SENTRI: Jurnal Riset Ilmiah
Vol.3, No.4 April 2024
ejournal.nusantaraglobal.ac.id/index.php/sentri

PRODUCTION AND GRASS QUALITY HYMENACHNE AMPLEXICAULIS (RUDGE) NEES AT VARIOUS LEVELS OF BIOURINE FERTILIZATION AND ARBUSCULAR MYCORRHIZAL FUNGI

Hardi Syafria
Faculty of Animal Husbandry of Jambi University, Campus of Pinang Masak Mendalo
E-mail: hardi@unja.ac.id

Article History:
Received:29-01-2024
Revised :15-02-2024
Accepted:25-02-2024

Keywords:
Production, Quality, Grass, Biourine and Mycorrhiza

Abstract: *The research aims to determine and study the effects of giving biourine and Arbuscular Mycorrhizal Fungi (AMF) on the production and quality of Hymenachne amplexicaulis (Rudge) Nees grass in former coal mining land. The research was carried out in a Randomized Block Design, with six treatments and three replications. Treatment consisted of: (A) Biourine 0% + AMF 0 g/clump, (B) Biourine 0% + AMF 20 g/clump, (C) Biourine 30% + AMF 0 g/clump, (D) Biourine 30% + FMA 20 g/clump, (E) Biourine 45% + FMA 0 g/clump, (F) Biourine 45% + AMF 20 g/clump. The variables observed were the cumulative production of forage dry matter, crude protein and phosphorus content. The results showed that the treatment had a significant effect on the cumulative production of dry matter, crude protein and phosphorus. The biourine treatment of 45% + AMF 20 g/clump resulted in a cumulative production of forage dry matter (2373.61 kg/ha), crude protein content (15.56%) and phosphorus (1.17%) higher than other treatments.*

INTRODUCTION

The urine potential of male cattle weighing ± 300 kg can produce 8 - 12 liters of urine / day, while female cattle weighing ± 250 kg can produce 7.5 - 9 liters of urine / day (Adijaya et al., 2008). Cow urine contains plant growth stimulants including IAA (Indole Acetic Acid). IAA contained in cow urine can have a good influence on plant growth (Bidwel, 2010). Cow urine is still not widely used because of its strong odor. However, urine that has been processed with a touch of technology can be used as fertilizer. The results of research by Syafria and Jamarun (2018) show that cow urine processed using aeration technology for 6 hours and fermented for 2 weeks produces the nutrient content N (0.50%), P (10.44%), K (1.18%) , C (10.48 %, C/N ratio (19.96) and pH (7.0).

According to Sundari et al., (2011) Using arbuscular mycorrhizal fungi as a biofertilizer can avoid soil damage due to the use of inorganic fertilizers. Prihastuti et al., (2007) Arbuscular mycorrhizal fungi are one of the microorganisms that have an important role for plants, namely facilitating the absorption of nutrients in the soil so that it can increase plant growth, a biological barrier against root pathogen infections, increasing the availability of water and plant growth hormones.

According to Syafria (1996) and Syafria (1998) the crude protein content of Hymenachne amplexicaulis grass in natural conditions is approximately 11.20% higher than elephant grass (approximately 10%). The results of Syafria's (2016) research on ultisol soil concluded that the combination of 20 g AMF/clump treatment with 100% cow dung fertilizer produced the highest forage dry matter in the first cutting and increased in the second cutting. The contents of crude protein, phosphorus, dry matter digestibility and organic matter digestibility (17.30%, 1.51%, 66.33%, and 64.54%), NDF, ADF and lignin respectively (51, 25%, 25.48%, and 5.13%). The results of research by Syafria and Jamarun (2018) in a greenhouse using former coal mining soil concluded that biourine treatment of 45% + 20 grams of AMF/clump produced crude protein (15.35%), and dry matter yield (160.44 grams/clump).

Department of Energy and Mineral Resources in Jambi Province (2010) the area of coal mining business permits reaches approximately 757,241.10 hectares. The ex-mining land has soil conditions that are deficient in nutrients, especially N and P, acid soil reaction, thin top soil, poor organic matter content and symptoms of Al and Mn toxicity (Kartika et al., 2006). The use of organic and biological fertilizers is a very necessary alternative, because it contains all the nutrients for plants, and the materials for making organic fertilizer are quite available and easy to obtain.

Based on the above framework, research was carried out on the effect of providing biourine and arbuscular mycorrhizal fungi on the production and quality of forage grass Hymenachne amplexicaulis on ex-coal mining land as ruminant feed.

METHODS

Location and Time of Research

The research was carried out in the former coal mining area of PT. Gea Lestari-Jambi. Forage dry matter analysis at the Animal Nutrition and Forage Laboratory, Faculty of Animal Husbandry, Jambi University. Analysis of forage quality is carried out at the Laboratory of the Livestock Research Institute in Ciawi Bogor. The research lasted approximately 5 months.

The forage used is kumpai grass (Hymenachne amplexicaulis (Rudge) Nees.), with planting material in the form of stem cuttings (cuttings), each consisting of 3 cuttings.

The biourine used comes from cow urine which is processed using flowing water aeration technology and fermented for 2 weeks (Syafria and Jamarun, 2018). Cow urine was obtained from People's Farms - Jambi. As basic fertilizer, TSP (45% P2O5), KCl (60% K2O), Urea (46% N) and agricultural lime CaCO3 are used.

The arbuscular mycorrhizal fungi used is a multiple spore type with the trademark Cemiko I consisting of (Glomus sp, Acaulospora sp and Scutellospora sp,). Arbuscular mycorrhizal fungi were obtained from the Soil Science Laboratory, Faculty of Agriculture, Andalas University.

The equipment used is soil processing equipment, grass cutters, rulers, sprinklers, plastic bags, scales, and laboratory equipment for forage quality analysis

Research methods

The research was carried out in a Randomized Group Design (RAK) with 6 types of treatment and 3 replications (groups). Treatment consisted of: (A) biourine 0% + AMF 0 g/clump; (B) biourine 0% + AMF 20 g/clump; (C) biourine 30% + AMF 0 g/clump; (D) biourine 30% + AMF 20 g/clump; (E) biourine 45% + AMF 0 g/clump and (F) biourine 45% + AMF 20 g/clump. The biourine dose is calculated from the soil organic C content and the organic C content of biourine fertilizer (Syafria, 2016)

The variables observed were: cumulative production of forage dry matter from 2 harvests, crude protein and forage phosphorus content. Data processing was carried out statistically using a Randomized Block Design. The results of the analysis of variance showed a real effect, followed by Duncan's Multiple Range Test (Steel and Torrie, 1991).

Implementation of Research

Cleaning and cultivating the soil until it is loose, and then making experimental plots, with dimensions of 1.00 m x 2.00 m, distance between blocks 1.00 m and between plots 0.50 m.

As basic fertilizer, TSP (45% P2O5) is used at a dose of 150 kg P205¬/ha ~ 66.67 g TSP/plot); KCl (60% K2O) at a dose of 100 kg K2O/ha ~ 33.33 g KCl/plot); Urea (46% N) at a dose of 200 kg N/ha ~ 88.82 g Urea/plot; and agricultural lime CaCO3 at a dose of: 2 tons/ha ~ 400 g/plot.

Apply basic fertilizer TSP, KCl, Urea and lime at the same time, by spreading it on the ground, then stirring using a rake to make it homogeneous. Soil that has been given fertilizer is incubated for a week until planting.

Before planting, the planting material in the form of stem cuttings 25 cm long (consisting of 2 segments and 3 nodes), is first sterilized by soaking it in a 2.6% NaOCl solution for five minutes and then rinsing with water. Providing arbuscular mycorrhizal fungi as a treatment is carried out at the same time as planting grass, by inserting the inoculum into each planting hole. The local kumpai grass planting material is planted to a depth of ± 8 cm.

Providing arbuscular mycorrhizal fungi simultaneously with planting grass is by immersing it in a planting hole to a depth of approximately 8 cm (Husen, 2012). Meanwhile, biourine fertilizer is given after the plants are approximately one week old.

Pruning plants for leveling in order to obtain a uniform growth start, and reduce the influence of seedling diversity, is carried out after the plants are three weeks old. Growth and development after leveling are considered to be a result of the influence of the treatment given. The next cutting is carried out twice with a cutting interval of 40 days after leveling, with an intensity of 15 cm above the ground surface.

Maintenance includes watering, controlling weeds, pests and diseases. Weed control is done manually, and insect pest control is done by removing them from infected plants.

Observations of each variable were carried out on sample plants in the middle of the experimental plot (5 clumps), this was done to avoid side effects. Determination of cumulative forage dry matter production was carried out twice forage cutting, with a cutting interval of 40 days. Cumulative dry matter production of forage per research plot was converted to forage production kg/ha.

Dry matter analysis was carried out at the Animal Nutrition and Forage Laboratory, Faculty of Animal Husbandry, Jambi University according to the AOAC method (1975). Determination of crude protein is using the Kjeldhal method (Ivan et al., 1974).

RESULTS AND DISCUSSION

The results of analysis of variance showed that the treatment had a significant effect ($P<0.05$) on the cumulative production of forage dry matter, crude protein and phosphorus of kumpai grass. The average research data is displayed in Table 1.

Table 1. Cumulative Production of Dry Material, Crude Protein and Phosphorus of Kumpai Grass in Various Biourine Treatments with Arbuscular Mycorrhizal Fungi

Treatment	Cumulative Dry Forage Production (kg/ha)	Crude protein (%)	Phosphorous (%)
A	1671,66 e	11.21 c	0.26 d
B	2021,26 c	13.03 b	0.75 b
C	1847,51 d	12.51 b	0.50 c
D	2171,01 b	15.24 a	1.13 a
E	1872,21 d	12.76 b	0.55 b
F	2373,61 a	15.56 a	1.17 a

des: Different lowercase letters in the same column indicate significantly different ($P<0.05$) based on Duncan's multiple range test

Cumulative Dry Material Production

From Table 1, it can be seen that there are significant differences ($P<0.05$) between treatments regarding the cumulative production of forage dry matter, and there are different value variations in each treatment. Cumulative dry matter production of forage was lowest in treatment A and highest in treatment F.

The oxygen consumption of the roots of mycorrhizal plants is 2 - 4 times greater than that of non-mycorrhizal roots, so they are better able to absorb mineral salts and supply exchangeable hydrogen ions, this causes the roots of mycorrhizal plants to have greater absorption kinetic energy. Nutrients and water that accumulate around the plant root area will be translocated to the internal hyphae, then to the host tissue via intracellular arbusculars. The better the root development, the better the translocation of water and nutrients from the soil to the plant means encouraging overall plant growth. Beinroth (2001) mycorrhiza can increase the absorption of nutrients and water from the soil, which allows plants to produce new cells and growth hormones, improve soil aggregates so that mass flow processes run better. The dry matter yield of forage is also a manifestation of various factors that influence plant growth and development, including genetic and environmental factors (Bidwell, 1979). Therefore, under the same climatic conditions, soil fertility has a greater influence on plant growth and development (Syafria, 2001; Mardani. 2004). Plants with mycorrhizae are more able to adapt than those without mycorrhizae, because the effects of drought stress will not be permanent on mycorrhizal roots. Husin et al. (2012) said that the roots of mycorrhizal plants will quickly recover during periods of water shortage, because their hyphae have the ability to absorb water from soil pores when the plant is no longer able to absorb water. The results of Syafria's research (2018) showed that the application of biourine and arbuscular mycorrhizal fungi to former coal mining soil had an effect on the growth and yield of kumpai grass.

Crude protein

From Table 1, it can be seen that there are significant differences ($P<0.05$) between treatments regarding crude protein content, there are variations in crude protein content between treatments, but statistically the crude protein in treatments D and F is not significantly different ($P>0.05$). The lowest crude protein content was in treatment A and the highest in treatment F.

This increase in crude protein content is caused by the hyphae of arbuscular mycorrhizal fungi which are associated with the roots, helping plants absorb more nutrients in the soil and water from the soil pores. Mycorrhiza infects the root system by forming an intensive network of hyphae so that it can increase nutrient absorption, especially phosphorus nutrients for carbohydrate metabolism, improve soil structure which allows plant roots to develop well, thus affecting the quality of forage. Arbuscular mycorrhizal fungal spores contain nitrate reductase so that their external hyphae have the capacity to absorb nitrate (Bago et al., 2008). External hyphae can also increase the absorption of mobile nutrients N, Ca and Mg (Hapsoh, 2008), and micro nutrients such as Zn, Cu, and B (Smith and Read, 2008).

Phosphorus

From Table 1, it can be seen that there are significant differences ($P<0.05$) between treatments regarding phosphorus content, so there are variations in phosphorus values between treatments. Statistically, the phosphorus content was not significantly different ($P>0.05$) between treatments C and E and between treatments D and F. The lowest phosphorus content was in treatment A and the highest in treatment F.

Phosphorus nutrient is one of the limiting factors in increasing plant productivity. This is because inorganic phosphate ions will combine with soil colloids or be fixed in the form of Fe-P and Al-P, making them relatively unavailable to plants. Increased phosphorus content in mycorrhizal plants is because the hyphae of arbuscular mycorrhizal fungi associated with roots are able to help plants absorb nutrients in the soil and water from soil pores. Mycorrhiza infects the root system of the host plant by forming an intensive network of hyphae, causing the plant to increase its absorption of nutrients, especially phosphate nutrients. According to Beinroth (2010), mycorrhizal infection in plants can produce phosphatase enzymes, which function to increase the availability of phosphate which is low in marginal land. Mycorrhizal hyphae in the soil can increase the uptake of phosphorus up to 8 cm from the roots, so that the supply of phosphorus to plants is greater. Mycorrhiza can use phosphorus bound by phytate efficiently, due to the presence of phosphatase enzymes released by hyphae (Smith and Read, 2009). Phosphatase can hydrolyze various organic phosphorus compounds (Tarafdar and Claassen, 2001), and this enzyme is abundant in the rhizosphere when plants lack phosphorus (Yun and Kaeppler, 2001; Wasaki et al., 2003).

CONCLUSION

From this research it can be concluded that the 45% biourine + 20 g AMF/clump treatment resulted in a higher cumulative production of forage dry matter (2273.61 kg/ha), crude protein (15.56%) and phosphorus (1.17%) compared to other treatments. .

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