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Growth and Biomass Production of Double Cropping Elephantgrass Odot Variety with Inserts of Bisi-16 Maize Plant at Different Planting Density

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ABSTRACT

Elephantgrass of the odot variety has a fast harvest period and is able to regrowth quickly after defoliation. Bisi-16 maize variety has high production of biomass, crude protein and digestibility of feed. The experimental plots were arranged in a block design of latin square method at 4 treatments of planting density and 4 replications for each planting density. The planting density used for the elephantgrass variety of odotwere high density (H), namely H1 = 25 cm x 25 cm (16 plants/m^2 without inserting maize) as a control, and H2 = 25 cm x 25 cm (16 plants/m2) with a maize plant insert of 64 plants, Middle density (M) = 25 cm x 50 cm (8 plants/m^2) with a maize plant insert of 80 plants, and Low density (L) = 50 cm x 50 cm (4 plants/m^2) with a maize plant insert of 100 plants. The insertion of maize plants is 1 plant for every 10 cm of density. Both elephant grass and maize will be harvested at the age of 90 days after planting. The result showed that growth and biomass production of elephantgrassodot variety and bisi-16 maize variety increased with decreasing density and increasing insertion of maize plants from high, medium and low density. Double cropping between elephantgrass variety of Odot and maize variety of bisi-16 became an excellent blend of plants in producing forage beef cattle. It was concluded that low density (50 cm x 50 cm) on elephantgrass variety of odot with insertion of 100 maize plants (1 cm/1 maize seedling) resulted in a high stocking rate as sustainable beef cattle feed.

Key Words: Biomass production; Double cropping; maize of bisi-16; odot-elephantgrass; planting density

Citation Style
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INTRODUCTION

Forage is the main food source for ruminants because it is a basic need for the process of growth, production and reproduction. Dwarf or odotelephantgrass varieties have been widely developed in all regions in Indonesia, including Gorontalo. Dwarf elephantgrass variety (dwarf late and dwarf early) have been developed and cultivated to obtain fresh and dry matter weight and also high quality and high productivity (Mukhtar, M., 2006a), research from aspects of density, application of organic and inorganic fertilizers, and application of liquid fertilizer as well as the application of various types of microorganisms. Odotelephantgrass (*Pennisetumpurpureum, cv. MOTT*) has been developed by community breeders because it has a high water content and fresh material content, thus helping to avoid dehydration while providing sufficient energy and protein for reconditioning. In addition, elephantgrass variety odot has a soft texture and a very high percentage of leaves and is very responsive to various types of fertilization. This elephant grass variety has a fast harvest period and is able to grow back quickly after defoliation. With these high productivity conditions, this odot variety elephantgrass is favored by breeders in Gorontalo. In addition, elephantgrass can be used as direct grazing field (Mukhtar, M. 2006b; Mukhtar, M., 2007a; 2007b).

One of the factors that influence the growth and production of high biomass is density factor. The elephantgrass of this odotvariety, shoots development very quickly so that most of the farmers planting with low density, so that replanting is carried out 3-4 years later. The higher density indicates high biomass production at the beginning of growth (6 – 18 months), but quickly decreases productivity because canopy formation has occurred and inhibits the development of new shoots. This is what requires farmers to plant with low density (50 cm x 50 cm or 50 cm x 75 cm). With this low density, it provides opportunities for planting other forages (double cropping) by utilizing the empty area in the spacing to get double biomass and farmers can formulate complete forage feeds that will be given to beef cattle. With a mixed cropping model like this, farmers can get a double benefit, biomass from grass and biomass from other crops such as forage from beans, maize and legumes.

One of the forages that has high production of biomass, crude protein and digestibility of feed is maize. In Gorontalo, there are so many varieties of maize and one of the varieties favored by the farming community is the bisi-16 maize, because apart from high shelled maize production, biomass (leaves and stems) are still very potential to be used as animal feed. This bisi-16 maize variety has a harvest period of 80-90 days after planting. With a relatively short time so that it can be used as an insert plant in the elephantgrass variety of odot cultivation field. To find out the biomass production of the two types of forage as ruminant feed, a study is needed that in the future makes mixed planting of elephantgrass varieties of odot with maize plants as an insert between the spacings to be applied by farmers and farming communities.

MATERIALS AND METHODS

Plant Materials

This study was conducted on a forage cultivation area for Livestock Food Crops, Department of Animal Science Department, Faculty of Agriculture, State University of Gorontalo from August to December 2021 during the rainy season in Bone Bolango Regency, Gorontalo Province. The examine varieties were elephantgrass varieties Odot (*Pennisetumpurpureum, cv MOTT*) and maize (Zea mays link) bisi-16 varieties as interplants in mixed crops. The elephantgrass cultivation area used is the elephantgrass variety of odot which has been previously planted and has been defoliated or harvested for 2 times, the first defoliation is carried out when the elephant grass odot is 90 days after

planting and the second defoliation is when the plant is 40 days after the first defoliation. The seeds of the bisi-16 variety of maize were introduced from the Central Office of the Maize and Cereal Plant Seedlings of Gorontalo Province.

The studyfiled used was first plowed and fertilized using organic fertilizer with an application of 600 g/m^2 and liming of 400 g/m^2 to normalize the degree of soil acidity. During the plant growth process, fertilization was carried out again at the age of 30 and 60 days after planting.

Experimental Design

The experimental plots were arranged in a block design of latin square method at 4 treatments of planting density and 4 replications for each planting density. The planting density used for the elephantgrass variety of odot is high density (H), namely H1 = 25 cm x 25 cm (16 plants/m^2 without inserting maize) as a control, and H2 = 25 cm x 25 cm (16 plants/m^2) with a maize plant insert of 64 plants, Middle density (M) = 25 cm x 50 cm (8 plants/m^2) with a maize plant insert of 80 plants, and Low density (L) = 50 cm x 50 cm (4 plants/m^2) with a maize plant insert of 100 plants. The insertion of maize plants is 1 plant for every 10 cm of spacing. Both elephant grass and maize will be harvested at the age of 90 days after planting.

Sampling Method for the Growing Period

The sample measurement for growth and biomass production in both types of plants was an area of 1 m^2 with 4 replications and divided into stems and leaves. In elephantgrass, the plant was cut 10 cm above the ground surface for each density, while for maizewas cut 0 cm above the ground surface for each density.

The variables measured at each density were (1) growth including plant height and tillers number and (2) Biomass production including fresh matter production and leaf percentage.

Data Analysis

The data were analyzed statically by analysis of variance and the difference in the mean value was calculated by the list significant difference (LSD) method at 5 % level.

RESULTS AND DISCUSSION

The results of growth and biomass production of odotelephantgrass variety at each density treatment was shown Table 1.

Table 1. Average growth and biomass production of odotelephantgrassvarietiy inserted with maize plants between density

Measured variable	Planting density of OdotElephantgrass varietyand number of Maize plant inserts			
	H1	H2	M	L
Plant Growth :				
1. Plant height (cm)	311±11[a]	275±11[b]	277±10[b]	278±11[b]
2. Tiller number (No./m^2)	70±6.5[a]	71±5.8[a]	67±48[b]	62±39,1[c]
Biomass production :				
1. Fresh Matter Weight (kg/m^2)	1,17±5,4[d]	2,09±4,6[c]	2,57±8,4[b]	3,05±6,1[a]
2. Leaf percentage (%)	69±5,8[a]	69±3,3[a]	67±2,6[b]	65±2,1[c]

H, M and L were high, middle and low density, respectively; H1 = 25 cm x 25 cm (16 plants/m^2 without inserting maize) as a control; H2 = 25 cm x 25 cm (16 plants/m^2) with a maize plant insert of 64 plants; M = 25 cm x 50 cm (8 plants/m^2) with a maize plant insert of 80 plants; L = 50 cm x 50 cm (4 plants/m^2) with a maize plant insert of 100 plants; Different letters in the row show a significant effect at 5% level

Plant height and number of tillers are two indicators in observing the growth and production of plant biomass in the elephangrass variety of odot. The highest plant and highes tiller number will greatly affect the production of biomass and the percentage of leaves of a forage (Mukhtar, 2006), but it is also an indicator of the ability of plants to compete to absorb nutrients properly.

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Plant growth and biomass production of OdotElephantgrass Variety

The treatment of elephantgrass density with the insertion of different bisi-16 varieties of maize had a significant effect (P<0.05) on the growth of plant height and the growth of tiller number of the odotelephantgrass variety (Table 1). At high density, H1 obtained higher plant height production than H2, on the contrary, in the growth of tiller number, the results obtained were almost the same and had no significant effect between both. The low growth of plant height on H2 was caused by the insertion of maize plants which caused the planting distance to be higher. This affects the amount of sunlight that reaches the soil surface, causing the process of formation of nutrients to be slower.

Comparing the treatments at plant density in which maize insertion increased with decreasing density of high, medium and low density i.e. 64, 80 and 100 insertions of maize, respectively. Plant height growth showed the same yield at all density, while growth in tiller number decreased with decreasing plant density from high, medium and low and increasing maize insertion from 64, 80 and 100 plant inserts, respectively. The tiller number growth at high spacing was the same on H1 and H2.

Under these conditions, it can be stated that the insertion of maize plants which increased from high, medium and low spacing, did not significantly affect the growth of plant height, but significantly affected the growth of tiller number. The higher the plant density, the more it affects the growth of plant height and tiller number. The efficiency of light use is a determining component in plant growth and development associated with the production of accumulated biomass from light interception (Pembengo, W., 2012). The same thing was stated by Suryadi (2013) that the increase in plant height was caused by the plant crowns getting closer and causing the quality of the light received to decrease.

Fresh matter production and leaf production are the most important indicators in assessing elephantgrass productivity. The high biomass production and the percentage of elephantgrass leaves indicate good quality and digestibility, high in crude protein and low in crude fiber. The high quality of elephantgrass and corn plants is a parameter of farmers in cultivating these two plants.

The treatment of elephantgrasspalting density with the insertion of different bisi-16 varieties of maize had a significant effected (P<0.05) on the production of fresh matter and the percentage of elephantgrass leaves of the odot variety (Table 1). The production of fresh matter of elephantgrass variety of odot increased along with decreasing planting density of elephantgrass variety of odot and increased insertion of maize variety bisi-16 from high, medium and low density. Meanwhile, the production of leaf percentage decreased along with the decrease in plantingdensity from high, medium and low density. This decreased in leaf percentage was positively correlated with the tiller number obtained. The higher the number of tillers, the more likely the plant will produce new mother shoot that will produce biomass and subsequent tillers.

The treatment of inserting maize plants on the elephantgrass variety of odot will provide benefits to the production of double biomass and efficiency of intercropping land use. In the first year to the second year of growth, tiller production has not completely covered the existing spacing, so the vacant land area can be used for planting other forages such as maize to get double biomass production and increase land efficiency and soil nutrients.

Carrying capacity of elephantgrass and maize biomass as beef cattle feed

The carrying capacity of forage as ruminant feed is the ability of a forage plant to produce forage throughout the year, and can be well consumed by ruminants. Annual biomass production

and carrying capacity of cattle forage for elephant grass varieties of odot and maize are shown in Table 2.

Table 2. Annual biomass production and carrying capacity of the Odot variety of elephantgrass and Bisi-16 variety of maize for 1 year of production

Measured variable	DensityDensity			
	H1	H2	M	L
1. Odot elephantgrass variety (ton/ha/yr)*	70,2	125,4	154,2	183,0
- Stocking rate(head/ha/yr)	7,7	13,7	16,9	20,1
2. Bisi-16 maize variety(ton/ha/yr)**	-	274,2	299,4	360,0
- Stocking rate(head/ha/yr)	-	30,0	32,8	39,5

H1, H2, M and L = As for simbols refer to Table 1.
* 6 times defoliation in one year
** 4 times planting in one year

One indicator of grass and corn cultivation as beef cattle feed is high biomass production so that it can support a sustainable supply of beef cattle feed. Elephantgrass and maize are high quality and high yielding feed. Both types of plants are highly favored by farmers because they support the productivity and growth of beef cattle.

Several studies have shown that the production of elephant grass and maize biomass increases with increasing planting density of low, medium and high density, respectively (Tudsri, S. et al., 2002; Mukhtar, M. 2006a). The difference from the results in this study was due to the treatment of maize plant insertion at the density, where the plant insertion became more numerous as the distances were low from high, medium and low, respectively. The higher the insertion of maize, the higher density, which also results in higher biomass production.

Biomass production was higher along with the higher insertion of maize plants (Table 2) which caused the stocking rate of elephantgrass varieties of odot and maize varieties of bisi-16 to be higher as capacity for beef cattle. The capacity of maize plants is 2 times compared to elephantgrass plants at all densities. In this study, it is recommended that double cropping of elephantgrass of the Odot variety and maize variety of bisi-16 be a very good combination of plants in producing forage for beef cattle.

CONCLUSIONS

Growth and biomass production of elephantgrassodot variety and maize variety of bisi-16 increased along with decreasing planting density and increasing insertion of maize plants from high density, medium density and low density.The double cropping of elephantgrass of Odot variety and maize of the bisi-16 variety are an excellent blend of crops in producing forage for beef cattle. Low planting density on elephantgrass variety of odot with insertion of 100 maize plants resulted in a high capacity for sustainable beef cattle feed.

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