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Frond Base Fracture and Dynamics of Palm Oil Inflorescence Applied with Different Nutrient Sources

Suprih Wijayani[1], *Herry Wirianata*[1] *Sri Gunawan* [2]

[2] *Department, of Agrotechnology Faculty of Agriculture Institut Pertanian Stiper, Yogyakarta. Indonesia*
[-2] *Akademi Komunitas Perkebunan , Yogyakarta. Indonesia*

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CORRESPONDING AUTHOR

*E-mail: *srigunawan@gmail.com*

ABSTRACT

Frond base fracture is an increasingly common phenomenon in oil palm plantations caused by various stress factors. This study aimed to determine the incidence of frond base fracture in the plantation where different nutrient sources were applied (palm oil mill effluent, oil palm EFB, and organic fertilizers) in relation to the dynamics of oil palm inflorescence. The incidence of frond base fracture and the production of male and female inflorescences were observed in 30 sample trees for each nutrient source. Observations were made three times with a monthly interval. To reveal the research objectives, it used descriptive analysis. The results showed that the routine application of POME increased the susceptibility of oil palms to fractured fronds and the sex ratio was higher other than that of EFB; the lowest incidence was found in the palm that was given inorganic fertilizers. frond base fracture trees produced fewer female inflorescence, although the number of male ones did not differ between frond base fracture palm and healthy ones.

1. INTRODUCTION

1.1. Research Background

Palm oil crop yields depend on several factors, such as planting materials, agronomic inputs, photosynthetic activity, and seasonal climatic conditions [1]. Photosynthesis and productivity of palm oil depend on the proportion of the length of sunlight, the sunlight absorbed by plants, light saturation, and loss due to dark respiration losses. Furthermore, this depends on the characteristics of vegetative growth, such as the number of smelts, the length of the smelt, and the plant population (planting distance), which determines the index of leaf area [2] Furthermore, it is stated that the variation in productivity can be explained by the interception of sunlight in the plant canopy and the efficiency of its use so that the area of tissue that actively performs photosites is needed attention in maintaining palm oil plants. This is related to the number of smelters in the palm canopy [3]. Oil palm yields are limited by the availability of assimilate to meet sink needs (fruit bunches) [4]. The canopy condition is one of the causes of the yield of the gab, so that the number of midribs that are maintained to support oil palm production needs attention [5].

1.2. Literature Review

Symptoms of disease in oil palm crown caused by Ganoderma in Indonesia and Fausarium oxysporum f.sp. elaeidis and Phytophthora palmivora in Africa and Latin America have received serious attention for causal agent of the crown diseases. In addition, some crown diseases are local. Dry frond disease in East Kalimantan and North Sumatra which from diseased tissue was isolated by the fungus Thielaviopsis sp, although it has not been confirmed as a pathogen [6]. In Ghana, crown fracture or brown break was found. The disease is also found on some plantations in Malaysia, although it is not yet considered economically important [7].

Frond base fracture is a phenomenon that is often found in palm oil that produces. The frequency and intensity of the event are getting higher [8]. Frond base fracture can not recover (recovery), must be trimmed (pruning), so that the ability of photosynthesis of plants decreases. The speed of production of new pelepah determines the recovery of the condition of palm trees. Palm oil production depends on the source-sink relationship and control mechanisms that have an impact on photostat partitions between sinks (organs/tissues that require photostats). As a source, the reduced number of effective smelt for

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photosynthesis due to zinc is estimated to have a major effect on the growth and production of palm oil.

Fertilizer costs are the largest component of palm oil production costs, so it is necessary to find alternative sources that can substitute or reduce the use of inorganic fertilizers. The cultivation of oil palm can lead to soil degradation, caused by the removal of understory vegetation, intensive use of chemical fertilizers, and the lack of carbon returns from crop residues [9]. The use of by-products such as empty bunches and cask waste of palm oil mills is highly recommended to reduce the use of inorganic fertilizers [10]. The empty fruit bunch and palm oil mill effluent application in oil palm plantation has been shown to positively influence soil quality and soil ecosystem functions [11]. However, its effect on crown development still remain unclear. The use of these two by-products is increasing with soil and water conservation management as part of mitigation and adaptation efforts to address the negative impacts of climate change [12].

1.3. Research Objective

The purpose of this study is to find out the influence of several sources of nutrients on the phenomenon of zinc and the dynamics of palm oil flowering.

2. MATERIALS AND METHODS

In accordance with the purpose of the study, three garden blocks (30 ha/block area) were determined for each treatment that each was applied inorganic, palm oil mill effluent (POME), and empty fruit bunch (EFB) Inorganic fertilizer consists of urea 2.75; SP-36 2.00; MOP 2.25 kg/tree/year; application of POME with flatbed system; application of empty bunches of 45 tons /ha/year in path (space between rows). Each treatment represented 90 sample trees per observation. Observations were made three times at one-month intervals (November, December, and January). The parameters of observation are the number of smelt of each observation, the number of male and of female inflorescences, and the sex ratio for each observation, the soil were podsolic type with 11-year-old palm tree.

3. RESULT AND DISCUSSION

The fractured frond that can not recover must be tapered (pruned) so that the number of frond in the canopy is reduced and has a major impact on palm production. Research reveals that the amount of healthy frond affects root growth, bunch weight, and the production of bunches of fresh palm fruit [13]. The effect of over pruning and zinc on palm oil production is only seen after 8-10 months, but the duration of the tree's recovery is not yet known [14]. Frond base fracture changes the water-plant relationship through the reduction of the transpirational surface area [15].

The results showed that POME applications using flatbeds produced the most zinc smelter followed by empty bunch applications with doses of 45 tons /ha/year in dead nets (Figure 1). These results reveal that the nutrients contained in the by-product are different from inorganic fertilizers, so both cannot completely replace the role of inorganic fertilizers.

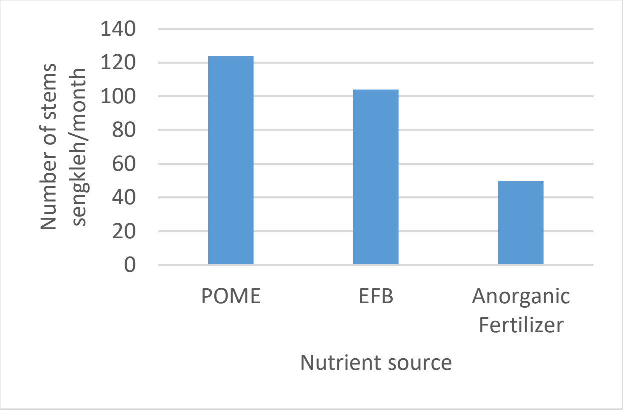

Fig. 1. The amount of smelt in palm oil that is given a different nutrient source

POME has a high potassium content, and this nutrient is antagonistic to magnesium and calcium. A high K will inhibit the absorption of Mg and Ca [16] frond base fracture as a structural phenomenon is closely related to the integrity of the petiole network (a zone prone to zinc). Ca, a constituent component of lamela plays a big role in maintaining the integrity of this network. In the condition of this element kahat (due to high K), the smelter is easy to experience zinc. Meanwhile, the nutrient content in empty bunches is low and more dominant as a source of soil C after decomposition. However, the K element contained in this vacuolar by-product comes out first without going through the decomposition process, so it has the potential to more quickly provide K for palm oil and is expected to contribute to the balance of K / Mg as well.

The presence frond base fracture affects the allocation of photosyntates to fruit bunches and potentially strongly affects the sex ratio so that the annual inflorescence cycle shifts [17]. As long as the tree undergoes physiological st due to poor canopy conditions, photosynthesis is unable to meet the needs of tree photosynthesis, as well as the reserves of carbon compounds in vegetative organs (trunks) [17]. This is indicated by the results of the study in Figures 2, 3, and 4.

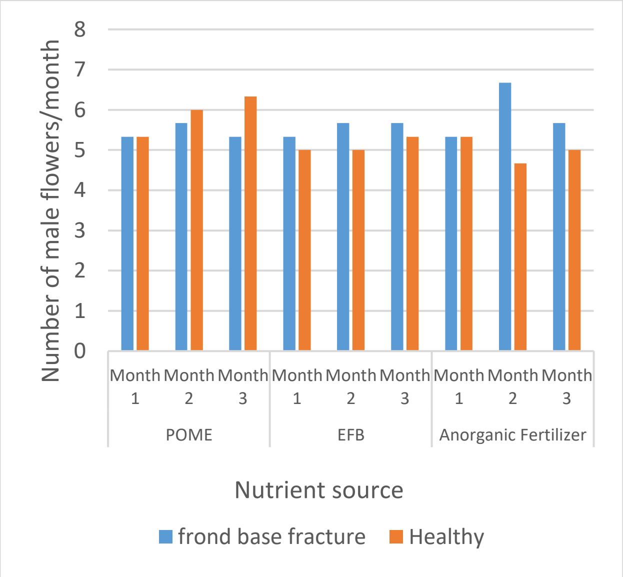

Figure 2. Dynamics of male palm flowers that are given different nutrient sources

Male and female inflorescences are the results of the growth and development of flower primordia that have been in the frond axil. Sex determination affected the sex of the flowers to be produced [18]. Fractured frond cause physiological stress that will affect sex determination. In a state of stress, palm oil tends to produce more or even relatively constant male flowers between nutrient sources. In contrast, the number of female flowers is more sensitive to the influence of suboptimum conditions, as shown in Figure 3.

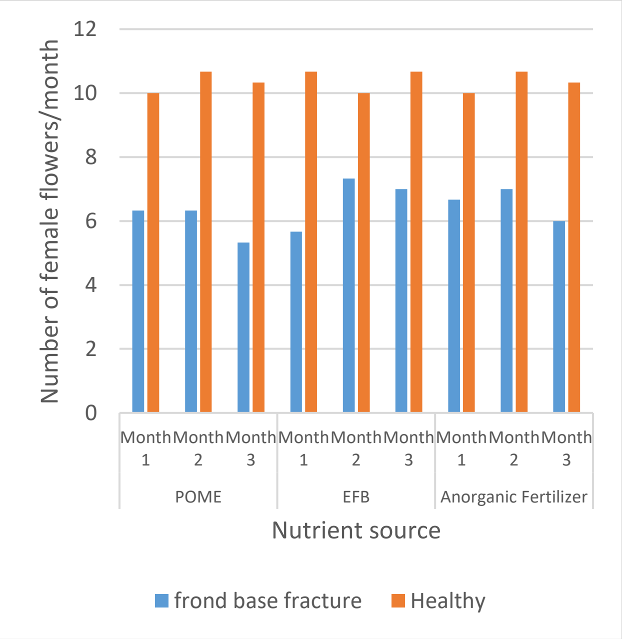

Figure 3. Dynamics of female palm flowers that are given different nutrient sources

Figure 3 shows that palm that do not experience frond base fracture (healthy) produce more female inflorescence than that of disorder palm, especially for EFB blocks and inorganic fertilizers. The number of EFB per tree depends on the rate of production of the new frond (each frond has one inflorescence primordium), the ratio of sex (the ratio of female inflorescence to total flowers, which are reduced due to drought or other stress factors), the rate of abortion (also associated with drought conditions), and the rate of failure of bunches (the failure of fruit bunches can occur 2-4 months from anthesis). Each of these components is determined consecutively from about 25 months before harvest (sex differentiation) to 1-3 months before harvest (bunch failure). The weight components of fruit bunches are determined in the following order: number of spikelets (16-18 months before harvest), number of flowers per spikelet (12-15 months before harvest), abortion of flowers (10-11 months before harvest), frutiset (when anthesis, 5-6 months per harvest).

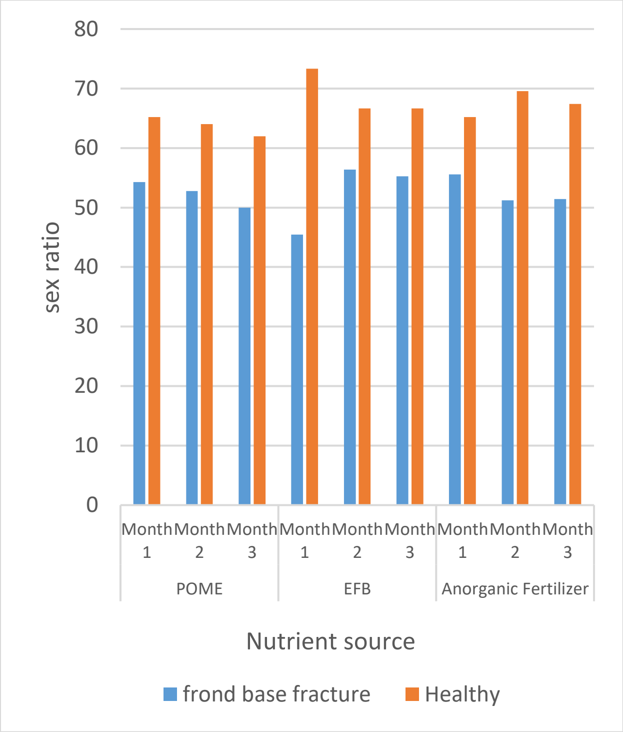

Figure 4. The sex ratio of palm oil that is given a different nutrient sources

Figure 4 shows that healthy palm oil has a greater sex ratio than the frond base fracture. This is closely related to the results shown in Figure 3. The dynamics of the sex ratio during the three months of observation showed different patterns between organic fertilizers and POME with EFB for palm oil that fractured frond. Observations during November, December and January with high rainfall intensity allowed for greater leaching of nutrients than empty bunched soil. As a source of organic matter, EFB can improve the physical and chemical properties of the soil and reduce the negative impact of erosion [19]. This has an indirect effect in reducing the dynamics of the palm oil sex ratio.

4. CONCLUSION

Frond base fracture is more common in oil palm plantations that are routinely given POME, which is known to have a higher K content than plants that are given EFB and anorganic fertilizers. Frond base fracture causes palm oil to produce fewer female inflorescence than male infloresecence, which further affects the sex ratio. Conversely, the production of male inflorescence does not change between disordered palm oil and healthy ones

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