

PAPER • OPEN ACCESS

Provision of micoriza arbuscula in some types of grass to the degree of infection and phosporus uptake

To cite this article: E Kurniawati *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **260** 012182

View the [article online](#) for updates and enhancements.

Provision of micoriza arbuscula in some types of grass to the degree of infection and phosporus uptake

E Kurniawati, N Diana* and Delvian

Faculty of Agriculture, Universitas Sumatera Utara, Medan, Sumatera Utara Indonesia.

Email: *nevydiana@yahoo.co.id

Abstract. This study was conducted in Faculty of Agriculture North Sumatera University. This study used a factorial completely randomized design (FCRD) consisting of two factors. The first factor was type of grass and the second factor is the microfer level with 5 treatments and 3 replications. The results of the diversity analysis showed the use of MVA significantly ($P < 0.05$) in the degree of root infection and phospor uptake. This study use five types of grass (S) with MVA levels (M). The ratio of the degree of root is found in the M3 treatment 47.53% and the ratio of phosporus uptake is found in the M3 treatment 110.10% and the ratio of phosporus uptake is found in the S1 treatment 91.85%. From this study, it can be concluded that the best treatment is found in M3 treatment.

1. Introduction

At the present time, it is difficult to get fertile land for animal feed crops because fertile land is generally used for food crops so that animal feed crops are planted by utilizing marginal land, less land with nutrients. Marginal land generally has a problem of P availability on the ground, if viewed from the aspect of crop cultivation can be categorized as unproductive because, in addition to having a high degree of acidity, it is also due to the low availability of nutrients they contain. The lack of availability of P elements is caused by high aluminium concentrations in the soil causing fixation of phosphorus elements.

Grass is one of the forages needed for ruminants as a basic feed which has benefits to meet the needs of life, for livestock production and reproduction. As a grass base feed has an important role in keeping the need for grass as animal feed is needed in large quantities in the preparation of ruminant rations. Fertilization is important in cultivation activities with the aim of improving the quality and health of the soil. Application of organic fertilizer can enrich the content of organic matter, macro-micro nutrients so that it can increase production [1]. According to [2] fertilization is an absolute requirement in cultivating a plant, fertilizing aims to replace nutrients that are lost due to the washing process and the transport of agricultural waste together. Harmful nutrient balance in the soil greatly affects good absorption, so that it is expected to increase crop production [3].

One effort to get around marginal land that lacks nutrients is to use mycorrhiza. This mycorrhiza acts to release P bonds from clay minerals and provide them for plants. Mycorrhiza plants are usually more dry than those that do not. The expected benefits of mycorrhizal use are related to the growth, quality, and productivity of forage crops. Mycorrhiza can help plant roots in the absorption of macro and micro nutrients, especially phosphate, increase water absorption by plants and increase plant resistance to



drought stress [4]. This fungus also produces hormones that can stimulate plant growth. Bengal grass (*Panicum maximum*) is one of the superior grasses that has been widely cultivated among farmers. In Indonesia, this grass is known as Bengali grass, in England known as Guinea grass and in Java known as Suket Londo. This grass is imported from Zimbabwe including the medium type with a height of 1.5-2.5 m. This grass is an annual plant that does not form a stretch but forms a clump. The texture of the smooth leaves is wider and longer with nine more real middle leaf bones, the rough leaf edges of the leaves form a large and easily seeded [5]. Research Results of [6] in mycorrhizal treatment 30 g + chicken 500 g gave the best contribution to variable leaf width (2.34 cm/bed/week), stem diameter (1.43 cm/bed/week), number of tillers (13.86 beds/week), fresh canopy weight (2752.10 gr/bed) and leaf moisture content (80.63%).

Based on the benefits of mycorrhizae, it is necessary to conduct research to see the response of growth, production, and quality of several types of grass with the addition of Arbuscular Mycorrhiza.

2. Materials and Method

This research was conducted in December 2015 to March 2016 on the field of the Faculty of Agriculture, University of North Sumatra. The materials used in this experiment were ultisol soil obtained from Desa Kuala Bekala, Kel. Simalingkar B, Kec. Pancur Batu, Kab. Deli Serdang. Mycorrhizal fungi of *Gigaspora sp*, *Glomus sp*, and *Acaulospora sp*. The host used 5 types of grass, namely: *Paspalum Guenarum*, *Paspalum Notatum*, *Brachiaria Ruziziensis*, *Brachiaria Humidicola*, and *Panicum Maximum*. This grass was obtained from the Sei Putih laboratory. This design uses a Factorial Completely Randomized Design consisting of two factors. The first factor was the type of grass used consisting of *Paspalum Guenarum* (S1), *Paspalum Notatum* (S2), *Brachiaria Ruziziensis* (S3), *Brachiaria Humidicola* (S4), and *Panicum Maximum* (S5). The second factor is the microfer level consisting of 0 gr (M0), 10 gr (M1), 20 gr (M2) and 30 gr (M3). All treatments were repeated 3 times so that 60 units were obtained. This research was carried out on land using pots. In 1 pot 5 kg of land is used.

3. Results and Discussion

3.1. Degree of infection

The results of the degree of infection due to mycorrhizae (M) and type of grass (S) can be seen in Table 1 below. From the results of analysis of variance and results on infection degree data, the table below.

The treatment of five types of grass in the highest treatment S2 (*Paspalum notatum*) was 41.67%, while in the lowest treatment S5 (*Panicum maximum*) the degree of plant root infection was 24.25%, with five levels of grass species.

Table 1. Degree of infection.

Treatment	Doses of MVA / Poly bag (5 kg)				Average
	M0 (0 g)	M1 (10 g)	M2 (20 g)	M3 (30 g)	
	--- % ---				
S1(<i>Paspalum guenarum</i>)	23.33	15.00	32.67	34.33	26.33 ^b
S2(<i>Paspalum notatum</i>)	23.67	40.00	43.00	60.00	41.67 ^a
S3(<i>Brachiaria ruziziensis</i>)	17.00	19.67	26.67	45.67	27.25 ^b
S4(<i>Brachiaria humidicola</i>)	24.00	28.00	33.67	45.00	32.67 ^b
S5(<i>Panicum maximum</i>)	13.33	12.33	18.67	52.67	24.25 ^b
Average	20.27 ^c	23.00 ^c	30.93 ^b	47.53 ^a	

Remarks: The number followed by the same letter is not significantly different at the 5% level according to the DMRT average test (Duncan Multiple Range Test)

From these data it can be seen that the administration of mycorrhizae (M) plays a role in increasing the degree of root infection (%) mycorrhizal treatment (M3) degree of plant root infection by 47.53%, while in the treatment without mycorrhizae (M0) the roots of the plant only had a slight infection of 20.27%.

The treatment of five types of grass in the highest treatment S2 (*Paspalum notatum*) was 41.67%, while in the lowest treatment S5 (*Panicum maximum*) the degree of plant root infection was 24.25%, with five levels of grass species.

From these data it can be seen that the administration of mycorrhizae (M) plays a role in increasing the degree of root infection (%) mycorrhizal treatment (M3) degree of plant root infection by 47.53%, while in the treatment without mycorrhizae (M0) the roots of the plant only had a slight infection of 20.27%.

3.2. Phosphorus uptake (P) plant

The results of Phosphorus uptake of plants on mycorrhizae (M) and type of grass (S) and the results of analysis of variance and the results of the phosphorus (P) uptake data of the plants are presented in Table 2.

Tabel 2. Phosphorus uptake (P) plant.

Treatment	Doses of MVA / Poly bag (5 kg)				Average
	M0 (0 g)	M1 (10 g)	M2 (20 g)	M3 (30 g)	
	--- mg/plants ---				
S1(<i>Paspalum guenarum</i>)	66.71	86.20	100.08	114.42	91.85 ^a
S2(<i>Paspalum notatum</i>)	56.92	52.88	101.75	119.87	82.85 ^a
S3(<i>Brachiaria ruziziensis</i>)	19.50	17.74	38.43	54.03	32.42 ^b
S4(<i>Brachiaria humidicola</i>)	43.68	63.65	107.14	141.90	89.09 ^a
S5(<i>Panicum maximum</i>)	37.77	72.24	71.93	120.27	75.55 ^a
Average	44.91 ^c	58.54 ^c	83.86 ^b	110.10 ^a	

Remarks: The number followed by the same letter is not significantly different at the 5% level according to the DMRT average test (Duncan Multiple Range Test)

The treatment of five types of Phosphorus (P) Plant uptake of grass in the highest treatment of S1 (*Paspalum guenarum*) was 91.85, while in the lowest treatment S3 (*Brachiaria ruziziensis*) uptake of phosphorus (P) Plant was 32.42%, with five levels of grass type. From the data of mycorrhizae administration (M), it plays a role in the uptake of phosphorus in the type of grass. In mycorrhizal treatment (M3) the highest degree of phosphorus uptake was 110.10%, whereas in the treatment without mycorrhizae (M0) the lowest plant phosphorus uptake was 44.91%.

From the data of mycorrhizae administration (M), it has a role in increasing the degree of root infection (%) in the grass type. In mycorrhizal treatment (M3) the degree of plant root infection was 47.53%, whereas in the treatment without mycorrhizae (M0) the degree of plant root infection was 20.27%. This can occur because the soil as a planting medium has been sterilized 2 times, so the possibility of naturally occurring mycorrhizae in the soil is inactive again, in other words, the possibility of mycorrhizae infecting the roots of plants is very small. This is in accordance with the statement of [7] which states that the time required for infection to occur between a mycorrhiza varies greatly. In addition to being determined by the level of infectivity of the symbionts, many are also influenced by environmental factors such as soil temperature, soil water content, soil pH, organic matter, light intensity, and nutrient availability, influence of heavy metals and other elements. This is supported by the literature of [8] which states that the working principle of mycorrhizae is to infect the host root

system, to produce hyphae intensively so that plants containing mycorrhizae will be able to increase capacity in nutrient absorption.

From the results of the study showed mycorrhizae play a role in crop productivity, especially in the production of P elements in ultisol soil which is indeed low in P. The growth of forage roots is better after treatment with arbuscular mycorrhizae. This is consistent with [9] statement which states that the function of P for plants is to accelerate seedling root growth, accelerate and strengthen the growth of young plants into mature plants in general. [10] also states that MVA is very useful for increasing nutrient uptake, especially phosphate (P). This happened because the MVA external hyphae network was able to expand the absorption field. MVA produces phosphatase enzymes that can release elements of P and Al and Fe-bound elements in acid soils, and Ca in calcareous so that nutrients are available to plants. MVA also plays a role in improving soil physical properties, namely making the soil loose. This is supported by [11] absorption of P nutrients from the soil by plant roots is influenced by the decomposition process of soil organic matter related to the extent of the affected cation and anion exchange surfaces by soil pH

4. Conclusions

Mycorrhizae increase plant P uptake and the degree of infection (%) roots in ultisol soil. The administration of Arbuscular mycorrhizal fungi (MVA) at a dose of 30 g per polybag showed the best results in response to the degree of root infection and uptake of plant phosphorus.

References

- [1] Zhou H, Peng X, Perfect E, Xiao T, and Peng G 2013 Effects of organic and inorganic fertilization on soil aggregation in an Ultisol as characterized by synchrotron-based X-ray micro-computed tomography *Geoderma* **195-196** pp 23–30
- [2] Santoso B 1994 *Petunjuk praktis budidaya lele dumbo dan lokal [Practical instructions for cultivation of African and local catfish]* (Yogyakarta: Kanisius)
- [3] Pincus L, Margenot A, Six J, and Scow K 2016 On-farm trial assessing combined organic and mineral fertilizer amendments on vegetable yields in central Uganda *Agriculture, Ecosystems, and Environment* **225** pp 62–71
- [4] Prabudi R 2014 Pengaruh berbagai tingkatan fungi mikoriza arbuskula terhadap produktivitas rumput gajah mini (*Pennisetum purpureum schamach*) pada tanah ultisol [Effect of various arbuscular mycorrhizal fungi on the productivity of mini elephant grass (*pennisetum purpureum schamach*) on ultisol soil] *Jurnal Peternakan Integratif* **3** 1 pp 22-36
- [5] Skerman P J and Riveros F 1990 *Tropical Grasses* (Rome: Food and Agriculture Organization)
- [6] Nahak O R, Haki G, and Maunnaifuf M N 2016 Respon pertumbuhan dan produksi rumput Benggala (*Panicum maximum*) terhadap aplikasi FMA (fungi *micoriza arbuscula*) dengan beberapa jenis pupuk kandang [Response of growth and production of Bengal Grass (*Panicum maximum*) to the application of FMA (*Micoriza arbuscula* Fungi) with several types of manure] *JAS* **1** 1 pp 12-6
- [7] Smith M M and Hartley R D 1983 Occurrence and nature of ferulic acid substitution of cell-wall polysaccharides in graminaceous plants *Carbohydrate Research* **118** pp 65-80
- [8] Hanafiah A S, Sabrina T, and Guchi H 2009 *Biologi dan ekologi tanah [The biology and ecology of soil]* (Medan: Universitas Sumatera Utara)
- [9] Sutedjo M M 2002 *Pupuk dan cara penggunaan* (Jakarta: Rineka Cipta)
- [10] Musfal 2010 Potensi cendawan mikoriza arbuskula untuk meningkatkan hasil tanaman jagung [The potential of vesicular arbuscular mycorrhiza in increasing maize yield] *Jurnal Penelitian dan pengembangan pertanian* **29** 4 pp 154-8
- [11] Matos-Moreira M, Lopez-Mosquera M E, Cunha M, Osés M J S, Rodríguez T, and Carra E V 2011 Effects of organic fertilizers on soil physicochemistry and on the yield and botanical composition of forage over 3 years *J Air and Waste Manag Assoc* **61** 7 pp 778–85