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# Effect of MVA Indigenous Isolates and Types of Planting Media on Growth and Result of Corn Plant on Dry Land Central Lombok

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**Abstract:** The potential of agriculture in Indonesia has not been fully explored. Indonesia has favorable climatic conditions, natural resources and human resources. West Nusa Tenggara (NTB) has an unproductive land area of 1.807.463 ha of the total area of NTB. One of the efforts to increase the productivity of dry land is the application of biological fertilizer. Biofertilizer that are expected to have a high contribution in increasing fertilization efficiency are Vesicular Arbuscular Mycorrhizae (MVA). MVA is important to apply to infertile soils with low nutrient content. The aim of this study was to determine the effect of MVA isolates Indegenous and media types on the growth and yield of corn plant on dry land in Central Lombok The study was carried out for 3 months using a Completely Randomized Design (CRD) with consisted of 2 factors, namely the Indegenous MVA isolate type factor with consisted of 3 levels and the planting media type factor consisting of 4 levels where each treatment was repeated 3 times so that 36 unit were obtained test. The results showed that the variety of isolates showed significant differences in all parameters of growth and yield of corn plat (plant height, root lengthand root weight). The type of planting media showed a significant difference in the parameters of root weight of corn plants. The high growth and yield response of corn plant was thought to be due to the association between corn plant and MVA which was seen in the increased plant growth in all MVA inoculated treatments with the highest plant growth in the treatment using isolate I2 (Gigaspora sp.) on the parameters observed for plant height, root length and root weight. In all parameters observed for corn plant growth, it was found that the genus Gigaspora was superior to the genus Glomus. The best kind of planting media in increasing the growth of corn plants is a mixture of rice husk and soil biochar media with a ratio of 1:3. The use of husk and soil biochar media that was given spores of the genus Gigaspora gave the best corn plant growth.

**Keywords:** Biochart; Types of isolates; dry land; types of planting media; growth

## Introduction

The agricultural potential in Indonesia has not been optimally explored. Indonesia has favorable climatic conditions, natural resources and human resources. Extensive agricultural land has not been used optimally. West Nusa Tenggara (known with NTB) has unproductive land covering an area of 1,807,463 ha or 84% of the total area of NTB with a slope of >15% and 3 wet months (Balitkabi, 2012; Permono, 2015), The potential land for development reaches 620,034.60 ha (Permono, 2015). High non-productive land is a big challenge for agriculture in NTB in particular and the nation in general.

Dry land farming has not been made a top priority in agricultural development in NTB in three decades. Dry land has become marginal, causing various socio-economic problems (poverty, unemployment), degradation of land resources including an increase in critical dry land (Sukmawati, 2021). The development of

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dry land agriculture has specific challenges, especially those related to capital, land biophysical limiting factors (soil fertility status, undulating topography and limited water availability) which will affect crop production (Sukmawati, 2021). Limited agricultural support infrastructure also has a major influence on agricultural cultivation (Astiko, 2015). These factors are assumed to be the biggest contributors to the phenomenon of crop failure, low soil fertility and vulnerability to land degradation processes.

The expected farming strategy in the management of dry land agriculture is sustainable agriculture which is oriented towards improving soil fertility and overcoming drought stress constraints. Improvement of sustainable dryland farming systems is needed with integrated management that can actualize the achievement of crop production, maintenance of soil fertility and improvement of farmers' income (Astiko et al., 2013).

National corn production has been in surplus since 2018, data for the last 5 years shows an average increase of 12.49 percent per year with projected production in 2018 reaching 30 million tons of dry shelled (PK). Increased production is supported by data on harvested area per year, which has increased by an average of 11.06 percent, and productivity has increased by an average of 1.42 percent (Badan Pusat Statistik, 2018). This is a challenge for the Indonesian government to further increase corn production by increasing the harvested area on dry land. One strategy that can be applied to corn cultivation on dry land is the use of biofertilizers, improvement of farmer institutional systems and capital assistance from the government. Biological fertilizers on dry land can increase the availability and uptake of nutrients and minerals for plants, improve soil health and provide protection against drought and some soil-borne diseases (Singh and Purosit, 2011), minimize land degradation and environmental pollution and reduce the use of chemical inputs and improve agricultural efficiency in a sustainable manner (Son et al., 2001).

Biofertilizers that are expected to have a high contribution in increasing fertilization efficiency are by utilizing Arbuscular Vesicular Mycorrhiza (MVA) (Mushafa et al,. 2015). Vesicular Arbuscular Mycorrhiza is important for infertile soils with low nutrient content. Indegenus MVA is mostly found on marginal lands. MVA spores that are inoculated on the roots of host plants are expected to interact positively by increasing plant growth and yield through the provision of nutrients and plant growth hormones (Purba, 2015), facilitate the absorption of various types of nutrients, synthesis of phytohormones and are antagonistic to pathogenic bacteria and fungi (Kesaulya et al., 2015).

Commercial Vesicular Arbuscular Mycorrhiza applied in various studies did not show significant results on the growth and production of agricultural crops. Sukmawati (2013), reported that the application of MVA with the Tehnofert trademark could increase the weight of soybean seeds per plant by 1.93% in sand textured soils. Ramadhana (2016), states that the use of Tehnofert MVA can increase soybean seed weight per plant 0.1% -8.56% in entisol soil. The above phenomena indicate that research is needed using Indigenous MVA (local NTB) which has the potential to be used as a biological fertilizer.

Indigenous Vesicular Arbuscular Mycorrhiza has been widely studied in various plants and gave positive responses. Proborini (2013), showed that the use of MVA Indigenus could spur the growth of cashew seedlings on dry land in Bali and increase the percentage of colonization to 49.467%. Ridwan et al. (2016) in their research reported that there was an increase in soil P levels of 0.09% and tissue P levels of 0.07 g/plant in plants that were treated with Indegenus MVA inoculants in soybean cultivation on dry land with inoculum sources from the corn rhizosphere. Musfal (2010), reported that maize yields were 5.03 tonnes/ha higher in 100% NPK fertilizer treatment and 20 g Indigenous MVA/plant. compared to the treatment of only 100% NPK fertilizer. Indigenous MVA has high potential to be used as a biological fertilizer for agricultural crops in local dry land areas because it is more adaptive so MVA hyphae and spores quickly germinate and colonize (Suryatmana et al., 2009).

The availability of Indigenus MVA spores in the soil is largely determined by the effectiveness and colonization of Indigenus MVA spores. Indegenus MVA colonization effectiveness is different for each growing medium. Kim et al. (2017) stated that there is a close relationship between soil, plants and MVA. Arbuscular Vesicular Mycorrhiza are found in the soil, but not all of them are effective in terms of colonization ability, competition with other fungi and ability to increase nutrient absorption (Jansa et al., 2016). Effective MVA can associate with host plants and be able to adapt to the environment (Jansa et al., 2016).

The application of Arbuscular Vesicular Mycorrhizae at the farm level faces obstacles in terms of the limitations and availability of Arbuscular Vesicular Mycorrhizae isolates which are unresolved problems making it difficult for farmers to obtain mycorrhizal biofertilizers (Sukasta et al., 2010). Research with Indegenus MVA is expected as an alternative to sustainable agriculture on dry land.

## Method

*Time and place of experiment*

The experiment was carried out at the Green House of the Faculty of Agriculture, Nahdhatul Wathan University, Mataram for 3 months (December 2020 - February 2021).

*Research design*

This research is a factorial study designed using a Completely Randomized Design (CRD) consisting of 2 factors. The details of the two factors are as follows:
Factor 1: Indigenous MVA (S) isolate type which consists of 3 levels, namely:
S0 = without MVA spores
S1 = Glomus sp.
S2 = Gigaspora sp.
Factor 2: Types of Planting Media consist of 4 (M) levels, namely:
A1 = Planting Media 1 (1 kg of zeolite : 3 kg of soil)
A2 = Planting Media 2 (1 kg kaolin : 3 kg soil)
A3 = Planting Media 3 (1 kg of quartz sand: 3 kg of soil)
A4 = Planting Media 4 (1 kg charcoal husk biochart : 3 kg soil)

Each treatment was repeated 3 times to obtain 36 experimental units. The research was conducted within 3 months. Each experimental unit consisted of 1 plant.

*Research procedure*

The Indigenous MVA inoculant used is a superior isolate obtained in the propagation process by providing 50 spore grains/polybag. 1 kg of kaolin, zeolite, quartz sand, rice husk biochart and 3 kg of soil (1:3 ratio) were put into polybags so that each polybag contained 4 kg of planting medium. Soil and carrier media are thoroughly mixed and then sterilized in a large drum at 105$^{o}$C for 3.5 hours. The cooling of the growing medium was carried out for 24 hours. Corn seeds were planted in each polybag within 30 days and watered regularly every evening using groundwater according to field capacity.

*Observation Parameters*

Parameters of plant growth observed were plant height (cm), root length (cm) and root weight (g). Measurements were made at the age of 30 HST.

*Data analysis*

Data were analyzed quantitatively using analysis of variance (ANOVA) at 5% level using Costat software. If between treatments had a significant effect on the observed variables, then continued with Duncan's Multiple Range Test (DMRT) at the 5% level.

## Result and Discussion

The results of research on plant height parameters showed that the average Gigaspora sp inoculum showed the best plant height in the four growing media (Figure 1).

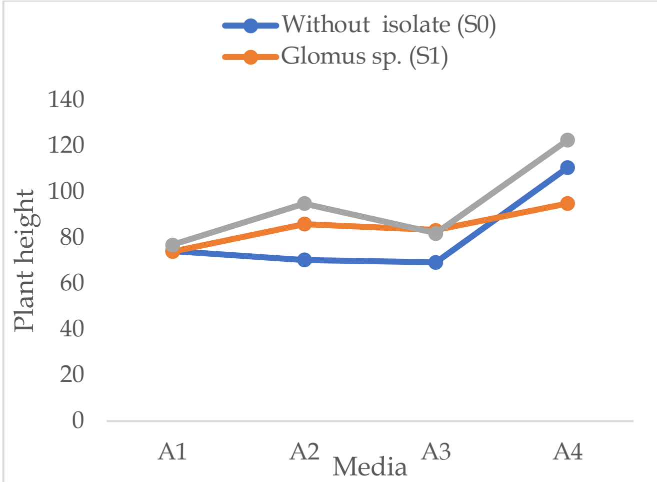


**Figure 1.** Corn plant height tested for the influence of native MVA isolates and types of planting media

The growth of maize plants on various MVA inoculants and growing media is shown in Figure 1.

**Figure 2.** Corn Plant Height on Effect Test of Kinds of Indigenous MVA Isolates and Types of Planting Media

The effect of the type of indigenous MVA isolates and the type of planting medium on root weight was dominant in the Glomus sp inoculant in planting media 2 and 4, while the root weight with Gigaspora sp inoculant was dominant in planting media 1 and 3 (Table 1).

**Table 1.** Effect Test of Types of Indigenous MVA Spore Isolates and Types of Planting Media on Root Weight (g) tested with 5% DMRT

| Isolate | Root weight on different media (g) | | | |
|---|---|---|---|---|
| | Media 1(A1) | Media 2(A2) | Media 3(A3) | Media 4(A4) |
| Without isolate ($S_0$) | $36.33^{d}$ | $59.00^{ed}$ | $96.67^{bc}$ | $198.67^{a}$ |
| *Glomus* sp. ($S_1$) | $35.00^{d}$ | $60.33^{cd}$ | $71.67^{cd}$ | $149.00^{b}$ |
| *Gigaspora* sp. ($S_2$) | $40.00^{d}$ | $56.33^{d}$ | $125.67^{b}$ | $124.67^{b}$ |

Note:
1. The mean value of the treatment followed by the same lowercase letter shows no significant difference based on the DMRT test at the 5% level
2. Media A1 = soil-zeolite mixture: Media A2 = soil-kaolin mixture: medium A3 = soil-quartz sand mixture: Media A4 = soil-charcoal husk mixture.

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The results of the study of root length showed that root length with Glomus sp (Media 1, 2 and 3) inoculation was higher than the root length with Gigaspora sp (Media 4) inoculation, which is shown in Figure 3.

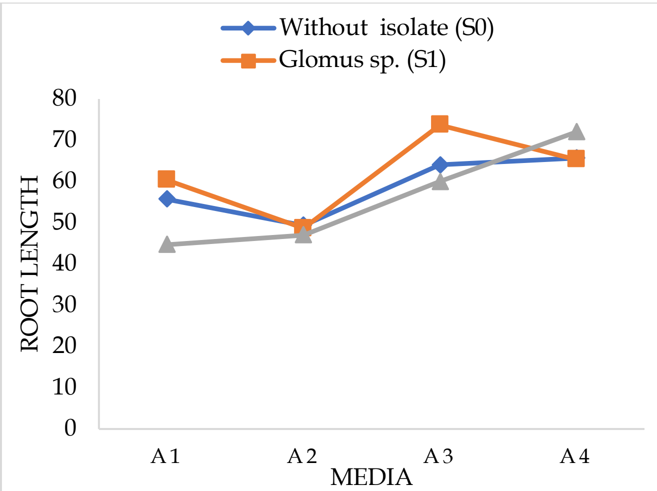


**Figure 3.** Root length of corn plants on the effect test of native MVA isolates and types of planting media

This research used isolates from previously inoculated MVA propagation on various carrier media. The variety factor of the isolates showed significant differences in all growth and yield parameters of maize plants, while the media variety factors were only significantly different in the root weight of maize plants.

The high response of maize plants was due to the association between maize plants and MVA which was seen in increased plant growth and yield in all treatments inoculated with MVA. Colonization of MVA on host plant roots will expand the area of root uptake of nutrients and water (Sari and Ermavitalini, 2014). Simanungkalit and Lukiwati (2001) stated that MVA in the agronomic aspect plays a role in increasing plant P uptake. MVA receives 12-27% of carbon from its host plant (simple sugars) which is used for growth and distributed in the mycorhizosphere (Tinker, et al., 1994) without causing necrosis like infection by pathogenic fungi (Rao, 1994). Talanca (2010), added that MVA functions in encouraging the formation of plant growth hormones, such as cytokinins and auxin which are used in cell division and elongation, resulting in increased plant growth. Muis et al. (2016) stated that plants added to MVA would be better because of the greater surface area of the roots in absorbing nutrients and water and the greater number of leaves to carry out photosynthetic activities.

In the observation of plant height and root weight, isolate S2 (Gigaspora sp.) was more dominant than Glomus sp. In the observation parameter of root length isolate S1 (Glomus sp) gave the best results. Proborini et al. (2020) in his research found that Gigaspora sp in single or mixed form in its propagules can increase the growth of cashew seedlings. Giving Gigaspora sp spores also significantly affected the increase in root weight. These results are relevant to the higher growth of maize plants that were given Gigaspora sp inoculant which was better than that which was not given an inoculant. Rosliani, et al (2006) stated that MVA inoculation as a supplement to a mixture of biological fertilizers can increase the dry weight of cucumber plants when compared to cucumber plants that are only given phosphate fertilizers. MVA application was able to increase the root weight of corn plants by 29.9% higher than without MVA application. MVA infection helps the absorption of immobile nutrients such as P, so that they can be utilized for metabolic processes whose results are more focused on root growth first compared to plant canopy growth.

Glomus sp inoculation gave the best results on the root length of corn plants. The optimal level of effectiveness of mycorrhiza in absorbing nutrients and water so that it has an impact on the process of forming plant organs such as roots. Ai and Torey (2003) state that the morphological characters of roots that have the potential to show plant resistance to water shortages are root elongation to deeper soil layers, increase in area and depth of the root system, expansion of root distribution horizontally and vertically and greater root dry weight in plant genotypes that are more drought tolerant, high root penetration, higher root to crown ratio and root length ratio.

The best type of planting media in increasing the growth and yield of corn plants in this study was a mixture of rice husk biochar and soil media with a ratio of 1:3. The use of biochar husk media and soil fed with spores of the genus Gigaspora provides the best growth and yield of corn plants. Husk charcoal biochar will maintain moisture and increase soil fertility, increase water and air circulation in the soil, provide nutrients so as to stimulate plant growth and yields. Research conducted by Kolo and Raharjo (2016) proved that husk charcoal has a positive effect on the growth and yield of tomatoes. Other media such as a mixture of soil with zeolite, quartz sand and kaolin have quite varied texture differences. Kaolin is in the form of flour, zeolite and quartz sand are in the form of granules, grains like small stones. Kaolin flour in wet conditions will agglomerate and blend with the soil. MVA hyphae of the genus Gigaspora did not spread optimally in the soil-kaolin flour medium so that the nutrient absorption process was low. Geeta et al. (2007) stated that a mixture of coarse soil such as zeolite and quartz sand was a medium that did not give the best results for the growth of MVA-inoculated corn plants because the coarse soil conditions had high porosity so that the absorption of nutrients and water was not optimal.

## Conclusion

From the research conducted, it can be concluded that the isolates that gave the best results on the growth and yield of corn plants (plant height, root length and root weight) were Gigaspora sp and the best planting media in increasing the growth and yield of corn plants was a mixture of rice husk biochar media and soil with a ratio of 1:3.

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