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Research Paper

Effect Of Drought Stress on Biomass Production of Various Brown Midrib Mutant Sorghum Lines As Ruminant Feed

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ABSTRACT: *This study aims to determine the effect of drought stress on biomass production of various Brown Midrib (BMR) mutant sorghum lines. This study used an experimental method with a completely randomized design (CRD) factorial pattern (3x3) with 6 replications. Factor A is the type of sorghum, consisting of: A1 (sorghum numbu), A2 (mutant sorghum BMR Bioss) and A3 (mutant sorghum BMR G-63). Factor B is soil water content, consisting of: B1: 25%, B2: 50% and B3: 75%. The variables observed were: leaves fresh weight, stems fresh weight, roots fresh weight, roots dry weight and plant dry weight. The data obtained were analyzed by analysis of variance (ANOVA) according to Steel and Torrie (1991), the difference between treatments mean was further tested by Duncan Multiple Range Test (DMRT). The results of the research showed that sorghum numbu (A1) had better biomass production than A2 (mutant sorghum BMR Bioss) and A3 (mutant sorghum BMR G-63) plants. From this study, it can be concluded that 25% moisture content of shorgum indicate a good response to the production of BMR mutant sorghum biomass for feeding of ruminant animals.*

KEYWORDS: *Biomass, Drought stress, Sorghum numbu, Sorghum BMR*

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I. INTRODUCTION

Forage is the main feed ingredient for ruminants with consumption levels reaching >80% of the total dry matter (Abdullah, 2011), so it is necessary to provide quality forage and available at all times. In the dry season, there is often a shortage of forage feed in terms of quality, quantity and continuity. To overcome this problem, it is necessary to cultivate forage that has high biomass production and is resistant to drought, one of which is sorghum. Sorghum is the most suitable species for drought-prone environments when compared to other cereal crops (Fracasso et al., 2016). According to Sirappa (2003), sorghum is a forage-producing plant of around 15-20 tons/ha/year and under optimum conditions it can reach 30-45 tons/ha/year in fresh form.

According to Ouda et al. (2005) currently has been developed mutant sorghum Brown Midrib (BMR) which is the result of plant breeding using mutation techniques through gamma irradiation, genetically has a lower lignin content and higher nutritional content than sorghum numbu (non BMR). Sriagtula and Supriyanto (2017) stated that the fresh production of BMR mutant sorghum was 48 tons/ha/harvest or 144 tons/ha/year. BMR mutant sorghum contains 9.28% crude protein and 66.47% dry matter digestibility (Sriagtula, 2016). Advances in mutation technology have produced various types of promising BMR mutant sorghum for animal feed. The lower lignin content in BMR is thought to affect the resistance of sorghum plants to drought. This lignin is important in water transport and maintaining vascular tissue in plants (Pedersen et al., 2005). Lower lignin content allows plants to experience water shortages, especially during the dry season due to reduced groundwater availability. As a result, plants experience drought stress.

Drought stress is one of the environmental factors that has a very bad impact on plant growth so that it can cause a decrease in plant production (Jun-Feng et al., 2010). Lack of water during growth will reduce plant growth which is manifested in biomass production.

Based on this thought, a study was conducted that aims to determine the effect of drought stress on several types of BMR mutant sorghum, in terms of biomass production.

II. MATERIALS AND METHODS

This research was conducted in the greenhouse of the Faculty of Agriculture, Andalas University and used sorghum seeds consisting of 3 types of sorghum, namely Numbu sorghum (conventional), BMR Bioss mutant sorghum and BMR G-63 mutant sorghum, soil and manure. The tools used are polybags, sieves, scissors, paper envelopes, scales, 60^oC oven, 105^0C oven.

This study used an experimental method with a completely randomized design (CRD) factorial pattern (3x3) with 6 replications. Factor A is the type of sorghum (A1: Sorghum Numbu, A2: Sorghum mutant BMR Bioss, A3: Sorghum mutant BMR G-63), and Factor B is soil water content (B1: 25%, B2: 50%, B3: 75%).

The planting medium used was 20 kg of soil plus manure and basic fertilizer, namely urea, SP36 and KCl. Drought stress treatment was carried out after the plants were maintained for one month.Drought stress treatment was carried out by watering according to the dose of soil moisture content according to the treatment. To find out how much water should be added to each polybag according to the treatment, the water content of the media (soil) was measured under field capacity conditions.

Determination of field capacity refers to Hendriyani and Setiari (2009). Field capacity measurements were carried out by preparing 500 g of planting media in several polybags, dousing them with water until they were saturated, then letting them sit for three days until no more water dripped. After three days, the weight of each polybag was weighed and the wet weight (Tb) was obtained. Furthermore, the soil is oven-dried at a temperature of 105^0 C, for 24 hours, so that the dry weight (Tk) is obtained. Then calculate the field capacity with the formula:

$W = \frac{\text{Tb}-\text{Tk}}{\text{Tk}}\, x\, 100\%$ (Islami and Utomo, 1995)

The results of the pre-research soil field capacity measurement showed that the field capacity value of the soil to be used was 37%, so for 100% of the 20 kg soil field capacity 1480 ml of water was needed. Data collection on plant biomass production was carried out at harvest time.

III. RESULTS AND DISCUSSION

The effect of drought stress on the biomass production of the studied sorghum plants is shown in Table 1.

Table 1. Average fresh weight (gr) of leaves, stems, and roots, dry weight of roots, and plant dry weight of several types of sorghum with different soil moisture content

Variables	Treatment	B1	B2	B3	Average	SD
Fresh weight of leaves	A1	15,60	11,17	27,13	17.97[a]	
	A2	0,40	2,13	1,79	1.44[b]	
	A3	2,52	2,71	3,03	2.75[b]	3,98
	Average	6,17	5,34	10,65		
Fresh weight of Stems	A1	14,17	13,14	20,34	15.88[a]	
	A2	0,10	0,57	0,56	0.41[b]	2,15
	A3	0,71	0,34	0,73	0.59[b]	
	Average	4,99	4,69	7,21		
Fresh weight of roots	A1	18,73	18,08	22,68	19.83[a]	
	A2	0,25	1,28	0,45	0.66[b]	3,32
	A3	1,04	0,65	1,22	0.97[b]	
	Average	6,67	6,67	8,12		
Dry weight of roots	A1	4,18	4,23	4,83	4,41[a]	
	A2	0,13	0,45	0,22	0,27[b]	0,56
	A3	0,58	0,35	0,50	0,48[b]	
	Average	1,63	1,68	1,85		
Plants dry weight	A1	6,49	8,09	9,21	7,93[a]	
	A2	0,16	0,57	0,39	0,37[b]	0,87
	A3	0,57	0,54	0,70	0,60[b]	
	Average	2,41	3,07	3,43		

Note: Different superscript at the same row and column indicate significantly different (P<0.05).
A1: Sorghum Numbu, A2: Sorghum mutant BMR Bioss, A3: Sorghum mutant BMR G-63), and Factor B was soil water content (B1: 25%, B2: 50%, B3: 75%). DS: Deviation standart

Table 1 shows that there was no interaction (P>0.05) between the type of sorghum (A) and soil moisture content (B) on the production of plant biomass. The type of sorghum significantly affected the fresh weight of roots, stems and leaves. The highest fresh weight value was seen in Numbu sorghum (A1), this was also influenced by the best growth of Numbu sorghum compared to BMR mutant sorghum (A2 and A3). This result was probably influenced by the adaptability and growth rate of the Numbu sorghum species itself, while the growth and adaptation capacity of the BMR mutant sorghum was not as good as the Numbu sorghum species.

Further test results showed that the BMR Bioss mutant sorghum and G-63 were not significantly different (P>0.05) on all observed biomass production variables. Although the difference was not significant, the production response of the BMR G-63 mutant line tended to be higher than that of Bioss. These results were in line with the growth response of each BMR mutant sorghum, it was seen that there was a tendency for the G-63 mutant sorghum to have a better growth value than the BMR Bioss mutant sorghum. These results indicate that the order of high levels of sorghum biomass production under study were Numbu sorghum, BMR G-63 mutant sorghum, and BMR Bioss mutant, respectively.

Different soil water content also showed no significant difference (P>0.05) on all variables of sorghum biomass production studied, but there was a tendency for sorghum plant biomass production to be higher at 75% soil water content (B3) compared to soil water content. the lower ones are 50 and 25% (B2 and B1). These results indicate that the soil moisture content indirectly affects the production of sorghum plants. This is in accordance with the opinion of Craufurd and Peacock (1993) which stated that in sorghum, the decrease in yield during water stress/drought stress was mainly caused by variations in the accumulation of total plant biomass.

IV. CONCLUSION

The conclusion that can be drawn from this study was that 25% soil moisture content gave a good response to the production of BMR mutant sorghum biomass.

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