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Effect of vesicular arbuscular mycorrhiza and organic matter on growth of rubber stump (*Hevea brasiliensis* Muell. Arg.)

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Abstract

The objective of the research was to study the effect of VAM (Vesicular arbuscular mycorrhiza) and organic matter to the growth of stump rubber (*Hevea brasiliensis* Muell Arg.). VAM is isolate potential and compatible with the rubber plant was *Glomus* sp. and *Acaulospora* sp. This research was conducted at screen house, Faculty of Agriculture, University of Sumatera Utara. This research is used a factorial randomized block design. As the first factor being tested is an inoculant mycorrhizalie M0 (without inoculant); M1 (Inoculant *Glomus* sp); M2 (Inoculant *Acaulospora* sp) and M3 (Inoculant *Glomus* sp + *Acaulospora* sp). The second factor is the organic matter (0300, 600 and 900 g compost/polybag). Each treatment combination was replicated four times. The results showed that the organic matter increases as height of plant, increasing accretion stem diameter, increasing the dry weight of the canopy and root dry weight rubber seedlings in soil under stress drought. To increase plant height and in trunk diameter was obtained from the treatment B1M3 is done by adding organic matter to 300g/ polybag combined with the provision of inoculant M3 (*Glomus* sp + *Acaulospora* sp). As for the dry weight of the plant canopy and root dry weight seen that the higher dose of compost given the dry weight of the plant canopy and root dry weight rubber seedlings increased significantly in soils experiencing drought stress.

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Introduction

The use of clones tolerant of disease and control pests and diseases carried out so far is inefficient and costly (Karyudiand Fletcher, 2001). With increasingly limited dry land fertile led the researchers started to think about the development plan of the area of rubber on critical land in dry climates. Other limiting factors are the soils in this area are generally poor in nutrients and organic matter and solum shallow, consequently growth and lower crop production (Neliyati, 2010).

Drought resulted in inhibition of the translocation of nutrients to the root surface or declining growth, production and quality of crops. Plants have different resistance against water stress is influenced by plant genotype and the level of water stress.

Vesicular arbuscular mycorrhiza (VAM) is a form of symbiotic association between plant roots with mushrooms endomikoriza. VAM presence of mold does not only have benefits for plants but also beneficial to the ecosystem. VAM can increase absorption of nutrients and water and plant resistance to pathogens (Phosri *et al.*, 2010) thus increasing plant resistance to drought, disease and nutrient-poor soil.

Sahar *et al.* (2013) showed isolates VAM (*Acaulospora* sp and *Glomuss* sp) having high compatibility with rubber seedlings demonstrated by the degree of root infection and uptake of nutrients P high. In subsequent studies Sahar *et al.* (2014) found that in conditions of water stress combined *Acaulospora* sp and *Glomus* sp isolate able to increase turgor pressure leaves, while giving *Acaulospora* sp, can enhance leaf water potential.

Added highest stem diameter at the conditions obtained in plants is inucalated with *Glomus* sp. The purpose of this study was to find a mycorrhizal association and rubber that are resistant to drought and the appropriate dose of organic matters.

Materials and methods

These experiments were conducted at the screen house, Faculty of Agriculture, University of Sumatera Utara. The research used a factorial randomized complete block design with two treatments, organic matter and granting mycorrhizae. Organic matter provided in the form of compost fruid branch of palm oil that has C/N. The treatment of organic matter consisting of four levels i.e not given compost, compost was given 300g, 600g and 900g compost.

As for the VAM treatment consisting of uninoculated, inoculated with *Glomus* sp, inoculated with *Acaulospora* sp, and inoculated with *Glomus* sp + *Acaulospora* sp. Given the amount of inoculum propagules are 100 grams per polybag (which has a 80% root infection). Each treatment combination was replicated four times. As Hyponex fertilizer, phosphate fertilizer, fertilizer NPK (15-15-6-4). Examples of land used is soil (top soil) from ultisol soil derived from Gebang having a pH was 4.66.

Planting and inoculating VAM

Soil sample put into polybag measuring 35 cm x 55 cm (10 kg) of approximately 3 kg per pot (1/3). Before planting inoculation VAM according to treatment by providing inoculum within propagules of 100 grams per polybag based treatment. Inoculant is placed in the ground in which the seeds will be placed polybag. Planting is done by inserting a rubber stump into the planting hole at a sprinkling spore.

Then given the appropriate treatment of organic matters diseliling seedlings. Afterwards polybag dipenuhkan with the rest of the land. Soil moisture at the beginning of the experiment was maintained at field capacity, after one week of treatment the water content of 60% field capacity to enter into force for the growth of plants. The supply of water is done through the weighing accordance with the treatment water needs, 60% of field capacity).

Plants fertilized with manure Hyponex solution that is sprayed through the leaves. After 3 days of rock phosphate fertilizer by as much as 50 g per polybag with digging way to the root zone (the neck of the

root). During plant growth do plant maintenance such as watering (every day), pest and disease control if there is a common attack.

Harvesting

The experiment was stopped after three formed *Johannesteijsmannia* i.e 24 weeks after seedling plants are transplanted. Plants are removed from the lacerating polybag poly bag,

Take soil samples from the root zone for analysis of total P, available P and pH. Separate parts of the plant by the roots; take the example of the roots to see VAM infection. After that included parts of plants and roots into different bags. Weigh the wet weight of the top plants and roots.

Dry the top of the plant in the oven (700°C) for 24 hours. Weigh the dry weight of the plant top, then analyzed the levels of N and P plant.

The observed parameters

Parameters were made every two weeks to increase plant height and increase the diameter of the stem (5 cm above the linkage rod on the rootstock),

dry weight of shoot, root dry weight, uptake of N and P, leaf water potential, turgor pressure, tekakan osmosis. For observation, the degree of root infection/colonization of the roots by staining techniques according Koske and Gemma (1989).

Data analysis

The data was analyzed by analysis of variance, and continued with different test average Duncan for the treatment significantly.

Results and discussion

High-Added ofPlant (cm)

Observations while week 24 against high accretion plant rubber seedlings were given to various treatment mycorrhizal and organic matters on the condition of soil moisture content of 60% field capacity (Table 1).

Table 1. Mean high added rubber stumpt on various mycorrhiza and compost of 24 weeks after planting.

Mycorrhiza	Compost				Mean
	B0	B1	B2	B3	
	..... (cm)				
M0	13.82	17.05	45.20	36.95	28.25
M1	22.87	30.67	18.97	30.50	25.75
M2	5.20	18.50	42.00	42.75	27.11
M3	18.87	42.27	33.95	35.87	32.74
Mean	15.19c	27.12b	35.03b	36.51a	

Description: B0: without any organic matter, B1: 300 g of compost, B2: 600 g compost, B3: 900 g of compost; Mo: without inoculation VAM, M1: Inoculation with Glomus sp: M2: inoculation with Acaulospora sp, M3: Inoculation with (Glomus sp + Acaulospora Sp 2).

Table 1 indicates that the administration of compost on the ground experiencing drought stress can improve significantly increase plant height. Added the highest plant height was obtained on composting 900 gram/polybag (B3). This suggests that as levels of soil organic matter used in the study were very low, the organic matter up to the highest doses are still significant effect in increasing plant height. In this case the quality of the compost can improve the physical, chemical and biological soil, thus increasing the absorption of water and nutrients and causes increased plant growth.

Mycorrhizal inoculation did not affect the plant height increment, but from the data obtained shows that the administration of M3 (*Glomus* sp + *Acaulospora* sp) increased plant height than other treatments. Combination treatment B3M2 and B1M3 generating plant height the highest compared with other treatments.

Diameter-Added of Plant (mm)

Table 2 appears that administration of mycorrhiza tends to increase the accretion average trunk diameter rubber plants on land experiencing drought stress,

especially in plants inoculated with the combined inoculant *Acaulospora* sp and *Glomus* sp (M3). For diameter rod look that good organic matter or mycorrhizal tends to increase the accretion dia meter rubber plant stems on the ground experiencing drought stress. Added highest stem diameter obtained on composting treatment of

600 g/polybag (B2), while the combined inoculation of *Glomus* sp and *Acaulospora* sp produce the highest stem diameter increment. When organic matter is given along with mycorrhizal inoculation, the best treatment is B1M3 (300 g compost + inoculant combined *Acaulospora* sp and *Glomus* sp.

Table 2. Mean diameter-added (mm) rod rubber stump onvarious mycorrhizae and compost at 24 weeks after planting.

Mycorrhizae	Compost				Mean
	B0	B1	B2	B3	
	..... (mm).....				
M0	3.98	3.17	6.72	6.65	5.13
M1	5.27	6.40	6.23	5.23	5.78
M2	4.70	5.15	5.90	5.28	5.25
M3	5.35	8.22	6.07	5.13	6.19
Mean	4.82	5.73	6.23	5.57	

Description: B0: without any organic matter, B1: 300 g of compost, B2: 600 g compost, B3: 900 g Compost Mo: without inoculation VAM, M1: Inoculation with Glomus sp: M2: inoculation with Acaulospora sp, M3: Inoculation with (*Glomus* sp + *Acaulospora*s p)

*Shoot and root dry weights (*g).

Table 4. showed mycorrhiza influence on the development of plant roots. The mycorrhizal inoculation tends to increase root dry weight of plants. The highest root weight plant obtained in the treatment of M3 (Inoculant + *Acaulospora* sp, *Glomus* sp).

Table 3. Mean shoot dry weight ofrubber stump in various mycorrhizae and compost at 24 weeks after planting.

Mycorrhizae	Compost				Mean
	B0	B1	B2	B3	
	.....(g).....				
M0	38.22	37.67	47.4	59.35	45.66
M1	39.40	46.87	34.4	39.05	39.93
M2	29.04	33.67	51.95	51.52	41.54
M3	34.37	45.67	46.72	48.70	43.86
Mean	35.25b	40.97ab	45.11ab	49.65a	

Table 4. Mean root dry weight ofrubber stump in various mycorrhizae and compost at 24 weeks after planting.

Mycorrhizae	Compost				Mean
	B0	B1	B2	B3	
	..... (g).....				
M0	12.80	12.52	15.15	18.70	14.79
M1	15.02	15.27	14.47	18.27	15.75
M2	14.20	17.20	15.62	18.05	16.26
M3	16.07	15.55	13.05	21.62	16.57
Mean	14.52b	15.13b	14.57b	19.16a	

Table 3 indicate that administration of the dry weight of compost increases significantly the plant canopy on the ground experiencing drought stress. The higher the dose of compost given the more severe the resulting weight of the plant canopy. Similar responses were obtained on plant root dry weight (Table 4). Mycorrhizal inoculation tends not affect shoot dry weight as can be seen in Table 3.

This is due to the possibility of growing media used in this case the land is limited in number in polybag, so the absorption of nutrients and water are limited. Dry weight of the plant canopy highest composting obtained when given along with 600 g inoculant *Acaulospora* sp (B2M2). In general, organic matter will improve the health of the soil. Organic matter will increase total pore space will improve soil bulk density, air aeration and water penetration into the soil. The ability of the bond carboxyl (-COOH) bind heavy metals makes the use of compost can neutralize polluted soils heavy metals (Huang and Schnitzer, 1997; Maeder *et al.,* 2002).

Conclusion

The results of this study showed that compost on the ground experiencing drought stress can boost the increase of plant height significantly. Mycorrhizal tends to increase the accretion average trunk diameter of rubber plants on land experiencing drought stress, especially in plants inoculated with the combined inoculant *Acaulospora* sp. and *Glomus* sp. (M3). When organic matter is given along with mycorrhizal inoculation, the best treatment is B1M3 (300g compost + inoculant combined *Acaulospora* sp and *Glomus* sp.).

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