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Identifying Plant Age to Determine Production Trend of Oil Palm Fresh Fruit Bunches

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Abstract. The productivity management of oil palm plantations is carried out by analyzing various influencing factors, but the growing conditions of oil palms are one of the causes of fluctuations in oil palm production. This paper aims to identify post-harvest increases in oil palm productivity. Productivity depends on the number of clusters and the weight of fresh fruit bunches (FFB) produced yearly. The methods of this study were conducted using a targeted sampling technique using available production data for plant time points from 4 to 13 years of age. The total plant sample was 636 ha in Central Kalimantan. As a result, plant growth factors can significantly impact oil palm productivity as measured by the components of oil palm plant production: fresh bunch production per hectare, average bunch weight, and the number of oil palm bunches. FFB tonnage and mean bunch weight increase each year from age 3 to age 13, according to a quadratic regression pattern, whereas the number of palm clusters, in contrast, decreases in number with increasing plant age. This study was intended to serve as a reference and source of information for making production decisions for oil palm plantations to achieve optimal results.
Keywords: fresh fruit bunches; oil palm production; plant age

INTRODUCTION

Palm oil is one of the major plantation products in most regions of Indonesia. This plant species is one of the fastest-growing crops in the tropics due to the high economic value of oil palm. Palm oil *(Elaeis guineensis* Jacq) (Wong et al., 2020), (Setyawan et al., 2021) has the highest vegetable oil content compared to the 17 most important petroleum-producing plants and fats in world trade. As the world population grows, the demand for vegetable oils constantly increases. The global market is now dominated by Indonesia, the world's largest exporter of its CPO, sharing a share with Malaysia (Munasinghe et al., 2018).

Oil palm plantation production can yield good results if the plantation company uses good and efficient production factors to mass-produce fresh fruit bunches (Wong et al., 2020). Fresh palm fruit bundles are produced from palm oil as feedstock for palm oil processing plants to produce crude palm oil. Increasing the productivity of oil palm plantations requires various supporting factors. Management of oil palm plantations by applying best management practices by large companies produces 33% more fresh bunches than management of small plantations (Heredia Salgado et al., 2020). In order to obtain optimum production, all factors affecting production must be tested under optimum conditions (Lawal et al., 2020). Local climatic factors and environmental sustainability are very important for oil palm cultivation (Khalid et al., 2019). However, plant age limits production beyond human control (Hanieh et al., 2020). Plant age is an important factor influencing fruit cluster production in oil palms. Palm oil is produced at about three years of age and peaks in production between 6 and 10 years (Promraksa & Rakmak, 2020).

Oil palm seeds are ready for harvest 30 months after planting with proper management practices and produce fruit bouquets continuously all year round until plant regeneration is implemented, up to 25 years or more (Mohd Luthfi et al., 2020). Calculating and estimating the age of oil palms is essential for managing oil palm plantations (Aji et al., 2020). Oil palm plants produce different palm fruits at different ages (Aji et al., 2022). Calculating oil palm age is critical for production monitoring and reforestation planning (Zaied et al., 2020). Proper and efficient management of oil palm plantations requires knowledge of the production trends of oil palm fruit clusters of different ages to adjust resource allocation for optimum yields during different harvest seasons (Raharja et al., 2020).

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METHODS

The methodology of this study was conducted using targeted sampling techniques. Researchers determine sampling by determining the specific characteristics of their research goals as they are expected to answer the research question (Setiawan & Hartono, 2020). Data collection in this study is secondary data in time series format from PT. Point Mulia Sawit Agro Lestari is one of the leading private oil palm plantation enterprises in Central Kalimantan. Collecting data in this study is secondary data in time series format from PT. Mulia Sawit Agro Lestari. It should be noted that PT Mulia Sawit Agro Lestari is one of the leading private oil palm plantation companies in Central Kalimantan.

The time series data used in this study were for an area of 634.28 ha, the main crop/ha with an average SPH stands per hectare 135, and the yield of fresh fruit bunch (FFB) production, bunch weight and number. They were grouped based on plant age (Gunawan & Fathoroni, 2020). The results of the above data calculations are statistically analyzed using the SPSS 21 program. The data analysis technique used is simple linear regression analysis. Data were processed by non-polynomial regression analysis to determine production and plant age trends for producing fresh fruit clusters from palm oil Harvested FFB. In addition to measuring the strength of the relationship, regression analysis also shows the direction of the relationship between independent and dependent variables. The M-polynomial regression method is used in linear regression models, is flexible and empirically evolvable, and helps determine the curvature of polynomials in your data. Regression results were tested with a t-test with 95% confidence or $\alpha = 5\%$.

RESULTS AND DISCUSSION

A total of 168 input data representing plant ages from 3 to 13 years yielded numbers of oil palm conductivity (FFB) at the harvest season from 2014 to 2021, and the results were the lowest for FFB production. Range from 1.38 tonnes/ha/year up to 23.74 tonnes/ha/year, minimum average bundle weight from 0.8 kg up to 11.47 kg, minimum number of bundles from 4 bundles/body/year to up to 25 bundles/year Figure 1, and staples/year as shown Figure 1.

Trends in FFB Production

The second-order polynomial regression t-test results showed that plant age significantly affected palm oil FFB production, with a significance value of 0.00 and less than 0.05. The pattern of the relationship between plant age and FFB production, following a polynomial pattern of degree 2, is shown in Figure 2.

The coefficient of determination R2 = 0.3072 indicates that 30.72% of FFB production in oil palm crops is influenced by plant age factors, and the rest by other factors not analyzed in this study. From the production trend plot, we can see that increasing the age of the plant from 3 to 13 years of age increases FFB production each year. This can be calculated using the polynomial order. Two regressions with the formula $y = -0.1564x2 + 3.7441x - 4.5314$.

Physiology at each age of oil palm plants can lead to differences in production numbers. Physiological oil palm changes with age. Changes in stem diameter, bud appearance, etc., can affect the level of production achieved. Besides the age of the plant, several other factors affect oil palm production. According to (Mustari et al., 2020), palm oil production is significantly influenced by the use of labor, good seeds, TSP fertilizers, and pesticides.

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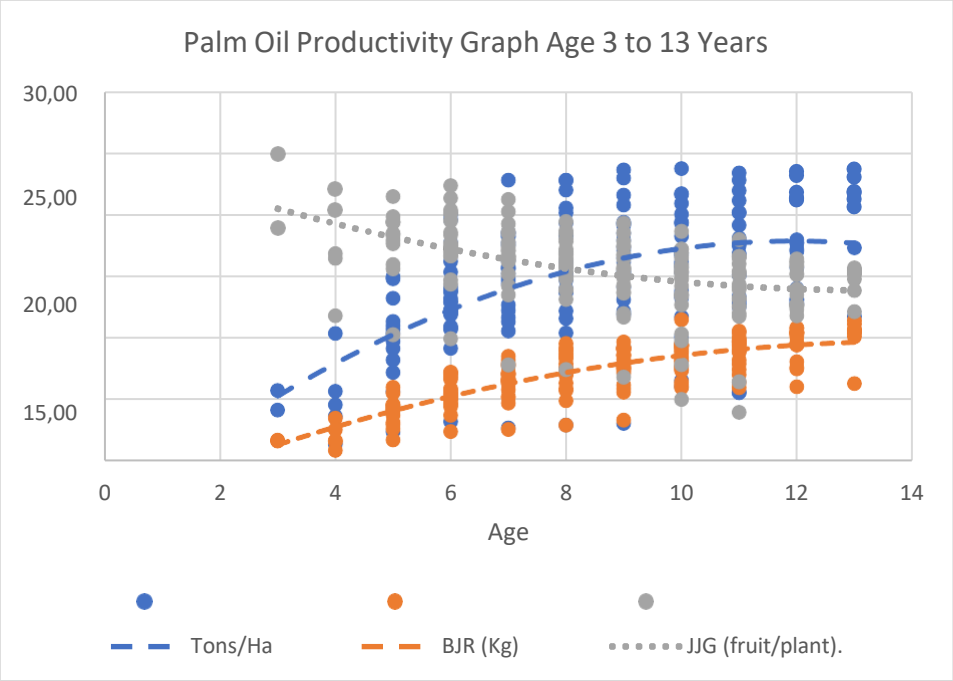

Figure 1. Palm productivity chart on aged 3 to 13 years

Oil palm plants from the age of 3 to 13 years are productive and the optimal age in producing fruit, at the age interval of 3 to 13 years, can produce high productivity provided that management is good and correct. So when compared with research that has been done before, according to Lubis & Lubis (2018), after the age of 22 years, the productivity of oil palm plants tends to decrease. This is because it has exceeded the optimum productivity age of oil palm plants.

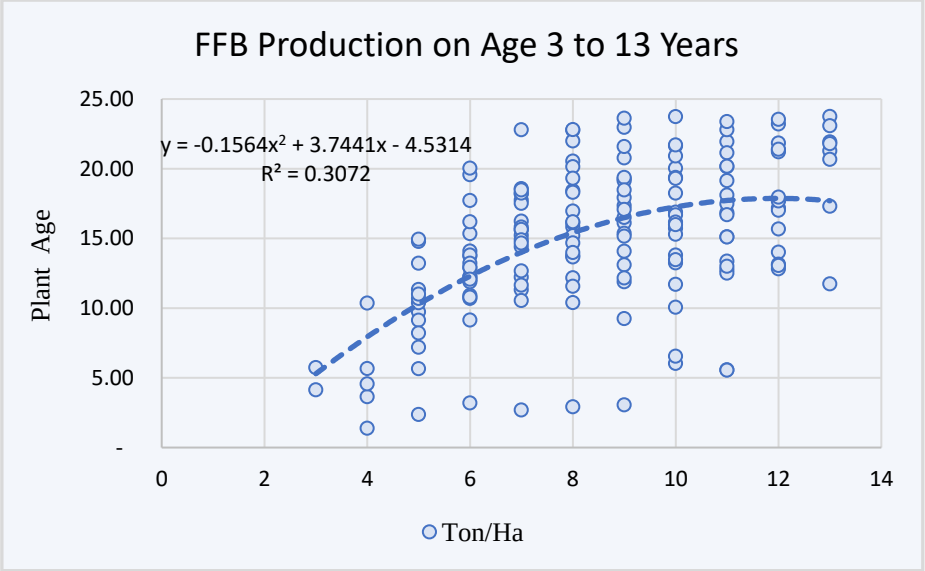

Figure 2. FFB production trend chart on aged 3 to 13 years

Average Bunch Weight Trend

The plant age factor significantly affects mean grape weight (BJR), as evidenced by the t-test of the second-order polynomial regression with a significance value of 0.00 less than 0.05. The pattern of the relationship

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between plant age and BJR with a polynomial pattern of degree 2 is shown in Figure 3.

From Fig. 2, the value of coefficient of determination R2 = 0.6742 indicates that the plant age factor strongly influenced the mean bunch weight (BJR) of oil palm plants in 67.42% and other factors did not influence the rest. The production trend plot shows that palm tuft weight increases yearly from age 3 to 13 with a second-order polynomial regression equation pattern.

From Figure 2, the coefficient of determination R2 = 0.6742 shows that the average bunch weight (BJR) of oil palm plants is strongly influenced by the plant age factor of 67.42% and the rest is not influenced by other factors. Based on the results analyzed in this study, the production trend plot shows that from the age of 3 to 13 years, the weight of the palm tassels increases every year with a second-order polynomial regression equation pattern.

Oil palm plant production is affected by plant age. Oil palms older than 15 years have heavier tufts than younger plants. Oil Palm Plant Production with the Age of 15 Years has a greater fruit weight than younger plants, one of which is due to its growth and development. Oil palm plants that grow and have an older age root system and stems become stronger and mature so that the plant is able to absorb more nutrients and water from the soil, this can lead to better fruit growth, (Pablo et al., 2023)

The production of oil palm plants is affected by the age of the plants. Oil palms over 15 years old have heavier tufts than younger plants.

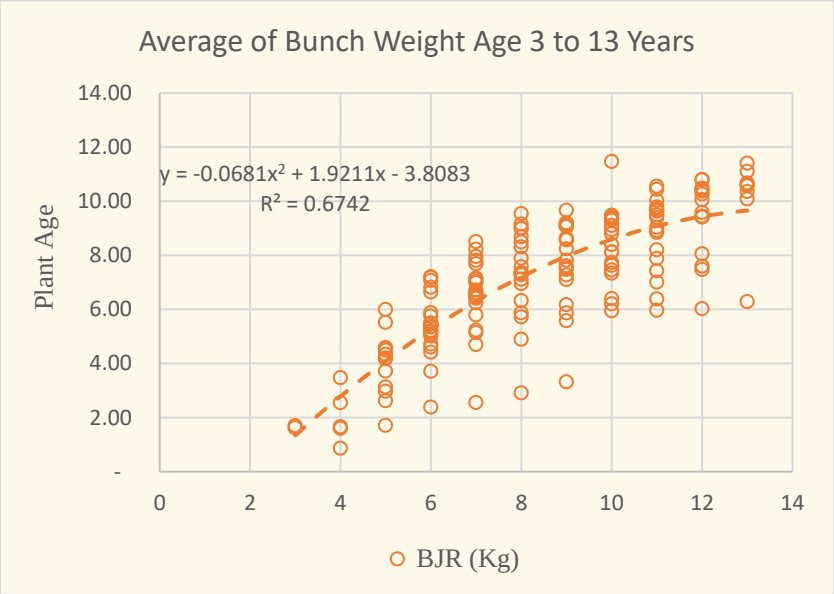

Figure 3. Trend chart of bunch weight average age 3 to 13 years

Trend in the Number of Bunches

After conducting a 2nd order polynomial regression t-test, it was shown that the plant's age significantly affected the number of oil palm bunches with a significance value of 0.006, more diminutive than 0.05. The pattern of the relationship of plant age with the number of bunches following the polynomial pattern of order two can be seen in Figure 4.

The results of the regression test of plant age factors to the number of bunches obtained a value of R^2 = 0.2392 indicating the number of bunches of oil palm plants is influenced by plant age factors by 23.92% and the rest by other factors that were not analyzed in this study. The trend in the number of bunches in Figure 4 shows that from 3 years to the age of 13, the number of oil palm bunches decreases yearly. The pattern of the regression equation is $y = 0.0618x^2 - 1.6525x + 24.917$.

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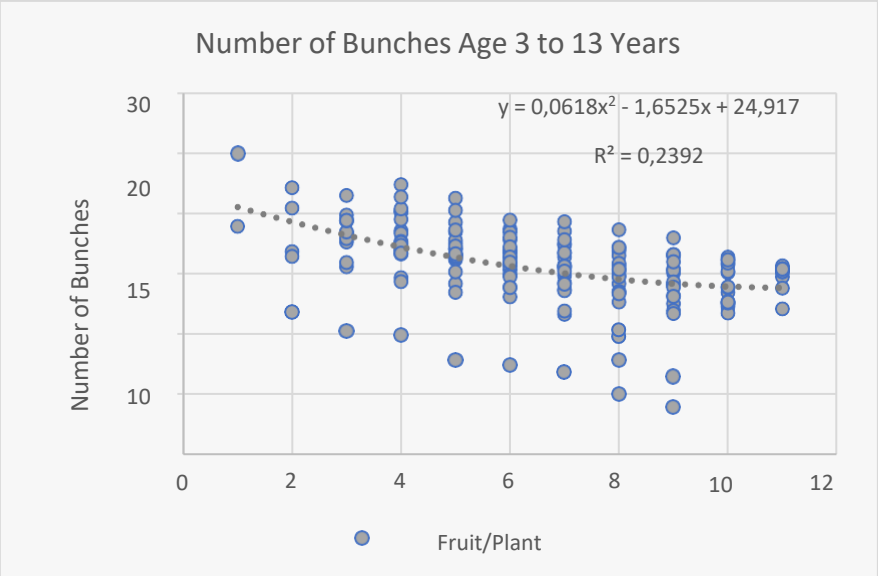

Figure 4. Trend chart of the number of palm bunches aged 3 to 13 years

The components of the production of oil palm fruit bunches include the weight of FFB and the number of bunches. The study's results stated that the number of bunches/principals in plants under eight years of age decreased production yearly. In addition to plant age, the number of oil palm bunches is also influenced by several factors, including the quality of seedlings. Excellent and superior seed quality significantly impacts the productivity of fresh fruit bunches, such as the weight and size of the fruit (Setyawan et al., 2020). In addition to the quality of seeds, it is usually also influenced by soil suitability. Soils that do not conform to the optimum growth classification of oil palm significantly affect growth and yield (Leijten et al., 2022; Tapia et al., 2021).

CONCLUSION

Harvest age significantly impacts oil palm productivity as measured by oil palm crop production components: fresh bunch tons per hectare, average bunch weight, and the number of oil palm bunches. Harvesting age has a significant effect on oil palm productivity as measured by the components of oil palm production: tons of fresh fruit bunches per hectare, average bunch weight, and the number of bunches, but apart from the age of the production plants, it is also influenced by the quality of the seeds and the suitability of the land for planting oil palm. FFB tonnage and average bunch weight increase each year from 3 to 13 years old following a quadratic regression pattern, whereas the number of palm bunches decreases with each age of the plant. Following a quadratic regression pattern, FFB tonnage and average bunch weight increase yearly from age 3 to 13. Although FFB tonnage and average bunch weight increase, the number of palm bunches per tree decreases as the plant ages.

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