Estimation of production and quality of forage under palm oil plantations in different sections

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Abstract. The objective of this experiment was to determine forage production and quality under palm oil plantations in different sections. Data were collected from palm oil plantations aged of 9 years in PT. Buana Karya Bhakti, South Kalimantan with a destructive sampling method and then analyzed for forage production, botanical diversity, and chemical compositions. The data were analyzed using T-test. The results showed that dry matter forage production in the edge section (2,914±854 kg/ha/year) was higher (P<0.01) than that in middle section (754±191 kg/ha/year). Chemical composition: DM, CP, EE, NFE and TDN contents of forage in the edge section were not significantly different with in the middle section, however OM and CF contents in the edge section were higher (P<0.01) than that in the middle section. The NDF and ADF contents in the edge and middle sections were not significantly different, while lignin content in the middle section (15.1±0.6%) was higher (P<0.01) than that in the edge section (10.8±1.0%). It can identified 90 plants species which consisted of 30 species grasses, 38 species forbs, 9 species ferns and 13 species other plants. In conclusion, the edge section under palm oil plantation more potential to provide ruminant feed.

1. Introduction

Vegetation under palm oil plantation is potential for ruminant feed by grazing or cut and carry, because it produces abundant amount of nutritious forage biomass [1]. Forage production under palm oil plantations depend on degree of shade. Degree of shade in palm oil plantation depend on age of plant, high of plant, distance between plants, soil condition and canopy characteristic [2]. Factors affecting the chemical composition and forage digestibility are species and plant age, climate (temperature, radiation, and rainfall), and forage management including nitrogen fertilization [3].

Oil palm plantations can be divided into edge and middle sections. The edge is area along the main road and collection path up to 10 meters in the direction of the oil palm plantations, while the middle is an area surrounded by edges. The edge and middle sections of the palm oil plantation have different characteristics, especially in the quality and quantity of sunlight received. Shade will affect the photosynthesis process, which in turn will affect plant morphology, production and nutrient quality from forage [4].

Through this research, it is expected to obtain data on the potential of forage production and the chemical composition of the forage. This data will support the sustainability of cattle-oil palm integration system.
2. Material and methods

This research was carried out on palm oil plantations aged of 9 years in PT. Buana Karya Bhakti (PT. BKB) located in Tanah Bumbu Regency, South Kalimantan for 2 months (September – October 2018). Sample was analysed at the Laptiab BPPT Feed and Nutrition Technology laboratory, PUSPIPETEK Serpong, South Tangerang.

Estimation of forage production used destructive sampling method [5] and carried out using a 1 x 1 m² quadrant at 90 points in 8 location by cutting forages 5 - 10 cm above the ground, weighed and then followed by a botanical diversity analysis. The existing vegetation is grouped by type (grass, forb and legum, and other plant), weighed and then analyzed for its nutrients content (by proximate analysis) and fiber fractionation. Estimated forage production was calculated using the equation [6] that has been modified according to land conditions, as follows:

\[ P = C \times 10,000 - (LP \times JS) + \text{frond stack zone area} + \text{trench (ditch) area} \]

Description: P = forage production per hectare (kg); C = average forage weight per m²; LP = circle zone (12.56 m² for oil palm plants aged of 3 years and 28.26 m² for 6 years); JS = the number of oil palm plants in 1 hectare (136 trees/hectare).

The nutrient content of vegetation under palm oil plantations was analyzed using proximate analysis, including analysis of dry matter (DM), organic matter (OM), crude protein (CP) and ether extract (EE) [7]. The modified fiber fractionation of Van Soest was carried out using the Ankom Fiber Analyzer for crude fiber (CF) parameters, NDF (neutral detergent fiber), ADF (acid detergent fiber) and ADL (acid detergent lignin) using DAISY Incubator (Ankom Technology Corp, NY, USA) [8]. The data were statistically analyzed using paired and independent T-test [9].

3. Results and discussion

3.1 Forage production

Result of sampling (Table 1.) shows that forage production at the edge was higher than the middle section (P <0.01). More sun exposure on the edges than in the middle causes higher forage production. The shade level will affect the production of forage, this is related to the photosynthesis process experienced by the forage. Shade inhibits plant growth and reduces the number of leaves [10].

Table 1. Average forage production under palm oil plantations in PT. Buana Karya Bhakti, Tanah Bumbu Regency, South Kalimantan

| Variable | Section |
|----------|---------|
|          | Edge    | Middle |
| Forage production (g/m²) |         |        |
| - As fed | 373.00±115.06** | 95.77±25.31 |
| - dry matter (DM) | 121.42±35.60** | 31.44±7.96 |
| - organic matter (OM) | 107.22±30.75** | 26.79±7.16 |
| Forage production (kg/ha/year) |         |        |
| - As fed | 8,952±2,761** | 2,299±607 |
| - dry matter (DM) | 2,914±854** | 754±191 |
| - organic matter (OM) | 2,573±738** | 643±172 |

** = Different superscripts in the same rows shows significantly different (P<0.01)

Estimation of forage production in 9 year aged oil palm plantation at PT. BKB in dry matter per unit in edge section was 2,914±854 kg/ha/year. This amount is greater than the results obtained by [11], where forage production in 8 to 22 years old oil palm plantations is 0.1 to 1.0 tons/ha/year and [12] research is 0.9 tons/ha/year in 10 years old oil palm plants. The study of [13] showed more varied
results, where forage production in the three oil palm plantation areas, middle, periphery and outside parts of oil palm plantations was 2.52; 3.01; and 1.90 tons /ha.

3.2 Botanical diversity
Overall, grass dominates the forage under pal oil plantation in PT. BKB (Table 2.), which *Paspalum conjugatum* grass is a forage which is dominant in oil palm plantations, characterized by its diversity index reaching 3.14 [14].

**Table 2.** Botanical diversity under palm oil plantations in PT. Buana Karya Bhakti, Tanah Bumbu Regency, South Kalimantan

| Vegetation       | Vegetation Percentage (%) |
|------------------|---------------------------|
|                  | Edge section | Middle section |
| Grass            | 69.44         | 49.42          |
| Forbs and legumes| 27.76         | 29.17          |
| Ferns            | 2.31          | 15.67          |
| Other plants     | 0.49          | 5.74           |
| Total            | 100.00        | 100.00         |

Botanical analysis of vegetation under oil palm plantation at PT. BKB identified 90 species, consisting of 30 grass species, 38 forb and legumes species, 9 ferns species and 13 species of other plants. This botanical diversity is more than that of [15] who reported vegetation in oil palm plantations of around 60 to 70 plant species and [12] who reported vegetation diversity in oil palm plantations aged 7, 10 and 14 years were 24, 24 and 27 types of vegetation. However, the results of this study are less than those of [16]. The composition of vegetation always changes depending on the growth rate of the main plants, because it will affect the conditions around where the vegetation grow [17].

3.3 Chemical composition
The botanical diversity under palm oil plantations also influences the quality of forage nutrients. Based on observations it is known that the edge section was dominated by grasses, while in the middle section of the type of forb and ferns grows more. Although the difference is not too high on some parameters (Table 3.), but for crude fiber content and organic matter in the edge section (90.1 ± 0.8% and 29.3 ± 2.2%) were higher (P<0.01) than that in the middle section (85.4 ± 2.5% and 25.9 ± 1.4).

**Table 3.** Chemical composition forage under palm oil plantations in PT. Buana Karya Bhakti, Tanah Bumbu Regency, South Kalimantan (% DM)

| Parameter                        | Edge     | Middle   |
|----------------------------------|----------|----------|
| Dry matter (DM)                  | 32.6±2.7 | 33.1±3.6 |
| Organic matter (OM)              | 90.1±0.8** | 85.4±2.5 |
| Crude protein (CP)               | 9.4±1.7  | 9.8±1.1  |
| Crude fiber (CF)                 | 29.3±2.2** | 25.9±1.4 |
| Ether extract (EE)               | 1.6±0.4  | 1.5±0.4  |
| Nitrogen free extract (NFE)      | 57.3±3.5 | 55.4±2.3 |
| Total digestible nutrients TDN   | 65.6±2.1 | 65.4±2.2 |
| Neutral detergent fiber (NDF)    | 66.0±3.7 | 62.5±4.3 |
| Acid detergent fiber (ADF)       | 45.3±1.1 | 47.1±2.1 |
| Lignin                           | 10.8±1.0 | 15.1±0.6** |

** = Different superscripts in the same rows shows significantly different (P<0.01)

The protein content in the middle section (9.8 ± 1.1%) higher than the edge section (9.4 ± 1.7%). Although there are not significantly different, this is in line with [18] which states that the
concentration of N in plant material that grows under shade generally increases. Based on the results of the analysis it is known that the lignin content of forage in the middle (10.8 ± 1.0%) is higher (P <0.01) than that of the edge (15.1 ± 0.6%). The type of forage that grows a lot in the middle is forb and legume, ferns and other plants, this also influences the content of fractionation of fibers from forages under palm oil plantation.

4. Conclusion
It can be concluded that forage production per unit area on the edge is higher than the middle section under palm oil plantation. The chemical composition of forages in the edge section were not significantly different with in the middle section, except for the CF and OM content, while lignin content of forage in the middle section was higher than that in the edge section. The edge section under palm oil plantation more potential to provide ruminant feed.

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