

# Potential of understorey vegetation in oil palm plantation as forage source for beef cattle feed in Musi Banyuasin, South Sumatera

Endang Sutedi<sup>1\*</sup>, Iwan Herdiawan<sup>1</sup>, Yeni Widiawati<sup>1</sup>, Dwi Yulistiani<sup>1</sup>, Diana Andrianita K.<sup>1</sup>, and Achmad Fanindi<sup>1</sup>

<sup>1</sup>Livestock Research Centre, National Research and Innovation Agency, Indonesia

**Abstract.** The study was conducted to determine the potential of understorey vegetation in oil palm plantations as feed source for beef cattle. The study was conducted in Sukadamai Village, Sungai Lilin Subdistrict, Musi Banyuasin District, South Sumatera Province in April representing the rainy season. Plant samples were taken under oil palm tree age at 5,8 and 11 years old. Sampling area were taken in 1 hectare at each oil palm plantation age, each area were taken randomly 9 samples in size 1 m × 1 m quadrant. Samples obtained were separated to determine its botanical composition, then separated into edible and non dible. All the sample were weighed to obtain amount of forage production. Light intensity of the palm plantation were also measured. The lower light intensity causes more varieties of weed (narrow and broad leaves) to grow. Production of palatable fresh forage grow under oil palm plantations was 509.78 g m<sup>-2</sup>, 76.01 g m<sup>-2</sup> and, 381.49 g m<sup>-2</sup> which is equivalent to 5.15 ton/ha; 2.76 tons/ha and 3.81 tons/ha, respectively for oil palm tree age 5, 8 and 11 years. Potential carrying capacity for cattle weights at 300kg was 0.27 AU /ha, 0.03 AU/ha and 0.058 AU/ha respectively for 5, 8 and 11 years old oil palm tree age. From the results of this study can be concluded that younger oil palm tree age produced more forage biomass for beef cattle feed and have higher carrying capacity.

## 1 Introduction

Oil palm plantation area increase from year to year. Oil palm industry provide feed source for livestock which are from plantation and from palm oil processing. The feed source from plantation consisted of vegetation grow under oil palm tree, oil palm frond and oil palm trunk, and oil palm processing. While feed source from oil palm processing consisted of palm kernel cake, oil palm sludge, empty fruit branch, and palm press fiber. In South Sumatera in 2021 the area of oil palm plantation was 1,058,600 ha [1]. While in Musi Banyuasin the oil plantation area was 202,758 ha. Oil palm plantation area can be used for feed source and for grazing area.

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\* Corresponding author: [endangsutedi@yahoo.co.id](mailto:endangsutedi@yahoo.co.id)

In oil palm plantation as forage source is affected by vegetation under the palm tree. Species diversity of vegetation grow in oil palm plantation is affected by age of oil palm plantation which related to humidity and light intensity [2]. Therefore, the production of the forage affected by age of oil plantation, which in turn affect carrying capacity.

Indonesian government including Musi Banyuasin District launching program on increasing beef cattle population to meet demand on beef. This program must be supported with sufficient available feed. The requirement of feed to support government program on increasing beef cattle population can be supplied from oil plantation. It is expected that with integration of oil palm with beef cattle, beef cattle population in Musi Banyuasin District can be increased through semi-intensive and extensive system. The objective of the study was to evaluate forage production and to identify species of vegetation grow in oil palm plantation at different of the oil palm tree.

## 2 Materials and methods

Study was conducted in Sukadamai village, Musi Banyuasin Distrik, South Sumatera Province. Sample vegetation collected on October 2020 representing rainy season. The research was done in three location based on age of oil palm plantation, i.e 5, 8 and 11 years. Forage sampling in each location taken from 1 ha area, in 9 spot randomly in each spot vegetative sample taken using quadrant 1x1 m<sup>2</sup>. Parameters recorded of study were light intensity, forage identification, forage production, chemical composition and carrying capacity.

Light intensity in each location was measured in Ha area of 9 sampling spot, the light intensity was measured using *Solari Photometer*.

The forage production was estimated using equation  $P = C \times 10.000 - (LP \times JS)$ , where P is forage production per-hectare (kg), C is the weight of forage per M2, LP is the circle area surrounding the palm tree and JS is the number of the palm tree in 1 hectare area. In Sukadamai village the number of oil palm tree per-hectare is 147. The radius of circle plate oil palm tree was 2m, 3m and 4m respectively for 5 years, 8 years and 11 years oil palm tree age. The circle plate area of each plant is 12.56 m<sup>2</sup>, 28.26 m<sup>2</sup> and 63.59 m<sup>2</sup> respectively for 5, 8 and 11 years oil palm tree age.

After the forage sample was weighed the forage was separate grass, legume and browse plant. Each of forage type was then identified by separating the sample each type of plant collected from sampling spot. Chemical composition analysis (crude protein, Gross energy, ash, NDF, ADF) of the sample was done on the favored forage which was taken from pooled forage sample from sampling spot.

Carrying capacity was measured using Voisin equation [3],  $(Y - 1) s = r$ , where Y land area needed for one head cattle for grazing, s is period of grazing in each land area, r is the rest period for the forage to grow. In this study s is 30 days, r is 60 days. While PUF (proper use factor) is 40%, with assumption of medium grazing activity for Bali cattle with body weight of 300 kg for 1 animal unit (AU).

## 3 Results and discussion

### 3.1 Forage identification and palatability

Type of plants grows in oil palm plantation at different age presented in Table 1. Type of plants grows are grass, legumes and other narrow and broad leaves. Species of vegetation under oil palm vary among the plantation depending on the age of oil palm tree [4]. Grass species grows in oil palm plantation are *Axonopus compressus*, *Digitaria ciliaris*, *Panicum*

*repens*, *Paspalum Conjunggatum*, *Chrysopogon aciculatus*. *Axonopus compressus* and *Digitaria ciliaris* are able to grow at different age oil palm tree. Indicating that these grass was able to tolerate at different light intensity. Different age of palm tree will have different canopy which resulted in light goes through in the plantation. In the current study the light intensity was 65, 35 and 30% respectively for oil palm tree age at 5, 8 and 11 years. More variety of grass species grow in younger oil plantation.

**Table 1.** Identification type of plants grows in oil palm plantation at different age.

No	Type of plant	Age of oil palm tree (years)			Palatable
		5	8	11	
<b>A Grass :</b>					
1	<i>Axonopus compressus</i>	√	√	√	√
2	<i>Digitaria ciliaris</i>	√	√	√	√
3	<i>Panicum repens</i>	√	-	-	√
4	<i>Paspalum Conjunggatum</i>	√	√	-	√
5	<i>Chrysopogon aciculatus</i>	√	√	-	√
6	<i>Cenotheca lappocia</i>	-		√	√
<b>B. Legumes</b>					
1	<i>Calopogonium muconoides</i>	√	-		√
<b>C. Others (Narrow and broad leaves):</b>					
1	<i>Ageratum</i>	√	-	-	√
2	<i>Asytasia intrusa</i>	√	√	√	√
3	<i>Borreria latifolia</i>	√	√	-	√
4	<i>Borreria alata</i>	-	√	√	√
5	<i>Clidemia hirta</i>	-	√	√	-
6	<i>Melastoma malbathricum</i>	√	√	√	-
7	<i>Nephrolepis biserrata</i>	√	√	√	-
8	<i>Sida rhombifolia</i>	√	√	√	-
9	<i>Soleirallia Soleilii</i>	√	√	√	-
10	<i>Duranta sp/teh tehan</i>	-	√	√	-
11	<i>Syzygum Sp/jambuan</i>	-	√	√	-
12	<i>Havea brasiliensi /karet</i>	-	√	√	-
13	<i>Elaeisis/ sawit</i>	-	√	√	-
14	<i>Phyllanthus sp/ katuk hutan</i>	-	√	√	-
15	<i>Lantana camara</i>	-	-	√	-
16	<i>Dicranopteris linearis/ pakis</i>	-	-	√	-
17	<i>Goniophlebium percusum/pakis</i>	-	-	√	-
18	<i>suplir</i>	-	-	√	-
19	<i>Seleria pterota/ Ilat</i>	-	-	√	-
20	<i>Imperata cylindrica</i>	-	√	√	-
21	<i>Lathyrus Vernus</i>	-	-	√	√
22	<i>Licopodium saeranum</i>	-	-	√	-
23	<i>Cyperus</i>	√	-	-	√
Total types		14	16	23	

While legumes forage was only grow in oil palm plantation at age 5 years. The only legume grows is *Calopogonium muconoides*. The single species of legumes found in this area could be related to the species legume that use for cover crop. *Calopogonium muconoides* only able to grow in the plantation age 5 years which has higher light intensity. More divers species of narrow and broad leaves grow in older oil palm tree (8 and 11 years) compare to

5 years old oil palm tree this indicate that narrow and broad leaves tolerate to low light intensity. In the present study the light intensity was 65, 35 and, 30% respectively for oil palm plantation at age 5, 8 and 11 years. Species of *Asistacia intrusa*, *Melastoma malbathricu*, *Neprolethia*, *Sida rhombifolia* *Soleirallia Soleilii* were able to adapt to any light intensity. *Asistacia sp* and *Neprolethia* is the most abundant forage species grow in oil palm plantation at age 9, 13 and 18 years [5]. Ashton-Butt et al. [6] in oil palm age between 23 to 29 years old the most abundant understorey plant species grow were *assistacya micranta* followed by *Nephrolepis biserrata*, *Peperomia pellucida*, and *Asplenium longissimum*. On the other hand, Putri et al. [7] did not found *assistacya micranta* and *Nephrolepis biserrata* grow in oil palm plantation age 13 and 15 years age in West Pasaman Regency, West Sumatera Province. Daru et al. [8] the most dominant vegetation grow in 6 years old oil palm plantation in Kutai Kertanegara East Kalimantan was *Otochloa nodosa* followed by *Melastoma malabatricum*. The type of vegetation grow in oil palm plantation affected by light intensity, type of soil, soil fertility. Soil fertility especially soil organic carbon decreased with increasing of palm oil tree age [6].

All grass species grow in oil palm plantation are palatable, similarly legume *Calopogonium muconoides* also palatable. On the other hand, narrow and broad leaves, though more species (24 species) able to grow in low light intensity, but the palatability of this species is only seven species. The ability of *Axonopus compresus* and *Digitaria ciliaris*, *Assistacya intrusa* potential plants as forage source in oil palm plantation due to its palatability and able to grow at different level of light intensity.

### 3.2 Forage production, chemical composition and carrying capacity

Based on observation in the field it shows that age of palm tree affected on diversity dan composition of vegetation grow under the tree. This condition directly related to light intensity goes to the land surface. Sunlight has important role in photosynthesis during plant metabolism therefore indirectly related to growth and plant development [9, 10]. The proportion type of vegetation grows under oil palm tree in Sukadamai Village, South Sumatera presented in Table 2. It shows that at the increasing age of the proportion of the grass decreased from 76.8% in 5 years age into 9.7 at oil palm age 11 years and the proportion of narrow and broad leaves plant increased from 23.1% into 90.3%. While legumes plant was not found in older oil palm tree. The reduction of light intensity will affect on temperature and humidity in the plantation area. Gopar et al. [10] reported that under the older (14 years) oil palm tree more fern plant grow compare to younger (7 or 10 years) tree. This due to fern plant grows well under humid dan shaded condition. However, in contrast to the current study that composition of narrow and broad leaves (include fern plant) was about 90.3%, while Gopar et al. [10] only observed the percentage of fern tree only 22.74%.

**Table 2.** Proportion (%) of type of vegetation in oil palm plantation at different age.

No	Type of vegetation	Oil palm tree age (years)		
		5	8	11
1	Grass (%)	76.8	10.7	9.7
2	Legumes (%)	0.13	-	
3	Others* (%)	23.1	89.3	90.3

\*Others: narrow and broad leaves

Palatable forage production decreased with increasing the age of oil palm tree from 4.37 ton/ha in 5 years age into 0.47 ton/ha in 8 years age (Table 3). This decrease is due to in the older palm more narrow and broad leaves grow which is only few of them are palatable. The forage production was the highest in 5 years old oil palm tree this due to more grass and legume which is palatable able to grow well. In contrast, in the older palm tree higher unpalatable forage production, this related to the dominant composition of narrow and broad leaves grow. Forage production in grazing area is affected by water availability in soil, light intensity, temperature, weather, land topography and soil fertility [10, 11].

**Table 3.** Fresh forage production (Ton/ha) based on palatability in oil palm plantation at different age (years).

No	Palatability	Oil palm tree age (years)		
		5	8	11
1	Palatable (ton/ha)	4.37	0.47	0.79
2	Unpalatable	0.72	2.29	3.02

Nutrient composition of the forage is affected by the botanical composition of vegetation grow in oil palm plantation. Nutrient content of forage composited from palatable forage shows that forage quality evaluated from Crude protein (CP) content and fiber content (NDF) was higher in younger at of oil palm (Table 4). At 5 years oil palm age the vegetation was a mixture of grass and legumes which has high protein content and low fiber content. at older age the dominants vegetation grows was narrow and broad leaves plant, while the type of these plant which is palatable was only few, therefore the quality was lower than composite vegetation at age 5. The quality forage decreased (CP decreased and fiber increased) at older oil palm age this could be the forage is the mixture only few grass and more narrow and broad leaves. With forage CP content 14.23% will able to support maintenance of beef cow when the obtain sufficient amount. Mudhita and Badrun [12] also reported higher CP content (19.91%) than forage grow in oil palm plantation belong to private company than forage grow in the oil palm belong to farmers group. The higher quality of forage grow under oil palm plantation belong to private company due to the forage is the mixture of legumes which is used as cover crop and grass.

Carrying capacity is the ability of grazing area to accommodate livestock in one hectare. Carrying capacity is related to forage production. Carrying decreased with increasing oil palm tree age (Table 5). The higher population of narrow and broad leaves vegetation grows in oil palm plantation reduce carrying capacity. The carrying capacity in Sukadamai village in South Sumatera was 0.27; 0.03 and, 0.05 AU/ha respectively for oil plantation age 5, 8 and 11 years. It shows that to accommodate 1 AU of cattle with body weight 300kg required 3.7 ha grazing area under oil palm plantation age 5 years. The lower carrying capacity in this study caused by the low of palatable forage production. Carrying capacity in the present study was lower than observation reported by Gopar et al. [10] in Riau. They observed that carrying capacity of vegetation grow in oil palm plantation at age 7, 10 and 14 years was 0.36, 0.21 and 0.2 AU/ha. Mohamed et al. [13] stated that oil palm plantation 1-2 years age able to accommodate 3 head cattle per hectare, then decreased into 2 head in oil palm plantation 2-3 years age, further decreased into 1 head per hectare at plantation 5 years age. To increase carrying capacity in oil palm plantation area can be done through increasing soil fertility and introducing high quality of forage type (grass and legumes) which able to tolerate shading condition and have high production.

**Table 4.** Chemical composition of composite of various palatable forage in oil palm plantation at different age.

Nutrients content	Oil palm tree age (years)		
	5	8	11
Crude Protein (%)	14.23	9.04	11.15
Neutral detergent fiber (%)	63.08	72.09	74.34
Acid detergent fiber (%)	46.64	51.32	52.25
Ash (%)	6.58	8.27	7.50
Gross Energy (kcal/kg)	3620	3420	3315

**Table 5.** Carrying capacity of vegetation under oil palm plantation at different age.

	Oil palm tree age (years)	Carrying capacity (AU/ha/year)
1	5	0.27
2	8	0.03
3	11	0.05

## 4 Conclusion

Vegetation grow in oil palm plantation is varied depend on oil plantation age, the quality of forage better in younger oil palm plantation. The forage is potential to be used as forage source for cattle. Forage production was low with carrying capacity based on forage production in Sukadamai village was able to accommodate 0.27 AU/ha at oil palm plantation age 5 years, 0.03 AU/ha at age 8 years and 0.05 AU/ha at age 11 years. To increase forage production and carrying capacity need to be introduced with high production forage which able to tolerate low light intensity in older age of oil palm plantation.

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