10.13
	310	14.87	1,953	10.69	11.28	10.94	11.78
	311	15.95	1,895	9.92	10.02	10.33	10.41
2015	330	13.12	1,541	10.58	10.92	11.40	11.40
	331	15.71	1,769	9.70	10.80	10.20	10.80
	350	18.43	2,262	10.58	10.80	10.50	10.71
	370	11.94	1,471	10.69	11.37	10.90	11.21
	390	11.57	1,315	10.69	11.39	10.92	11.33

Source: Secondary Data (2026)

Based on the table above, it can be observed that, in general, the Average Bunch Weight (ABW) values after the dissemination of *Elaeidobius kamerunicus* tended to be higher, reaching an average of 11.12 kg, compared to the condition

before dissemination, which averaged 10.58 kg. These results indicate that the dissemination of pollinating insects contributed to an increase in oil palm bunch weight production.

Data Normality Test

The normality test was conducted to determine whether the data distribution was statistically normal or non-normal. This test was performed to ensure the normal distribution of Average Bunch Weight (ABW) data before and after the dissemination of *Elaeidobius*

kamerunicus. Since the sample size was less than 50 ($n = 15$) with a significance level of $\alpha = 0.05$, the normality test was carried out using the Shapiro–Wilk method. The results of the normality test are presented in the following table.

Table 2. Data Normality Test

Observation Variable	Statistic	df	Sig.	Description
ABW Before Dissemination July 2025 (Kg)	0.815	15	0.006	Non-Normal
ABW After Dissemination January 2026 (Kg)	0.927	15	0.246	Normal
ABW Before Dissemination August 2025 (Kg)	0.946	15	0.470	Normal
ABW After Dissemination February 2026 (Kg)	0.949	15	0.504	Normal

Source: Secondary Data (2026), Prossed

The results of the normality test showed that the significance value of ABW before dissemination in July 2025 was 0.006, which was below the threshold of 0.05 ($p < 0.05$), indicating that the data were not normally distributed. In contrast, the significance values of ABW after dissemination in January 2026, before dissemination in August 2025, and after dissemination in February 2026 were 0.246, 0.470, and 0.504, respectively, all of which were greater than 0.05 ($p > 0.05$). These results indicate that the three datasets were normally distributed.

However, the presence of one variable that did not meet the normality assumption caused the overall research data to be categorized as non-normally distributed. Therefore, further analysis was conducted using the non-parametric Wilcoxon

Table 2. Data Normality Test

Comparison	Sig. (2-tailed)	Description
ABW July 2025 – January 2026	0.001	Significantly Different
ABW August 2025 – February 2026	0.008	Significantly Different

Source: Secondary Data (2026), Prossed

Based on the comparative analysis of ABW before dissemination in July 2025 and after dissemination in January 2026, the analysis results showed a significance value of 0.001, which was lower than 0.05 ($p < 0.05$). Likewise, the comparative analysis of ABW before dissemination in August 2025 and after dissemination in February 2026 showed a significance value of 0.008, which was also lower than 0.05 ($p < 0.05$), indicating that H_0 was rejected. These findings demonstrate that there were significant differences in ABW values before and after the dissemination treatment during the observation periods.

Therefore, it can be concluded that the dissemination treatment had a significant effect on the Average Bunch Weight (ABW) of oil palm,

Signed Rank Test to evaluate the differences in Average Bunch Weight (ABW) before and after the treatment dissemination.

Wilcoxon Signed Rank Test Hypothesis Testing

The Wilcoxon Signed Rank Test was used to determine the differences in Average Bunch Weight (ABW) before and after the treatment dissemination because the research data did not meet the assumption of normality. This test is a non-parametric method used to compare two paired samples under before-treatment and after-treatment conditions. The analysis was conducted at a significance level of $\alpha = 0.05$. The results of the Wilcoxon Signed Rank Test are presented in the following table.

where the ABW values after dissemination showed an increase compared to those before dissemination. The increase in ABW in oil palm is closely related to the success of flower pollination, which is strongly influenced by the presence of pollinating insects, particularly *Elaeidobius kamerunicus*. Research conducted by Pernando et al. also reported that the population and activity of pollinating insects in oil palm plantations are highly influenced by environmental conditions and flower availability. An increase in pollinator populations can support successful pollination, thereby improving fruit formation in oil palm bunches [8].

The results of this study are also consistent with the findings reported by Syaiful Efendi, who

stated that *Elaeidobius kamerunicus* is the main pollinator in oil palm plantations and plays an important role in the pollination process between male and female flowers. The visitation activity of pollinating weevils on oil palm flowers can increase the fruit set rate, which subsequently affects the number of fruits within a bunch as well as the bunch weight produced by oil palm plants [10]. Biologically, the relationship between the dissemination of *E. kamerunicus* and the increase in ABW is causal and sequential: dissemination of insects → increase in active pollinator populations → improvement in pollination effectiveness →

increase in fruit set → increase in fruit density within the bunch → increase in Average Bunch Weight (ABW). Oil palm productivity is highly dependent on efficient pollination processes, in which *Elaeidobius kamerunicus* functions as the primary natural pollinator connecting the pollination process [9]. Therefore, if dissemination is carried out in plantation blocks with low pollinator populations, there will theoretically be an increase in insect visitation to receptive female flowers. This condition increases the opportunity for successful fertilization in each spikelet within the bunch.

CONCLUSION

Based on the results of the study, it was found that the Average Bunch Weight (ABW) of oil palm before the dissemination of the pollinating insect *Elaeidobius kamerunicus* at Sei Silau Plantation of PT Perkebunan Nusantara IV Regional I showed an average value of 10.58 kg per bunch, which was relatively lower based on observations from the research blocks. After the dissemination of pollinating insects, the ABW value increased to an average of 11.12 kg per bunch, indicating higher results compared to the condition before treatment. The results of the Shapiro–Wilk normality test showed a significance value of

0.006 (< 0.05), indicating that the data were not normally distributed; therefore, the analysis was continued using the non-parametric Wilcoxon Signed Rank Test. The hypothesis test results showed significance values of 0.001 for the comparison between July 2025 and January 2026 ABW, and 0.008 for the comparison between August 2025 and February 2026 ABW ($p < 0.05$), indicating that the dissemination of *Elaeidobius kamerunicus* had a significant effect on increasing the Average Bunch Weight (ABW) of oil palm at Sei Silau Plantation of PT Perkebunan Nusantara IV Regional I.

ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to Sei Silau Plantation of PT Perkebunan Nusantara IV Regional I for providing permission, support, and facilities during the implementation of this research.

Appreciation is also extended to all plantation staff and employees who assisted in the data collection process and provided the necessary information, enabling this research to be conducted successfully.

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