INTERNATIONAL JOURNAL OF SOCIAL SCIENCE, EDUCATIONAL, ECONOMICS, AGRICULTURE RESEARCH AND TECHNOLOGY (IJSET) | ISSN (E): 2827-766X
Website: https://ijset.org/ | Volumes 5 No. 3 (2026)

STUDY OF THE EFFECTIVENESS OF COMPOST FROM OIL PALM EMPTY FRUIT BUNCH (OPF) WASTE AS AN ALTERNATIVE SOURCE OF POTASSIUM (K) ON NUTRIENT ABSORPTION AND OIL PALM YIELD IN PANGKATAN PLANTATION OF PT. EVANS GROUP

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Received:01 /01/2026 | **Revised**: 20/01/2026 | **Accepted:** 10 /02/2026 | **Published**: 28/02/2026

Abstract

Oil palm (Elaeis guineensis Jacq.) is one of Indonesia's leading plantation commodities and plays a strategic role in the national economy. The purpose of this study was to determine the effectiveness of EFB compost as an alternative source of potassium, analyze its effect on potassium nutrient uptake, and assess its impact on oil palm yields at PT Evans Group. This research method used a field experiment approach by comparing two treatments: a control treatment without EFB compost and a treatment with EFB compost at a dose of 50 kg per plant. The results showed that compost application had a positive effect on plants, as indicated by increased leaf potassium content in the compost treatment compared to the treatment without compost. Although the difference was not significant, these results indicate that compost plays a role in increasing potassium availability and uptake by plants, thus supporting better plant growth.

Keywords: Oil palm plants, compost effectiveness, oil palm empty fruit bunches, potassium.

INTRODUCTION

Oil palm (Elaeis guineensis Jacq.) is one of the leading plantation commodities in Indonesia which has a strategic role in the national economy.(Themas et al., 2019)As the world's largest producer of vegetable oil, palm oil contributes significantly to the country's foreign exchange and is a primary source of income for communities in various production centers. However, despite the high economic value of this crop, the processing of fresh fruit bunches (FFB) in palm oil mills also produces a huge volume of waste every day. The problem is, much of this waste is not optimally utilized and often only becomes a burden on the environment surrounding the plantations.(Syarovy et al., 2021). One type of solid waste generated by the palm oil industry is empty fruit bunches (EFB). They can account for approximately 23–25% of the total processed FFB. This EFB waste generally accumulates in the mill area or around the plantation and is often only used as mulch to a limited extent. The problem that arises is that the accumulation of EFB that is not properly managed can cause environmental disturbances, such as unpleasant odors, pest nests, and soil and water pollution due to uncontrolled decomposition. This situation highlights the need for more efficient and environmentally friendly management alternatives.(Fadhillah & Susanti, 2023).

On the other hand, OPEFB actually has great potential to be used as a raw material for compost. Compost from OPEFB contains various macronutrients such as nitrogen (N), phosphorus (P), and especially potassium (K), which are essential for plant growth. The problem faced in utilizing OPEFB as compost is its relatively slow decomposition process due to its high lignin and cellulose content, requiring proper management and composting techniques to ensure the nutrients are effectively available to plants.(Ricki Arianci, Nelvia, 2014). Potassium is an essential macronutrient that plays a crucial role in the physiology of oil palm plants, including aiding oil production, increasing resistance to environmental stress, and maintaining water balance within plant tissues. A common problem encountered in the field is low soil K availability, particularly in sandy or organic-poor soils. This leads to potassium deficiency, characterized by yellowing leaves and decreased fresh fruit bunch (FFB)

production.(HALIM, 2014). Until now, potassium requirements in oil palm plantations have generally been met through the application of inorganic fertilizers such as potassium chloride (KCl). While effective in the short term, excessive use of chemical fertilizers can cause various problems, such as soil degradation, reduced organic matter content, and increased operational costs due to dependence on imported fertilizers, the price of which tends to fluctuate. This situation calls for innovation in alternative nutrient sources that are more economical and sustainable.(Kurniawan et al., 2017). Utilizing OPEFB compost as an alternative source of potassium (K) is a potential solution to address these issues. By converting solid palm oil mill waste into nutrient-rich compost, it is hoped that dependence on inorganic fertilizers can be reduced, production costs reduced, and soil fertility naturally improved. Within the PT Evans Group, the application of this OPEFB compost technology is expected to support a sustainable plantation system based on zero-waste principles. However, the effectiveness of OPEFB compost as a potassium source on nutrient uptake and oil palm yields still requires further systematic research.(Engga Yora Yusbaini, 2020). Based on these problems, the researcher will conduct a study entitled "Study of the Effectiveness of Compost from Empty Oil Palm Fruit Bunches (EFB) as an Alternative Source of Potassium (K) on Nutrient Absorption and Oil Palm Crop Yields at PT Evans Group."

RESEARCH METHODS

Place and Time of Research

This research will be conducted at the PT Evans Group oil palm plantation, which has productive oil palm plantations. The study will be conducted from November to January 2026.

Tools and materials

The tools and materials used in this research include several equipment for application, processing, and documentation, including digital scales to weigh the results of fresh fruit bunches (FFB), wheelbarrows, iron forks, as well as stationery, notebooks, and cameras for recording and documenting data. The materials used consist of empty oil palm bunches (EFB) as the main compost material, bioactivator or EM4 to accelerate the composting process, clean water to maintain the humidity of the compost, molasses, boiler ash and POME (Palm Oil Mill Effluent).

Research methods

This research method uses a field experiment approach by comparing two treatments: a control treatment without the application of EFB compost and a treatment with EFB compost at a dose of 50 kg per plant. The study was conducted on oil palm plants of uniform age and growth conditions in blocks 1 and 2, where each treatment was applied to a predetermined experimental plot. Observations focused on differences in nutrient uptake and plant yield to assess the effectiveness of EFB compost application compared to the control treatment.

The research used a Completely Randomized Design (CRD) with 2 treatments:

P0 = without compost (control).

P1 = 50 kg of TKKS compost per plant

The treatment consisted of 12 experimental plots. The plants used were of the same age, healthy, and of uniform height. Compost was applied around the base of the plants and then mixed evenly into the soil.

Research Implementation

1. TKKS Preparation
   Empty Oil Palm Fruit Bunches (EFB) are chopped and composted for 45 days with the addition of bioactivators to accelerate the decomposition process until mature compost is obtained that is ready to be applied.
2. Land Preparation
   The area around the oil palm plantations was cleared of weeds and plant residues, then the experimental plots were determined and marked according to the research design.
3. Compost Application
   TKKS compost is applied to each plot according to the treatment dose and mixed into the soil in the disc area or fertilization trench around the oil palm plants.
4. Maintenance
   Plant maintenance includes weed control and regular monitoring of plant conditions so that treatment can run smoothly.
5. Observation
   Observations are carried out periodically according to research parameters which include soil conditions,

nutrient absorption, and oil palm yields.

Observation Parameters

1. potassium content of leaves (mature leaf samples taken, analyzed in the laboratory).
2. weight of fresh fruit bunches (FFB) per plant.
3. Number of fresh fruit bunches per plant

Data analysis

Data analysis in this experimental study was conducted using an independent two-sample t-test to determine the difference in fresh fruit bunch (FFB) weight between treatments using and without compost. The test results showed that the data met the assumption of homogeneity, so the t-test could be conducted. Based on the analysis results, there was a significant difference between the two treatments, where the use of compost resulted in a higher FFB weight compared to without compost.

RESULTS AND DISCUSSION

Potassium Content of Leaves

Based on the laboratory results of the Potassium Content of Oil Palm Leaves at PT. Evans Group Pangkatan, the results obtained are presented in Table 1.

Table 1. Laboratory results of potassium content in oil palm leaves at PT. Evans Group Pangkatan

No	Sample	Parameters Analyzed	Test Results
1	Compost	Potassium (K)	2.64
2	Plant leaves (using compost)	Potassium (K)	1.03
3	Plant leaves (without compost)	Potassium (K)	0.9

Based on the results of laboratory tests on potassium (K) content in plant leaves, it was found that the leaves of plants using compost had a potassium content of 1.03, higher than the leaves of plants without compost use, which was only 0.90. This difference indicates that the provision of compost containing relatively high potassium, namely 2.64, was able to increase the availability and absorption of potassium elements by plants. Potassium plays an important role in plant physiological processes, such as yield formation and water balance regulation, so that the increase in leaf potassium content in the compost treatment indicates better plant nutritional conditions compared to plants without compost.

Figure 1. Oil palm leaves tested in the laboratory

Weight of Fresh Fruit Bunch (FFB) Per Plant.

Based on the results of the Fresh Fruit Bunch Weight (FFB) per Plant of PT. Evans Group Pangkatan, the results obtained will be presented in table 2.

Table 2. Results of Fresh Fruit Bunch (FFB) Weight Per Plant of PT. Evans Group Pangkatan

Independent Samples Test						
	Levene's Test for Equality of Variances		t-test for Equality of Means			
Variance	**Levene's Test F**	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**
Equal variances assumed	0.742	0.41	1,183	10	0.264	0.33
Equal variances not assumed			1,183	9.29	0.265	0.33

Based on the results of the t-test of two independent samples, the Levene's Test value of 0.41 (> 0.05) indicates that the data variance between groups is homogeneous so that the analysis is continued using the equal variances assumed row. The results of the t-test show a Sig. (2-tailed) value of 0.264 (> 0.05) with a t-value of 1.183, which indicates that there is no significant difference between the two groups being compared. The average difference (mean difference) of 0.33 indicates that the differences that occur are relatively small, so it can be concluded that the treatment given has not had a significant effect on the variables studied.

Figure 2. Fresh Fruit Bunch (FFB) Weight Results

Number of Fresh Fruit Bunches Per Plant

Based on the results of the Number of Fresh Fruit Bunches Per Plant of PT. Evans Group Pangkatan, the results obtained will be presented in table 3.

Table 3. Results of the Number of Fresh Fruit Bunches per Plant at PT. Evans Group Pangkatan

Independent Samples Test						
Levene's Test for Equality of Variances			t-test for Equality of Means			
Variance	**Levene's Test F**	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**
Equal variances assumed	0.482	0.505	3,268	10	0.009	11.84
Equal variances not assumed			3,268	9.24	0.01	11.84

Based on the results of the t-test of two independent samples on the number of fresh fruit bunches (FFB) per plant, the Levene's Test value was obtained at 0.505 (> 0.05) which indicates that the data has a homogeneous variance so that the analysis is continued using the equal variances assumed row. The results of the t-test show a Sig. (2-tailed) value of 0.009 (< 0.05) with a t-value of 3.268, which indicates a significant difference between the compared treatments. The average difference (mean difference) of 11.84 indicates that the number of FFB per plant in the given treatment is higher than the treatment without treatment, so it can be concluded that the treatment has a significant effect on increasing the number of fresh fruit bunches per plant.

Discussion

The application of compost has been shown to increase the potassium (K) content in plant leaves compared to plants without compost. Laboratory test results showed that the potassium content of leaves in the compost treatment reached 1.03, while in the non-compost treatment it was 0.90. This indicates that compost with a potassium content of 2.64 acts as a source of potassium nutrients that can increase the availability of this element in the soil and support the absorption process by plants. Potassium is an essential macronutrient that plays a vital role in various plant physiological processes, such as enzyme activation, photosynthesis, as well as regulating water balance and translocation of photosynthetic products. Although descriptively, the potassium content of leaves in the compost treatment was higher, the results of the independent two-sample t-test showed that the difference was not statistically significant. The significance value (Sig. 2-tailed) of 0.264 (> 0.05) indicates that the compost treatment did not significantly affect leaf potassium content. This is thought to be due to the relatively small variation in potassium content between plants and the influence of other factors, such as soil conditions, the balance of other nutrients, and the plant growth phase at the time of leaf sampling.

In contrast to the results of leaf potassium content, the results of the t-test on the number of fresh fruit bunches (FFB) per plant showed a significant difference between treatments. The significance value (Sig. 2-tailed) of 0.009 (<0.05) indicates that the use of compost has a significant effect on increasing the number of FFB per plant. The average difference of 11.84 indicates that plants given compost were able to produce more fresh fruit bunches than plants without compost. This indicates that although the increase in leaf potassium content was not statistically significant, the use of compost still contributed positively to increasing crop production. The increase in the number of fresh fruit bunches (FFB) in the compost treatment is thought to be related to improvements in the physical, chemical, and biological properties of the soil due to the addition of organic matter. Compost not only provides macronutrients such as potassium, but also increases cation exchange capacity, soil microbial activity, and the soil's ability to retain water and nutrients. Furthermore, the results of this study were also influenced by several factors, including compost nutrient content, soil conditions (pH and texture), plant growth phase, interactions with other nutrients, soil microbial activity, and environmental factors such as water availability and light intensity, which collectively influence plant growth and productivity.

CONCLUSION

The application of compost had a positive effect on plants, as demonstrated by the increased potassium content in leaves in the compost-treated treatment compared to the uncomposted treatment. Although the difference was not significant, these results indicate that compost plays a role in increasing potassium availability and uptake by plants, thus supporting better plant growth.

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