The Effect of Releasing The Pollinating Weevil *Elaeidobius kamerunicus* Faust on Increasing Oil Palm Production Per Block At Torgamba Estate Ary

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Abstract

Increasing oil palm (*Elaeis guineensis* Jacq.) productivity is influenced by the success of pollination. The pollinating weevil *Elaeidobius kamerunicus* Faust plays an important role in oil palm flower pollination, thereby supporting fruit formation and increasing fresh fruit bunch (FFB) production. This study aimed to determine the effect of releasing E. *kamerunicus* on oil palm production per block at Torgamba Estate. A comparative method was used involving 20 oil palm blocks 10 control blocks without weevil release and 10 treatment blocks with weevil release all planted in 2010 (16 years old). FFB production was converted to production per hectare (kg ha^{-1}) and analyzed using an independent-samples t-test at the 5% significance level. Mean FFB production was 12,704.80 kg ha^{-1} in the control blocks and 16,377.50 kg ha^{-1} in the treatment blocks an increase of 3,672.70 kg ha^{-1}, or 28.91%. The t-test yielded $t = 8.439$ with $p < 0.001$, indicating a highly significant difference between groups. These results demonstrate that releasing E. *kamerunicus* is associated with higher oil palm production and has potential as a pollination-management strategy to support productivity at Torgamba Estate.

Keywords: *Elaeidobius kamerunicus; oil palm; pollination; fresh fruit bunch production; t-test*

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Introduction

Oil palm (*Elaeis guineensis* Jacq.) is a strategic plantation commodity that plays an important role in Indonesia's economy. It is a major global source of vegetable oil and contributes significantly to agribusiness, processing industries, and rural income in plantation areas. Improving productivity is a central focus of plantation management because higher production enhances the efficiency and sustainability of plantation enterprises [1]. Oil palm production is influenced by plant genetics, environmental conditions, nutrient availability, crop-management practices, and the success of pollination. Pollination is a key stage in fresh fruit bunch (FFB) formation because it determines the number of fruits formed, the fruit-set percentage, and bunch quality [3]. Inefficient pollination can reduce the formation of normal fruits and lower productivity [4].

Under natural conditions, oil palm relies on pollinating agents. The weevil *Elaeidobius kamerunicus* Faust is recognized as the main oil palm pollinator owing to its ability to carry and transfer pollen from anthesising male flowers to receptive female flowers, thereby increasing the probability of fertilization and supporting FFB production [8]. Weevil population size is an important determinant of pollination success; a low population may reduce pollen-transfer efficiency and fruit set. Consequently, pollinator-management strategies have been developed, including the release or introduction of *E. kamerunicus* in areas requiring higher pollinator populations [2]. Such releases are expected to increase pollination activity and produce more optimal fruit formation, and several studies associate greater weevil activity and density with improved pollination success and production [5].

Torgamba Estate comprises intensively managed production blocks and provides a suitable setting for evaluating the effectiveness of weevil release. Comparing blocks with and without E. *kamerunicus* release can indicate the contribution of pollinator availability to productivity. Accordingly, this study was conducted to determine the effect of releasing E. kamerunicus Faust on oil palm production per block at Torgamba Estate, by comparing FFB production between 10 treatment blocks and 10 control blocks. The findings are expected to provide scientific information on the effectiveness of pollinator management as a strategy for increasing productivity.

Literature Review

The role of E. *kamerunicus* in oil palm productivity has been widely studied, and the weevil's presence is consistently linked to successful pollination, fruit formation, and increased FFB production. Rezki et al. (2021) reported that raising the weevil population through the hatch-and-carry technique in mature plantations enhanced pollination activity and positively affected production [2]. Prasetyo and Susanto (2021) emphasized that pollinating insects are a key component of the production system, since the weevil's transfer of pollen to receptive female flowers influences fruit set [3]. Siregar and Rahutomo (2022) further noted that pollination success is a limiting factor for optimal productivity and that maintaining pollinator populations improves fruit-formation efficiency and supports higher FFB production [4].

Several studies link weevil population density to reproductive success. Kurniawan found that greater weevil activity was associated with improved fruit formation [5], while Ata et al. (2024), through genomic characterization, showed that the species is important for maintaining the sustainability of the oil palm pollination system [6]. Hanjaya et al. (2025) reported that the use of attractants increased weevil activity and could support pollination and production [7].

Complementary work indicates that environmental factors and the availability of male flowers influence weevil populations, so pollinator management should consider the specific conditions of each plantation [8].

Overall, previous studies confirm that E. *kamerunicus* plays an important role in supporting pollination and improving productivity. However, most have focused on weevil populations and fruit set, whereas studies evaluating the direct effect of weevil release on FFB production through block-level comparisons in commercial plantations remain limited [9][10]. This study addresses that gap by comparing FFB production between 10 treatment blocks receiving E. *kamerunicus* release and 10 control blocks without release at Torgamba Estate.

Methods

The study was conducted at Torgamba Estate, South Labuhanbatu Regency, North Sumatra Province, from July to December 2025. It involved 20 oil palm blocks: 10 control blocks (without *E. kamerunicus* release) and 10 treatment blocks (with release). Blocks were selected to have similar characteristics, including planting year (plant age), plant condition, block area, and maintenance system. All blocks were planted in 2010.

The materials comprised oil palm from the 20 blocks, the pollinating weevil *E. kamerunicus*, and FFB production records for each block during the observation period. Equipment included recording sheets, computers, and statistical software for data analysis. FFB production per block was converted to production per hectare to allow objective comparison despite differences in block size, using the formula:

FFB Production (kg ha^{-1}) = Total FFB per block (kg) ÷ Block area (ha)

Production data for both groups were summarized descriptively (mean, standard deviation, minimum, and maximum). The following statistical hypotheses were tested at the 5% significance level ($\alpha = 0.05$):

H_0: $\mu_1 = \mu_2$ — there is no difference in mean production between control and treatment blocks.

H_1: $\mu_1 \neq \mu_2$ — there is a difference in mean production between control and treatment blocks.

The decision rule was: if $p < 0.05$, H_0 is rejected (a significant difference exists); if $p \geq 0.05$, H_0 is not rejected. Prior to the t-test, the data were checked for normality and homogeneity of variance. Because the data met the normality assumption and the variances were homogeneous, an independent-samples t-test (equal variances assumed) was applied. The percentage increase in production was calculated as: *Production Increase (%) = [(Mean treatment − Mean control) ÷ Mean control] × 100%.*

Result and Discussion

The study involved 20 blocks (10 control and 10 treatment), all planted in 2010 and aged 16 years. The uniform planting year and age were intended to minimize the effect of age differences on production, so that production differences could be attributed primarily to the weevil-release treatment. Control-block areas ranged from 23.94 to 25.26 ha and treatment-block areas from 20.45 to 24.67 ha; because areas differed, production was expressed as kg ha^{-1} to allow objective comparison.

Table 1. Descriptive statistics of FFB production in the control and treatment blocks

Group	No. of Blocks	Mean (kg ha⁻¹)	SD	Min (kg ha⁻¹)	Max (kg ha⁻¹)
Control (without E. *kamerunicus*)	10	12,704.80	887.12	11,042	14,157
Treatment (with E. *kamerunicus*)	10	16,377.50	1,052.12	14,579	17,677

As shown in Table 1, mean FFB production was 12,704.80 kg ha^{-1} in the control blocks and 16,377.50 kg ha^{-1} in the treatment blocks, a difference of 3,672.70 kg ha^{-1}. This corresponds to a 28.91% increase relative to the control blocks. In the control group, the lowest production was recorded in block X36 (11,042 kg ha^{-1}) and the highest in block T32 (14,157 kg ha^{-1}); in the treatment group, the lowest was in block Y28 (14,579 kg ha^{-1}) and the highest in block Y29 (17,677 kg ha^{-1}).

To test whether the difference in means was statistically significant, an independent-samples t-test was performed at $\alpha = 0.05$ (Table 2).

Table 2. Independent-samples t-test of FFB production between control and treatment blocks

Variable	Mean Control	Mean Treatment	Mean Diff.	t-value	df	Sig. (p)
FFB Production (kg ha⁻¹)	12,704.80	16,377.50	3,672.70	8.439	18	<0.001

The t-test yielded $t = 8.439$ ($df = 18$) with $p < 0.001$, which is below the 0.05 threshold; therefore H_0 was rejected and H_1 accepted. This indicates a significant difference in mean FFB production between blocks with and without *E. kamerunicus* release, with the treatment blocks producing more. The weevil supports pollination by transferring pollen from anthesising male flowers to receptive female flowers; greater weevil availability in the treatment blocks is assumed to have promoted more effective pollination, improving fruit-set success and contributing to higher FFB production [3][4].

The uniform plant age (all blocks planted in 2010) strengthens the comparison, since production differences were not driven by age variation. Nevertheless, although the difference was statistically significant, the increase cannot be attributed solely to weevil release. Other factors plant condition, nutrient availability, fertilization, rainfall, soil conditions, maintenance, plant health, and harvesting intensity may also influence FFB production. Because blocks were selected rather than randomly assigned, the weevil release is best interpreted as a treatment factor associated with higher production under the observed block comparison, rather than as the sole cause. Overall, weevil release was associated with higher mean FFB production and a significant difference relative to control blocks, indicating its potential as a management strategy to support oil palm productivity at Torgamba Estate.

Conclusion

The release of the pollinating weevil *E. kamerunicus* was associated with higher FFB production. Mean production reached 16,377.50 kg ha^{-1} in the treatment blocks versus 12,704.80 kg ha^{-1} in the control blocks a difference of 3,672.70 kg ha^{-1} (28.91%)—and the independent-samples t-test confirmed a highly significant difference ($t = 8.439$; $p < 0.001$). Because all blocks were of the same age, the comparison was not confounded by plant age. While other agronomic factors may also contribute, these results indicate that releasing *E. kamerunicus* has strong potential as a pollination-management strategy to support increased oil palm productivity at Torgamba Estate. Further study using randomized blocks and direct measurement of pollinator density and fruit set is recommended to confirm the causal contribution of weevil release.

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