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Combination of liquid organic fertilizer sap of aren [*Arenga pinnata* (WURMB) Merr.] with water hyacinth (*Eichhornia crassipes*) on the growth and results of corn crops

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Abstract

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To address fertilizer scarcities in corn production, organic fertilizers can be derived from plants such as water hyacinth, which is typically less productive. This study will investigate the impact of combining palm sap with water hyacinth to produce a liquid organic fertilizer (LOF). P0, P1, and P2 were the four treatment doses included in the experiment, which had to be repeated five times. These dose levels were: 20 mL/L of water, 40 mL/L of Water, and 60 mL/L of water. Data analysis was carried out using a single-factor Randomized Block Design (RBD). According to the study, the palm sap LOF and water hyacinth mixture did not have a significant impact on plant height, leaf count, and stem diameter at 20, 40, 60, 90, and 120 days after planting (DAP), nor on fruit diameter and dry seed weight at those time frames. Despite this, the 60 mL/liter dose resulted in a significant increase in both ear length (24.18 cm) and weight (70.89 g). A 60 ml/liter concentration of LOF palm sap and water hyacinth is found to be effective in increasing fruit length and weight, according to the study.

Keywords: Fertilizers; liquid organic fertilizer; Palm sap; water hyacinth; *Zea mays*

Introduction

The application of fertilizer is a key factor in corn cultivation, whether in the form of chemical fertilizer or organic fertilizer. Organic fertilizer consists of 2, namely liquid and solid, both of which have complete nutritional elements needed by corn plants. Liquid organic fertilizer (LOF) mainly comes from animals and plants. Palm sap liquid organic fertilizer comes from liquid palm sap, which is processed to become fertilizer (Lukman, 2019a; Lukman et al., 2023). Palm sap liquid organic fertilizer contains the nutrients N, P, and K (Lukman, 2022). Almost all liquid organic fertilizers contain Organic carbon, which is composed of nitrogen (N), phosphorus (P), and potassium (K) (Haryanta et al., 2022).

Water hyacinth liquid organic fertilizer contains complete nutrients, namely, N, P and K, respectively 0.29%, 0.52%, 0.002% and 0.098% (Yuliatin et al., 2018; Lukman and Kusrianty, 2021) liquid organic fertilizer has a significant effect on plant height, number of tillers, number of leaves, and chlorophyll index (Sekutowski, 2019).

Corn plants require fertilizer with a complete nutritional profile, specifically N, P, and K, which is applied at various growth stages (Singh et al., 2019). Fertilizer can be provided in two forms: inorganic fertilizer and organic fertilizer. When combined, they will have a better effect on plants (Baghdadi et al., 2018). Combining organic materials can increase nutrient availability and stimulate plant growth (Zhao et al., 2019; Sekutowski, 2019). Organic fertilizers can increase growth significantly (Liu et al., 2023; Midranisiah et al., 2017). Having expanded on previous work, this study will look to evaluate the effects of using palm sap and water hyacinth to grow maize plants.

Materials and Methods

Materials such as palm sap, water hyacinth, and Bisi 18 variety corn seeds were used in the research. Apart from palm sap, several additional ingredients were added, namely rice washing water and coconut water, followed by the addition of crushed water hyacinth. The ingredients used are 3 liters of palm sap, 1 liter of rice washing water, 1 liter of coconut water, and 1 kg of water hyacinth. All these ingredients are mixed in 1 container (bucket) with a capacity of 10 liters and then fermented for 32 days.

Research Implementation

Using a randomized block design (RBD), four treatment dosage levels were randomly selected and then repeated five times, resulting in 20 experimental plots. The total number of plants in each plot was 320, with 16 plants per plot. The sample used for each plot consisted of 8 plants, resulting in a total of 160 samples. Each plant was given 200 ml of fertilizer material that had been dissolved in water by shaking. The treatment doses are:

P0 = Without application of liquid organic fertilizer (control);

P1 = 20 ml/liter of water;

P2 = 40 ml/liter of water;

P3 = 60 ml/liter of water.

Data Analysis

Analyses of variance (ANOVA) were conducted on the data to determine the impact of the treatments used. Analysis results indicating an influence (authentic or very real) will be further tested using the Duncan Multiple Range Test (DMRT) at a 5% significance level.

Results and Discussion

Plant Height

According to the variance analysis, plant height did not show a statistically significant change when using DAP, based on palm sap and water hyacinth, for fertilization at 20, 40, and 60 days after planting. However, each additional dose also increased the height of the corn plants. This increase was caused by the increasing number of nutrients contained in the dose concentration applied, and according to the needs of the growth phase of the corn plant. This can be seen in the image below:

At 20 days after planting, the average plant height ranged from 34.11 to 35.17 cm when using DAP, a liquid organic fertilizer made from palm sap and water hyacinth, at different concentrations. The results were encouraging. Both

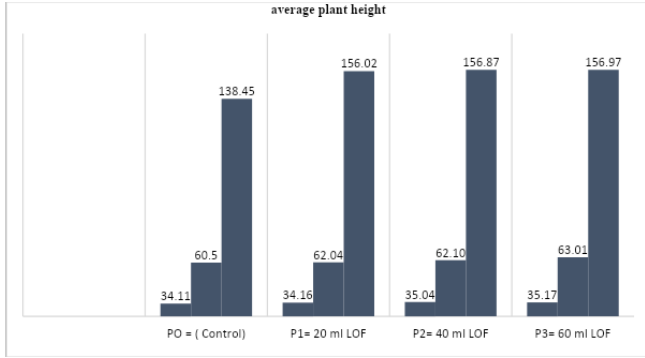

Fig. 1 Average plant height (cm) at 20, 40 and 60 DAP

methods, 40 DAP 60.5–63.01 cm and 60 DAP, are 138.45–156.97 cm, according to (Zulkarnain and Hartanto, 2020), which states that the variety more influences the height of corn plants; the height of Bisi 18 plants reaches 198–206 cm (Oktavia et al., 2019). After 20 days of planting, the plant reached a height of 34.11 to 35.17 cm on average due to the use of DAP, containing liquid organic fertilizer derived from palm sap and water hyacinth at different concentrations, 40 DAT 60.5–63.01 cm, and 60 DAP was 138.45–156 cm. .97 cm, according to (Zulkarnain and Hartanto, 2020) that corn plant height is more influenced by variety, Bisi 18 plant height reaches 198–206 cm (Oktavia et al., 2019). Water hyacinth sap liquid organic fertilizer contains the elements N, P, and K (Lukman, 2019b), as does water hyacinth liquid organic fertilizer (Ende and Salawati, 2023). The use of fertilizer has a significant influence on plant growth, particularly fertilizers containing Nitrogen, Phosphorus, and Potassium (Tulungen et al., 2019).

Number of Leaves

The use of DAP, a liquid organic fertilizer made from palm sap and water hyacinth, did not exhibit any statistically significant effect at 20, 40, and 60 days after planting.

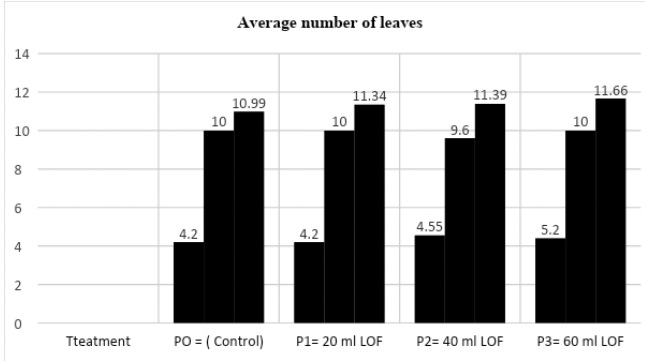

Fig. 2 Average Number of Leaves at 20, 40, and 60 DAP

The most significant yield of leaves can be achieved by the liquid organic fertilizer, which is produced using sugar palm sap and water hyacinth, as shown in Figure 2, namely: 4.55–5.2 pieces (20 DAP), 9.6–10.0 pieces (40 DAP), and 10.00–11.66 pieces (60 DAP). Corn plants at the age of 20 DAP average 4.7–4.8 strands, and at the age of 60 DAP, they reach 11–12 strands (Nanda et al., 2017). Furthermore, apart from genetic factors, the K nutrient in fertilizer can improve corn plant growth (Kandil et al., 2020). The mixture of palm sap and water hyacinth yields roughly twice as many leaves as those obtained from chemical and organic fertilizers, suggesting that this liquid organic fertiliser can be used instead (Shaji et al., 2021).

Bar Diameter

A variance analysis revealed that the application of palm sap-based liquid organic fertilizer mixed with water hyacinth did not have a statistically significant impact on stem diameter at 20, 30, and 60 days post-planting.

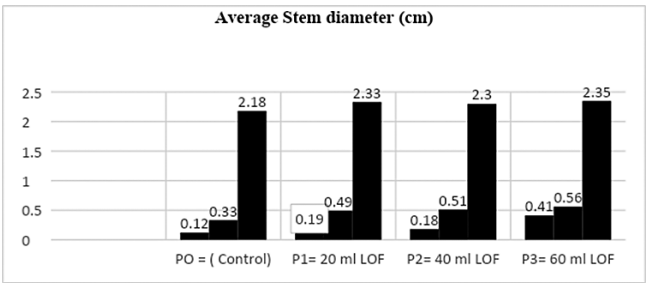

Fig. 3. Average Stem Diameter (cm) at the age of 20, 40 and 60 DAP

As illustrated in Figure 3, the use of liquid organic fertilizer made from sugar palm sap and water hyacinth resulted in the highest stem diameters of 0.41 cm, 0.56 cm, or 2.36 cm for the Bisi-18 corn variety at 20, 40, and 60 days after planting (DAP). The stem diameters were lowest at 0.12 cm, and the lowest value was recorded at 2.18 cm. Stem thickness and plant height increase are linked to the use of liquid organic fertilizers, as reported by Muktamar et al. (2020). Organic fertilizer can increase stem diameter by 1.34 to 2.47 (Regina Intansari and Subiksa, 2022). The development of stem base diameter is influenced by competition between plants, with planting patterns having a greater impact (Ray et al., 2020).

Cob Length (cm)

The average length of corn cobs was significantly affected by the use of a mixture made from palm sap and water hyacinth, as revealed by analysis of variance.

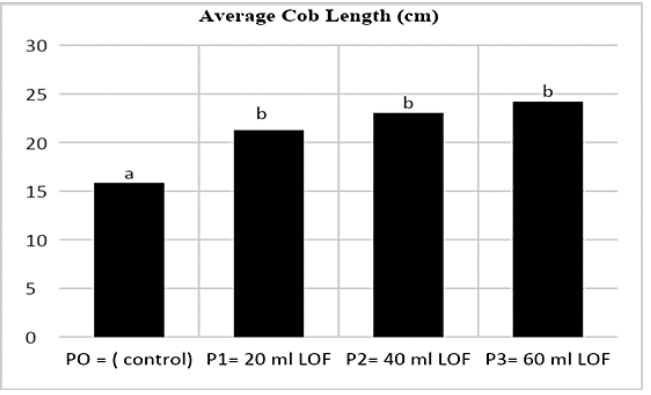

Fig. 4. Average fruit length (cm) of corn plants at 115 DAP

As per the statistical evidence, Figure 4 indicates a significant influence. In the P3 treatment, the average cob length (24.18 cm) was the highest, while the shortest was in the control group (15.82 cm). The evidence suggests that corn cob length can be improved by using a liquid organic fertilizer made of sugar palm sap and water hyacinth. The potential for kernel development is higher with longer cobs, as they account for around 40–50% of the total yield (Islam et al., 2023). Nutrient availability during generative growth has a significant impact on fruit size and quality. For example, Liquid organic fertilizers provide both macro- and micronutrients necessary to improve soil quality (Hariyadi et al., 2009), and their use is more effective (Fauziah et al., 2023).

Cob Diameter (cm)

A significant impact was observed on the size of the corn cob when palm sap and water hyacinth were used to produce organic fertilizers (Figure 5).

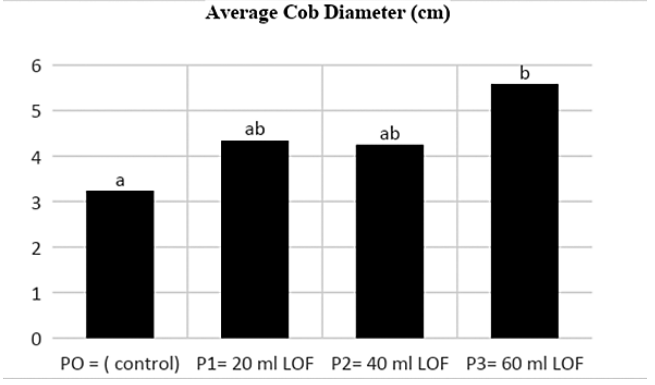

Fig. 5. Average Cob Diameter (cm) of corn plants at 115 DAP

By producing a diameter of 4.34 cm when using 20 ml/L water (P1) and 5.58 cm when using 60 ml/L water (P3) is used in this manner, which is significantly different from the control (without treatment). The diameter of the corn cob ranges from 5.86 cm to 7.03 cm (Kasman et al., 2022). For the Bisi 18 variety, the average fruit diameter is 4.39–4.47 cm (Kantikowati et al., 2023).

Dry Seed Weight per Plant (g)

Variance analysis showed that the combined use of liquid organic fertilizer was successful. Fertilizer with sugar palm juice and noted that water hyacinth significantly affected the normal dry shell weight of the plants, namely 55.8 g (P0) – 70.89 g (P3). Meanwhile, the average dry pellet weight of Bisi 18 corn plants given 500 kg/ha of Urea reached 50–87 g (Kantikowati et al., 2023) (Figure 6).

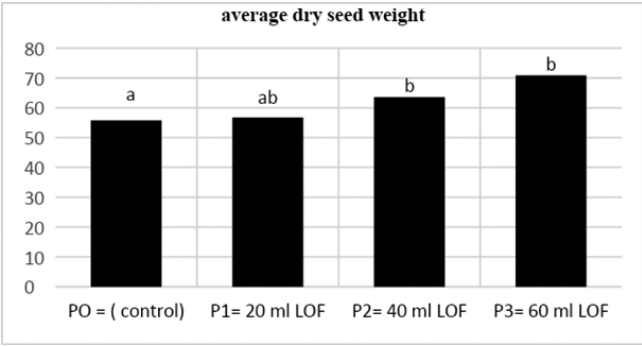

Fig. 6. Average dry pellet weight per plant (g)

The factors that influence seed weight in corn are nitrogen, phosphorus, and potassium, which are three of the primary nutrients that must be present (Pangalila et al., 2023), with a weight ranging from 88.0 g to 115 g per plant. Liquid organic fertilizer can result in increased uptake of macro and micronutrients. Liquid organic fertilizer also increases soil organic matter content (Shaji et al., 2021). Thus, it is seen that the dry weight of maize kernels responds to the essential elements, including nitrogen (N), phosphorus (P), potassium (K), and growth-promoting substances such as auxins and gibberellins, which are provided by the mixture of palm sap and water hyacinth that make up the formulated liquid organic fertilizer. **A c**ombination of palm sap and water hyacinth due to the nutrients N, P, K, Auxin, and Gibberellin hormones contained in the tested liquid organic fertilizer.

Conclusions

The adoption of a fluid organic fertilizer prepared from a mixture of water hyacinths and sugar palm sap has a favorable effect on maize growth and yield, indicating its potential as a promising substitute for a nutritional source. The application of concentrated fertilizers increased the height and number of leaves of the plants, followed by an increase in ear and seed dry matter.

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