

Growth and Results Forage Hymenachne amplexicaulis (Rudge) Nees in Former Coal Mining Land

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Growth and Results Forage *Hymenachne amplexicaulis* (Rudge) Nees in Former Coal Mining Land

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ABSTRACT

Background: Cow urine contains a growth stimulating substance IAA (Indole Acetic Acid) and is a compound from the auxin group. IAA has a good effect on plant growth. Arbuscular mycorrhizal fungi have an important role for plants to overcome Al poisoning in marginal soils. Many of the marginal lands in Jambi Province are former coal mining areas. The role of AMF will be better if organic matter is added as a source of nutrition. Therefore, a study was conducted on the effect of a combination of biourine treatment with arbuscular mycorrhizal fungi on the growth and yield of forage in former coal mining areas.

Methods: The experiment was conducted in a randomized block design, with six treatments and three replications. The treatments consisted of: (A) biourine 0% + AMF 0 g/clump (control), (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, (F) biourine 45% + AMF 20 g/clump. The variables observed were leaf width, number of leaves, plant length, number of tillers and yield of dry forage.

Result: The results showed that the treatment had a significant effect ($P < 0.05$) on leaf width, number of leaves, plant length, number of tillers and yield of forage dry matter. The conclusion in this study is that E treatment (biourine 45% + AMF 20 g/clump) is the best.

Key words: Biourine, Forage, Growth, Land, Mycorrhizae.

INTRODUCTION

Cow urine contains a growth stimulating substance IAA (Indole Acetic Acid). It is a compound from the auxin group. IAA has a good effect on plant growth. Cow urine has not been widely used, because of its strong smell. Urine that is processed with aeration technology becomes biourine, which is useful for organic plant fertilizers. Urine contains complete nutrients, but in small amounts. Syafria *et al.* (2019) stated that cow urine treated with aeration technology for 6 hours and fermented for 2 weeks resulted in an average nutrient content of N (0.50%), P (10.44%), K (1.18%), C (10.48%), C/N ratio (16.90) and pH (6.65).

Arbuscular mycorrhizal fungi have an important role for plants to overcome Al poisoning in marginal soils. According to Fortin *et al.*, (2002) the arbuscular mycorrhizal fungi are one of the microorganisms that have an important role, namely facilitating nutrient absorption in the soil, biological barrier to root pathogen infections, increasing water availability and plant growth hormones. Many of the marginal lands in Jambi Province are former coal mining areas. The total area of the coal mining business license reaches approximately 757,241.10 hectares. The former landfill has soil conditions that are deficient in nutrients, especially elements of N, P, K, acidic pH, thin top soil, Al and Mn toxicity.

One type of local forage that has potential as forage is kumpai grass [*Hymenachne amplexicaulis* (Rudge) Nees.]. The results of the research by Syafria *et al.* (2019) concluded that the treatment of arbuscular biourine and mycorrhizal fungi produced the highest dry matter for kumpai grass.

Organic fertilizers contain complete nutrients that are beneficial to plants (humic acid, fulfat acid and other organic compounds) but are low in content (Mardani, 2004).

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Arbuscular mycorrhizal fungi (AMF) infect the root system of the host plant by forming hyphae intensively, so that mycorrhizal plants can increase their ability to absorb nutrients and water. This increase is not only for macro nutrients but also micro elements, but more importantly, phosphate nutrients, because mycorrhizal infections in plants can produce phosphatase enzymes which function to increase the availability of soil phosphate which is actually not available (Husin *et al.*, 2012).

Rhizosphere quality is determined by interactions between soil, plants and microorganisms associated with plant roots. To get the dominant rhizosphere with beneficial microorganisms is by giving mycorrhizae. This is as a microorganism that will help improve nutrient and water uptake in the rhizophyte. Mycorrhizae are heterotrophic and require relatively good aeration. Its role will be better if organic materials are added as a source of nutrition. Therefore, a study was conducted on the effect of a

combination of biourine treatment with arbuscular mycorrhizal fungi on the growth and yield of forage in former coal mining areas.

MATERIALS AND METHODS

Place and time of research

The research was conducted on a former coal mine area located in Mestong District, Batang Hari Regency, Jambi Province. The research was conducted for 4 months, from March to June 2019.

Materials and equipment

The forage used is local kumpai grass, with planting material in the form of cuttings. Multiple spore arbuscular mycorrhizal fungi (*Glomus* sp, *Acaulospora* sp and *Scutellospora* sp) is used at a dose of 20 g/family (Syafria *et al.*, 2019). Biourine fertilizer is obtained from the processing of cow urine with a running water aeration system. The tools used include hoes, lawn mowers, rakes, sprinklers, scales and other agricultural equipment. TSP (45% P₂O₅), KCl (60% K₂O), urea (46% N) and agricultural lime CaCO₃ are used as basic fertilizers.

Research methods

The experiment was carried out using a randomized block design (RBD), with six treatments and three replications. The treatments consisted of: (A) biourine 0% + AMF 0 g/pot as a control, (B) biourine 0% + AMF 20 g/pot, (C) biourine 30% + AMF 0 g/pot, (D) biourine 30% + AMF 20 g/pot, (E) biourine 45% + AMF 0 g/pot and (F) biourine 45% + AMF 20 g/pot.

Observed variables

The variables observed consisted of leaf width, number of leaves, plant length, number of tillers and yield of dry forage.

Research implementation

The first stage of the research was measuring the area of land used, then hoeing it. Furthermore, making experimental plots, with a size of 2.00 m x 3.00 m, the distance between blocks is 1.00 m and between plots of 0.50 m. Basic fertilizer is given a week before planting. Mycorrhizal administration is concurrent with planting. Give biourine one week after the grass is planted. Pruning of plants to obtain uniform growth and reduce the effect of seed diversity is done after

the plants are three weeks old. Subsequent cuts were carried out twice with cutting intervals of 45 days with an intensity of 15 cm above the soil surface. Observation of each variable was carried out on sample plants in the middle of the experimental plot.

Data processing

Statistical data is processing with a randomized block design. Variance analysis is used to determine the effect of treatment on the observed variables. The results of analysis of variance which showed a real effect were followed by Duncan's Multiple Range Test (Steel and Torrie, 1993).

RESULTS AND DISCUSSION

The results of the analysis of variance showed that the treatment had a significant effect ($P < 0.05$) on leaf width, number of leaves, plant length, number of tillers and yield of forage dry matter. The mean value of the observations for each variable is shown in Table 1.

Leaf width

From Table 1, it can be seen that the leaf width in treatment F is wider, but not different from treatment D. Likewise, the leaf width in treatment E, C and B is not different. The smallest leaf width was obtained in treatment A (1.30 cm), while the widest was obtained in treatment F (1.75 cm). Increase in leaf width is due to mycorrhizal plants being able to increase the absorption of nutrients and water from the soil. Meanwhile, the biourine organic fertilizer in the soil is broken down by microorganisms that use it as a source of nutrition and energy. Organic fertilizers are also able to increase soil organic C content, nutrients, physical, chemical and biological properties of soil (Sumarsono *et al.*, 2005). The results of Karti's (2004) study concluded that giving arbuscular mycorrhizal fungi on grass *Setaria splendida* Stapf. resulted in significantly higher leaf area than without mycorrhizae. The factor that causes wider leaves in the biourine + AMF treatment is the K nutrient content in biourine organic fertilizer. Tisdale and Nelson (1975) function to open and close the stomata, increasing water uptake by plants. The nutrient potassium also plays an important role in the photosynthetic process, because it directly increases the growth and area of leaves, increases CO₂ assimilation and

Table 1: Average leaf width, number of leaves, plant length, number of tillers and yield of dry forage in various treatments.

Treatment	Leaf width (cm)	Number of leaves (leaves/clump)	Plant length (cm)	Number of tillers (tillers/clumps)	Dry matter yield (kg/ha)
A	1.30 ^a	61.56 ^a	56.55 ^a	10.67 ^a	1,651.65 ^a
B	1.50 ^b	74.22 ^b	63.22 ^c	12.89 ^b	2,001.25 ^c
C	1.51 ^b	71.10 ^b	65.33 ^c	12.40 ^b	1,827.50 ^b
D	1.70 ^c	98.55 ^c	59.56 ^b	14.22 ^c	2,151.00 ^d
E	1.54 ^b	77.80 ^b	64.11 ^c	12.56 ^b	1,892.50 ^b
F	1.75 ^c	101.55 ^c	60.65 ^b	16.55 ^d	2,253.60 ^e

Description: The numbers in the same row followed by different superscripts of lowercase letters are significantly different based on Duncan's multiple distance test at 0.05 level.

increases the translocation of photosynthetic products out of the leaves.

Number of leaves

From Table 1, it can be seen that the number of leaves in treatment F was more, but not different from treatment D. Likewise, the number of leaves in treatment E, C and B was not statistically different. The least number of leaves was obtained in treatment A (61.56 leaves/clump), while the highest number was obtained in treatment F (101.55 leaves/clump). The increase in the number of leaves is caused by mycorrhizal plants that can increase nutrient and water absorption from the soil. Nutrients are transported by plant roots to the vegetative part for plant growth and development. According to Smith and Read (2008) absorption of nutrients and water by mycorrhizal plants allows plants to produce new cells and hormones for plant growth. Furthermore, the plant becomes more fertile so that it produces more leaves. The application of organic fertilizers can increase the soil organic C content, a nutrient. Tisdale and Nelson (1975) stated that potassium serves to help maintain osmotic potential, opening and closing stomata. Therefore, plants that contain enough potassium lose less water, so they can produce more leaves for growth.

Plant length

From Table 1, it can be seen that there is a significant difference ($P < 0.05$) in the length of the C, E, B treatment plants with the F, D and A. The shortest plant length was obtained in treatment A (56.55 cm), while the longest was obtained in treatment C (65.33 cm).

Plant length increases with increasing biourine concentration. This is due to the increase in soil nutrient content. Organic fertilizers are also a source of nutrition and energy for soil microbes, so that the role of mycorrhizae will be more influential in increasing nutrient absorption by external mycelium. N, P and K nutrients in organic fertilizers have an effect on plant length. Elemental N functions to make plants green because they contain chlorophyll which plays a role in the photosynthesis process. The P element plays a role in strengthening the stems so they do not collapse easily and root development. Elemental K tends to remove the bad influence of N and reduces the plant ripening that is accelerated by P. While the energy provider for plant growth is sugar produced through photosynthesis (Bidwell, 1979).

Number of tillers

Table 1 shows a significant difference ($P < 0.05$) in the number of tillers in treatment D with other treatments. The highest number of tillers was obtained in treatment F (16.55 tillers/clump), while the lowest was obtained in treatment A (10.67 tillers/clump).

The increase in the number of tillers has a close relationship with the development of plant roots. Mycorrhizae help the roots to absorb nutrients and water. The external hyphae of mycorrhizal plants can increase the surface area

of the roots and are able to enter the soil pores to absorb phosphate. Plant roots that develop due to the application of organic fertilizers will support the development of rhizomes and stolons. The more roots, the more tillers will be developed. The water content in plants and the aeration conditions of the planting medium are also factors that influence the formation of plant saplings. According to Bidwell (1979), the percentage of water in plants affects the physiological activities of plants. Therefore, a good aeration condition of planting media will have a positive effect on the development of plant roots, so that the active absorption of nutrients by the roots goes well, so that the growth of more tillers.

Dry material yield

From Table 1, it can be seen that the dry material yield in treatment F is higher, significantly different from other treatments. The highest yield of forage dry matter was obtained in treatment F (2,253.60 kg/ha), while the highest was obtained in treatment A (1,651.65 kg/ha).

The yield of dry forage is closely related to the growth of the vegetative part of the plant (leaf width, plant length and number of tillers). The combination of biourine + AMF treatment showed better growth than other treatments. The oxygen consumption of mycorrhizal roots was 2-4 times greater than that of non-mycorrhizal plants. Therefore, it is better able to absorb mineral salts and supply exchangeable hydrogen ions. This causes mycorrhizal plant roots to have greater absorption kinetic energy. Nutrients and water accumulate around the root area of the plant, will be translocated to the internal hyphae, then the host network through the intracellular arbuscular, the better the root development, the better the translocation of water and nutrients from the soil to the plant, which means encouraging overall plant growth. Therefore, for maximum growth there must be enough leaves, which will absorb most of the solar radiation. Beinroth (2001) mycorrhizae can increase the absorption of nutrients and water from the soil, which allows plants to produce new cells and growth hormones, improve soil aggregation so that the mass flow process runs better. Therefore, the arbuscular mycorrhizal mycorrhizal fungi are more able to influence the increase in dry material yield compared to those without mycorrhizae (Smith and Read, 2008). However, the yield of forage dry matter is also a manifestation of various factors that influence plant growth and development, including genetic and environmental factors (Bidwell, 1979). Therefore, in the same climatic conditions, soil fertility has more influence on plant growth and development (Syafria *et al.*, 2020). Mycorrhizal plants are more able to adapt than without mycorrhizae, because the influence of drought stress will not be permanent on mycorrhizal roots. Husin *et al.* (2012) Mycorrhizal plant roots will quickly recover during periods of water shortage, because mycorrhizal hyphae have the ability to absorb water from soil pores when plants are no longer able to absorb water.

CONCLUSION

Treatment F (biourine 45% + AMF 20 g/clump) resulted in better growth and yield of forage dry matter compared to other treatments.

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