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Evaluating rotational grazing technology for integrated Bali cattle-oil palm system onherbage productionto support sustainable meat production in Bengkulu Province, Indonesia

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This study aimed to evaluate the production and the natural forage species that grow in the area of oil palm plantations on rotational grazing system with Bali cattle. Twelve Bali cows with an average weight of 100 kg and aged 1-1.5 years of use in this study. Twelve cows were divided into 3 treatment, namely 1 AUE/ 1 ha, 1 AUE/1.5 ha, and 1 AUE/2 ha. Paddock area built adapted to the calculation of AUE (Animal Unit Equivalent). Each paddock consisted of four sub-paddock used for implementing grazing rotation. Grazing rotation is conducted by putting the cows in the paddock for 7 daysgrazing period and 21 days of resting period. Four samples for the production parameters (total weight, leaf, stem, live and dead material) were taken for each sub-paddock with quadrat (0,5x0.5 m^2) square. The samplings were conducted one day before every cows entering into their respective sub-paddock. The results obtained were analyzed using ANOVA followed by DMRT to test the difference between the means. The results showed that different AUE has no effect on the total production, leaf weight, stem weight, leaf:stem ratio, and live:dead ratio. Forage production for the first month was significantly ($P <0.05$) higher than those of the second and third month.

Keywords: oil palm, rotational grazing, production

Introduction

Until now, Indonesia is the largest palm oil producer in the world with 10.9 million ha (growth rate of 4.7%) and total oil palm production of 29.3milliontonnes (growth rate of 5.6%) (Ministry of Agriculture, 2014). The amount of workforce that is absorbed by plantations and oil palm mills is around 3.3 million households (Hasan, 2008). The oil palm area would reach 20 million ha in the future, with plans for expansion speed reaches about 400.000 hectares/year (Hasan, 2008).

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Indonesia has still faced a problem in providing meat for its population. It was expected that in 2015 Indonesia would still import approximately 1.1 million cattle from overseas, to support 2.56 kg meat consumption per-capita (Handoyo, 2014). An un-used land in the oil palm area of oil palm plantations has a huge potential to be utilized as farm land, particularly ruminants. Integration of ruminants in the un-used oil palm area also has several advantages, including lowering dependence on herbicides to tackle weeds and increasing economic benefits per unit area of plantation land (Chee and Faiz, 1990; Devendra, 2011). Under the oil palm systems, cattle in Indonesia has shown to be successfully used also as working animals to transport oil palm fresh fruit bunch (FFB) from the harvesting site to the collection area and or oil palm mills (Dwatmadji *et al*., 2004).

Although cattle-oilpalm integration is still not popular in Indonesia, this integration has been studied by several researchers in Malaysia (Wan Mohamad, 1978; Chee and Faiz, 1990; Tajuddin *et al.*, 1990), especially related to some aspects of grazing and weed controlling in the oil palm plantation area.The integration of cattle in oil palm plantation needs some basic information regarding the production of forage under the oil palm plantation as main feed for ruminants.

Objectives: This study aimed to evaluate rotational grazing technology for integrated Bali cattle-oil palm system on herbage production.

Materials and methods

The study was conducted in oil palm plantations area (average age of 7-8 years) in Central Bengkulu Regency, Bengkulu Province, Indonesia for 4 months. Initial land preparation is done by cutting the forage growing on oil palm plantations with machines mower with a height of 7 cm from ground level. Three paddock for each treatment (1 AUE/ha, 1 AUE/1.5 ha, and 1 AUE/2 ha) was built based on the initial cowsweight. Each paddocksconsisted of 4 (four) sub-paddock to accommodate targeted grazing rotation plan, which consisted of7-daysgrazing period and 21-days of resting period for each sub-paddock. Using this schedule, every sub-paddock was re-grazed by the same cows every three weeks period.

Twelve Bali cows, approximately 1year old, Body Condition Scores of 6-7, and weight of around 100 kg, were used in this research, and divided each 4 heads for each treatment. Cows for each treatment were given the opportunity to graze in the sub-paddock started at 8:00 in the morning to 16:00 in the afternoon. Beyond the allocated time, cows were kept inside the cages for safety reasons.

Samples for the production parameters (total weight, leaf weight, stem weight, dead and live part) were taken for each sub-paddock each treatment with quadrat (0.5 x 0.5 m) method (Numata *et al.,* 2007). Sampling of production parameters were conducted one day before the cows entered intotheir respective sub-paddock, by cutting 5 cm of the forage above the ground. All samples were then manually separated for production parameters. The data obtained were analyzed by using ANOVA and the difference between the average values was tested using Duncant's Multiple Range Test (DMRT) (Steel and Torrie, 1980).

Results and Discussions

The total forage production, leaf:stem ratio, and live:dead ratio are presented in Table 1.

Table 1. Average total production (DM g/m^2/month), ratio of leaf: stem, ratio of live:dead, and SEM were measured in each paddock for each treatment (1 AUE/1 ha, 1 AUE/1.5 ha, and 1 AUE/2 ha).

Parameter	1 AUE/1 ha		1 AUE/1.5 ha		1 AUE/2 ha		P
	Means	SEM	Means	SEM	Means	SEM	
Total forage production (g/m^2/month)	19.33^{a}	2.718	24.59^{a}	3.23	23.06^{a}	4.692	0.61
Leaf:stem Ratio	3.22:1^{a}	0.540	2.65:1^{a}	0.399	3.61:1^{a}	0.767	0.51
Live:deadRatio	8.18:1^{a}	1.431	10.05:1^{a}	1.827	13.80:1^{a}	6.894	0.62

On the same rows, different superscript indicates significant differences (P <0.05).

Overall there was no significant effect (P>0.05) on all production parameters measured (total production, leaves, stems, and the part that dies in DM g/m^2/month) among treatments. Likewise for the ratio of the leaf: stem ratio and dead parts: life (Table 1 and Table 2). However, there is a tendency that the overall total forage production is likely to increase with the increase in the paddock area (Table 1). Smart *et al.* (2004) states that the ratio of leaf: stem is an important factor affecting forage selection, quality, and consumption of forage. The range of live:dead ratio for pasture is between 0.34:1 to 9.84:1 (*Brome* grass) (Smart *et al*., 2004) and 4.71:1 to 54.6:1 for the species *Panicum maximum* (Onyeonagu and Asiegbu, 2005). The ratio of leaf:stem may vary depending on the plant species, the sampling location and sampling time (Smart *et al*., 2004). In addition to the above factors, the cutting interval also affected ratio of leaf: stem (Onyeonagu and Asiegbu, 2005). The ratio of leaf:stem in this study was 3.22:1 for the 1 AUE/1 ha, 2.65:1 for 1 AUE/1.5 ha, and 3.61:1 for the 1 AUE/2 ha, in which this result was still within a reasonable range. Any decline in the ratio of leaf:stem will result in reduced digestibility of forage value, considering any significant increase in the shaft will have implications on the quality of nutrition (Nelson and Moser, 1994). Curran *et al.* (2010) and Wims *et al.* (2010) mentioned that sward structure (*e.g.* the ratio of leaf to stem and the ratio of dead to live leaf) and quality is influenced by management and can have a significant effect on intake and animal performance. It was very clear through this study that the higher number animal were put in the paddock, the lower of forage production would be.

Table 2 showed that all treatments had no significant effect on the average weight of the leaves, stems and dead materials. For each treatment, however, it appeared that the leaves are significantly have more weight than those of the stems and parts of dead material.Leafiness is particularly important for the Bali cows as the higher the leaf content the higher the forage quality. Leafiness can be affected by plant species, by stage of maturity at harvest, and by handling that results in leaf loss (Ball *et al*., 2001).

Table 2 showed that forage production in month 1 was higher (P<0.01) than those of the month 2 and 3 (Table 3). The production of forage from month 1 to month 2 was decreased to 32.8%, 44.9%, and 28.6% for each treatment (1 AUE/1 ha, 1 AUE/1.5 ha, and 1 AUE/2 ha) respectively. A sharper decline occurred in month 3, which is 18%, 22.1% and 19.57% for each treatment (1 AUE/1 ha, 1 AUE/1.5 ha, and 1 AUE/2 ha) respectively.

Table 2. Average production of forage (DM g/m^2/month) and SEM were measured for month 1, 2, and 3 in each paddock for each treatment (1 AUE/1 ha, 1 AUE/1.5 ha, and 1 AUE/2 ha).

Month	1 AUE/1 ha		1 AUE/1,5 ha		1 AUE/2 ha	
	Means	SEM	Means	SEM	Means	SEM
1	38.44 ^{a}	3.921	44.16 ^{a}	5.658	46.60 ^{a}	11.223
2	12.62 ^{b}	1.472	19.84 ^{b}	7.038	13.45 ^{b}	2.262
3	6.92 ^{b}	1.296	9.76 ^{b}	1.035	9.12 ^{b}	1.612
P	0.01		0.01		0.01	

In the same columns, different superscript differs significantly (P<0,001).

Forage production results in this study (Table 2) showed that rotational grazing with 7-days grazing followed by 21-days resting period was not sufficient for the forage to substantially regrowth to meet the needs of the Bali cows. Based on calculation by McDonald *et al.* (1995), it was estimated that the Bali cows in this experiment roughly needed 2.5-5 kg DM feeds/day. In this experiment, the forage production for 1 AUE/1.5 ha and 1 AUE/2 ha treatment were sufficient to provide the DM intake for the cows. Special attention should be given to treatment of 1 AUE/1 haas the forage production was not enough to provide feed higher than 5 kg DM/day for the cows.

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