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The Effect of Palm Oil Boiler Ash on The Growth of Lettuce Plants (Lactuca sativa L.)

Pengaruh Abu Boiler Kelapa Sawit Terhadap Pertumbuhan Tanaman Selada (Lactuca Sativa L.)

Yudia Azmi*, Mardiani Putri, Fradilla Swandi, Rannando, Salmiyati

Program Studi Agroteknologi, Institut Teknologi Perkebunan Pelalawan Indonesia, Indonesia
*Email: udiaazmi@gmail.com

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ABSTRAK

Limbah industri kelapa sawit yang memiliki potensi untuk dijadikan pupuk organik dan tersedia cukup banyak di Provinsi Riau adalah abu boiler. Penelitian ini bertujuan untuk menentukan dosis abu boiler kelapa sawit terhadap tanaman selada. Penelitian ini menggunakan Rancangan Acak Kelompok (RAK) non faktorial terdiri dari 4 perlakuan dan 3 ulangan yaitu: P0 (Kontrol), P1 (176 g abu boiler kelapa sawit), P2 (352 g abu boiler kelapa sawit), dan P3 (528 g abu boiler kelapa sawit). Parameter yang diamati meliputi tinggi tanaman (cm), jumlah daun (helai), dan lebar daun (cm). Berdasarkan hasil ANOVA pada taraf 5%, pemberian abu boiler kelapa sawit pada memberikan pengaruh terhadap tinggi tanaman, jumlah daun, dan lebar daun tanaman selada. Dosis abu boiler kelapa sawit terbaik pada tinggi tanaman, jumlah daun, dan lebar daun tanaman selada adalah 352 g/*polybag*.

Kata kunci: Abu boiler, Kelapa sawit, Selada.

ABSTRACT

The industrial palm oil waste with potential to be used as organic fertilizer and abundantly available in Riau Province is boiler ash. This study aims to determine the optimal dosage of palm oil boiler ash for lettuce plants. The research employed a Randomized Block Design (RBD) consisting of 4 treatments and 3 replications, namely: P0 (Control), P1 (176 g of palm oil boiler ash), P2 (352 g of palm oil boiler ash), and P3 (528 g of palm oil boiler ash). Observed parameters included plant height (cm), number of leaves (pieces), and leaf width (cm). Based on the results of ANOVA at a 5% significance level, the application of palm oil boiler ash significantly influenced the height, number of leaves, and leaf width of lettuce plants. The optimal dosage of palm oil boiler ash for plant height, number of leaves, and leaf width was 352 g/polybag.

***Keywords**: Boiler ash, Lettuce, Palm oil.*

INTRODUCTION

Oil palm (*Elaeis guineensis Jacq*.) is the main plantation crop in Indonesia. The oil palm plays an important role as a source of non-oil and gas foreign exchange for Indonesia. Indonesia has a planted area of 15,380,981 ha and a total fruit production of 48,235,405 tons of oil palm plants in 2022. Specifically, Riau province has a planted area of 2,999,743 ha and a fruit production of 9,059,611 tons of oil palm plants in 2022 (Directorate General of Plantations 2022). Oil palm fruit processing waste has the potential to develop sustainable agriculture derived from the utilization of oil palm fruit bunch boiler ash.

Astianto (2012) stated that every 100 tons of fresh fruit bunches processed by a palm oil mill can produce 250 kg to 400 kg of palm oil boiler ash, so that every 30 tons of fresh fruit bunches will produce 82 kg to 149 kg of palm oil boiler ash. Wahid (2009) stated that the nutrients contained in palm oil boiler ash include P 2.67%, K 3.89%, Mg 1.89%, and Ca 38.06%, and it also contains high base compounds and microelements so that it can increase soil pH. Therefore, boiler ash can be used as a fertilizer that can increase the availability of nutrients in the soil so that the needs of plant nutrients can be met. The results of the study on the use of boiler ash treatment have previously been carried out on cauliflower plants in research (Ariswandi *et al.*, 2023) using doses of P0: control, P1: 176 g, P2: 352 g, P3: 528 g. However, no one has tried using lettuce plants.

Lettuce (*Lactuca sativa* L.) has various nutritional contents, such as fiber, vitamin A, and iron. As the population grows and public awareness of health increases, consumer demand for lettuce is increasing. According to USDA data (2010), the iron content in 100 g of leaf lettuce is around 0.86 mg. The iron content is thought to be able to be increased to meet human needs for iron every day.

Lettuce (*Lactuca sativa* L.) is a plant that can grow in cold and tropical areas; lettuce marketing increases along with economic growth and population (Cahyono 2014). This condition is an indication that the need for lettuce (*Lactuca sativa* L.) production needs to be continuously increased in order to meet market needs. Lettuce plants are in demand by the community by consuming them raw, so it is necessary to pay attention to the fertilizer used. As much as possible, reduce the use of chemical fertilizers and try to switch to using organic fertilizers, such as boiler ash fertilizers, that are able to meet the nutrient needs of lettuce plants, are friendly to health and the environment, and hope to continue to be sustainable. The purpose of this study was to determine the effect of the dose of boiler ash on the growth of lettuce plants.

METHODS

This research was conducted in August to September 2023 at the Horticultural Seed and Germplasm Center of Pangkalan Kerinci, Pelalawan Regency, Riau Province. The method used in this study was a randomized block design (RBD) with oil palm boiler ash fertilizer treatment consisting of 4 levels and repeated 3 times, namely P0 (control), P1 (176 g of oil palm boiler ash), P2 (352 g of oil palm boiler ash), and P3 (528 g of oil palm boiler ash). With a soil weight per polybag of 3 kg.

Data analysis using analysis of variance. Data obtained from observations were analyzed to find the average using SPSS (Statistical Program for Social Science). If there is a difference between treatments, it is continued by using DMRT at a level of 5% to determine the real difference in treatment. The general model of a randomized block

experimental design uses the formula from Rochiman (2008), as follows: Yij = μ + τi + βj + ε ij
information:
Yijk = Observation value in the i-th treatment j-th replication,
μ = General mean value, τi = effect of the i-th treatment,
β = effect of the j-th group, ε ij = Error of the experiment in the i-th treatment j-th group

The research stages include land preparation, preparation of oil palm boiler ash, preparation of planting media, sowing lettuce seeds, labeling, and maintenance. Observation parameters include plant height, number of leaves, and leaf width.

RESULTS AND DISCUSSION

Plant Height

The results of testing on the effect of palm oil boiler ash on the height of lettuce plants can be seen in Table 1.

Table 1. Height of lettuce plants under palm oil boiler ash treatment

Treatment of boiler ash	Plant height (cm)
P0	3.00 a
P1	3.80 a
P2	9.36 c
P3	7.03 b

Numbers followed by the same letter are not significantly different at the 5% DMRT test level.

Based on Table 1, treatment P2 with a treatment dose of 352 g/polybag resulted in a lettuce plant height of 9.36 cm, which was significantly different from the other treatments. Treatments P0 and P1 did not show significant differences. This is consistent with the study by Rumahorbo *et al.* (2023), which stated that a dose of 352 g/polybag was the best compared to other doses for tomato plants, leading to the conclusion that a boiler ash dose of 352 g/polybag can enhance the growth of lettuce plant height.

Palm oil boiler ash contains nutrients that can stimulate the growth of lettuce plants. According to Lubis (2008), nutrients provided in sufficient quantities to meet plant needs can enhance plant growth and development. Amaru (2008) stated that the application of boiler ash is an ameliorant material that can improve the physical and chemical properties of soil, as well as ameliorate acidic soils. Additionally, it increases soil nutrient content and can be applied to various plants.

Sutedjo (2010) noted that the function of nutrient N is to aid in the synthesis process and increase the levels of amino acids and proteins in plants, thereby increasing leaf production, providing color to plants, and supporting vegetative growth. Jumin (2002) stated that nutrient N functions to stimulate plant height growth, thereby accelerating overall plant growth, particularly in stems and leaves.

Nitrogen is one of the nutrients in boiler ash that functions to stimulate growth in the vegetative phase, including plant height, number of leaves, and leaf width (Lingga 2005). According to Haq (2009), the soil's ability to retain water increases with larger soil particles. This supports the growth of planted lettuce, as the soil can absorb and provide water for plant roots. This aligns with Prestianingsih's (2015) opinion that plant height

growth occurs due to active cell or tissue division and cell elongation in plants. Kuswadi (1993) added that ash is one of the materials that can be used as a lime substitute because ash contains Ca and Mg, which can reduce soil acidity as Ca and Mg can displace H^+ on the soil colloid surface and combine with carbonic acid in the soil.

Number of Leaves

The results of further testing on the effect of palm oil boiler ash on the number of lettuce plant leaves can be seen in Table 2.

Table 2. Number of lettuce plant leaves under palm oil boiler ash treatment

Treatment of boiler ash	Number of leaves
P0	2.00 a
P1	4.00 b
P2	6.00 c
P3	4.66 b

Numbers followed by the same letter are not significantly different at the 5% DMRT test level.

Based on Table 2, treatment P2 with a treatment dose of 352 g/polybag resulted in a lettuce plant leaf count of 6.00 leaves, which was significantly different from the other treatments. Treatments P0 and P1 did not show significant differences. This is consistent with the research by Dita (2020), which stated that a dose of 375 g/polybag of boiler ash was the best for okra plants with observation parameters including plant height, stem diameter, number of leaves, leaf length, leaf width, number of fruits per plant, and fruit weight per plant. Palm oil boiler ash has the availability of nutrients that can stimulate the growth of lettuce plants. The growth in the number of leaves in plants is influenced by the nutrients contained in organic matter. Nutrients that play an important role in the number of leaves are Nitrogen and other nutrients, such as Phosphorus, Calcium, Carbohydrates, and others (Oktiningtyas 2015). Palm oil boiler ash contains P 2.67%, K 3.89%, Mg 1.89%, Ca 38.06%, and also contains high alkaline compounds and microelements, which can increase soil pH, playing a role in enhancing plant growth, especially the number of leaves (Wahid 2009). The best number of lettuce plant leaves was found in the treatment of 352 g/polybag (P2).

Leaf Width

The results of the further test on the effect of palm oil boiler ash on the leaf width of lettuce plants can be seen in Table 3.

Table 3. Leaf width of lettuce plants under palm oil boiler ash treatment

Treatment of boiler ash	Leaf width (cm)
P0	2,46 a
P1	4,03 b
P2	6,13 c
P3	4,03 b

Numbers followed by the same letter are not significantly different at the 5% DMRT test level.

Based on Table 3, treatment P2 with a treatment dose of 352 g/polybag resulted in a lettuce leaf width of 6.13 cm, which was significantly different from the other treatments. Treatments P0 and P1 were significantly different. This is consistent with the research by Rumahorbo et al. (2023), which stated that a dose of 352 g/polybag was the best for tomato plants. The 352 g/polybag boiler ash dose can increase the leaf width growth in lettuce plants.

Palm oil boiler ash has the availability of nutrients that can stimulate the growth of lettuce plants. Boiler ash has the same role as lime because it contains SiO2 58.02%, Al2O3 8.7%, Fe2O3 2.6%, CaO 12.65%, MgO 4.23%, Na2O 0.41%, K2O 0.72%, H2O 1.97% (Hutahean 2007). Boiler ash is an alternative ameliorant that can improve the chemical properties of acidic peat soil while reducing the waste burden on the environment (Rini *et al.* 2005). According to Lubis (2008), elements provided in sufficient quantities to meet plant needs can enhance plant growth and development.

Nutrients play a significant role in leaf extension and expansion. Increasing nutrients can increase the leaf area of lettuce plants, thereby increasing the rate of photosynthesis and the carbohydrates produced. Carbohydrates are substrates needed in the respiration process. The higher the carbohydrates oxidized; the more energy is produced for the metabolic processes occurring in the plant body. Fe is a nutrient that plays a role in photosynthesis, producing food. Food is used in plant development and growth, such as leaf area. Fe also affects leaf color because it is related to chlorophyll content (Amalia & Muji 2010).

Salisbury & Ross (1995) stated that Mg is not only a component of chlorophyll, but it also functions in various reactions and as an enzyme activator in photosynthesis and respiration reactions. According to Jumin (2002), the presence of N will increase the growth of the vegetative parts of the plant, namely the leaf width of lettuce plants. According to Triastuti *et al.* (2016), nitrogen absorbed by plants plays a role in supporting vegetative and generative growth, phosphorus plays a role in photosynthesis and respiration reactions, and is part of nucleotides, and potassium also plays an important role in photosynthesis. Hakim et al. (1986) stated that N functions in the formation of chlorophyll cells useful in the photosynthetic process, thus forming the energy needed for cell division, enlargement, and elongation activities. The best plant treatment was found in the 352 g/polybag (P2) treatment.

CONCLUSION

The application of palm oil boiler ash affects the growth of lettuce plants, specifically in plant height, number of leaves, and leaf width. The best dose of palm oil boiler ash for lettuce growth in terms of plant height, number of leaves, and leaf width is 352 g/polybag.

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