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Application of mycorrhizal indigenous from Bangkalan Madura Indonesia and Rhizobium in peanut plants (*Arachis hypogaea*) local varieties

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ABSTRACT

One of the areas in East Java as a central producer of peanuts is Petong region, Tanah Merah, Bangkalan, Madura. So far, the community in improving the growth of plants tend to use chemical fertilizers. The fertilizer has side effects that are not good for the soil conditions. On the other hand, mycorrhiza Madura has a high diversity (Nurhidayati *et al.*, 2010). Mycorrhiza can be utilized as biofertilizer which has a function as an environmentally friendly fertilizer. In addition, it also has potential as biofertilizer rhizobium. Peanuts including legumes that can interact with Rhizobium and mycorrhizae. The application of rhizobium and mycorrhiza, is expected to occur tripartite beneficial symbiosis. This study aims to determine the growth of peanut plants by the application of indigenous mycorrhiza (*Glomus* sp. and *Gigaspora* sp.). The village of Tanah Merah Petong subdistrict Bangkalan and Rhizobium. The study design used a completely randomized design. The data obtained was tested by Analysis of Variance (ANOVA), if it was significantly affected it continued using the Dunnet test. The result showed application of mycorrhiza and rhizobium increases plant height and plant dry weight and application of inoculant mycorrhiza indigenous be single or double and mycorrhiza mycofer increase the percent of infection mycorrhiza.

Keywords : *Mycorrhizal, micofer, Petong, Rhizobium, Arachis hypogea*

Introduction

Petong village is one of the villages in Bangkalan district which with peanut production amounting to 87 tons in 2008, and 98 tons in 2009. The productivity of peanuts in 2008 was 1.18 tons / ha and in 2009 was 1.26 tons / ha. The productivity results did not increase significantly.

Bangkalan Madura is one area of dry land in East Java (Nurhidayati *et al.*, 2010). The amount of dry land is increasing in the dry season because there is a water deficit in some fields (Nurhidayati *et al.*, 2010). One technology that may be developed in the dry land is biotechnology Arbuscular Mycorrhiza Fungi (FMA) and Rhizobium. Based on the results Nurhidayati *et al.* (2010) on dry land Bangkalan, East Java found 6 genus mycorrhizae. The mycorrhiza is potential as biofertilizer (Utami and Hariyanto, 2020). Another microorganism that has the potential as a biofertilizer is *Rhizobium* (Manuhara *et al.*, 2015).

Rhizobium and arbuscular mycorrhizal double plant inoculation showed favorable tripartite symbiotic relationships. According to Sylvia (1998) states that tripartite symbiosis is a synergistic relationship that can increase the N and P content in plants. Arbuscular mycorrhiza fungi on legumes can improve plant nutrients, especially phosphorus that are needed by plants in N fixation and the formation of nodules (Hartwig, 1998). On the other hand, *Rhizobium* help plants anchoring element N from the air, so as to improve the availability of N and growth. According to Santi *et al.,* (2013) reported that the tripartite symbiosis had a positive influence on the growth, root nodule formation, nitrogen fixation, as well as the absorption of phosphate. According to Linderman (1998) mostly symbiotic legumes with rhizobium and arbuscular mycorrhiza fungi (tripartite symbiosis) generally grow better if compared with only symbiotic with one of them (Rahman, 2006). So that the user simultaneously at a plant it is possible to increase crop productivity (Bertham and Harini, 2007). This study aims to determine the growth of peanut plants by the application of indigenous mycorrhizal (*Glomus* sp. and *Gigaspora* sp.) The village of Tanah Merah Petong subdistrict Bangkalan Madura and Rhizobium.

Research Methods

Mycorrhiza inoculant is used as bio-fertilizer form of propagules. The propagules contain mycorrhiza isolated from the roots of maize. Inoculant isolated from Petong region, Tanah Merah, Bangkalan, Madura. Carrier inoculant is the land of origin mycorrhiza isolate results.

Media Preparation Plant and Giving Treatment in Crop Peanut (*Arachis hypogaea*)

Planting media in the form of top soil layer soil. The soil is sterilized by autoclave for 1.5 hours. Further prepared polybag size 5 kg. The polybags filled sterilized soil media. Polybag placed in a green house. Planting medium that has been sterilized. Each fertilizer given at a dose as follows:

a. Treatment 1: Mycorrhizae indigenous given as much as 100 g/kg of soil
b. Treatment 2: Mycorrhizae mycofer (*Glomus* sp.) Is given as much as 10 g/kg soil
c. Treatment 3: Rhizobium given as much as 10 g / kg seed
d. Treatment 4: Mycorrhizae indigenous and Rhizobium given as much as 10 g / kg seed
e. Treatment 5: Manure is given as 18.52 g/kg of soil
f. Treatment 6: Fertilizer SP-36 is given as 0.56 g/ kg soil

Preparation Seeds, transplanting seedlings and harvesting

Seed derived from varieties of type upright and short-lived. Seeding is done by sowing in the petri dish. Preparation of seed carried out for 10 days. Seeds that have relatively uniform height moved in growing media according to treatment. Each polybag contains one seed plant. Peanuts are harvested at the age of 3 months. The results of the research observations consisted of Visual observation (morphology of peanut plants) include: peanut plant height, number of nodules and dry weight of peanut plants. Microscopic observation: percent mycorrhizal infection. The data obtained were tested by Analysis of Variance (ANOVA), if the real effect is continued using *Dunnet test.*

Results and Discussion

Microorganisms have important roles and functions in supporting the implementation of environmentally friendly agriculture (Nurhidayati *et al.,* 2017; Nurhidayati *et al.,* 2018). Microorganisms positioned as a manufacturer of nutrients where his work serves as a major supplier of nutrients to support the growth needs of the plant (Purnobasuki *et al.,* 2020). The following is a graph of the mean height of peanut plants.

Based on Figure 1, it is known that the treatment of indigenous mycorrhiza (T1), mycorrhizal mycorrhiza (T2) and mycorrhizal indigenous double inoculation and rhizobium (T4) have higher plant height than the treatment of chemical fertilizers. This condition shows the positive role of mycorrhizal inoculation both indigenous and mycofer and which is interacted with *Rhizobium*. Rhizobium inoculation and double inoculation of rhizobium and

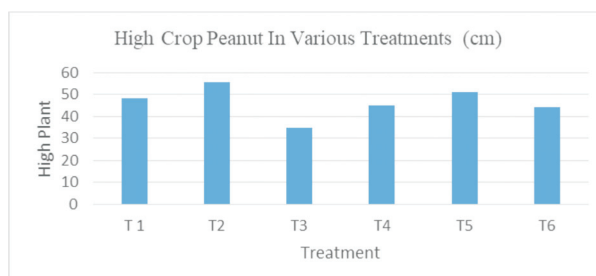

Fig. 1. Height of peanut plants in several treatments of application of mycorrhiza indigenous and rhizobium Description: T1: Application of indigenous mycorrhiza; T2: Mycorrhizal Mycofer application; T3: Application of Rhizobium; T4: Mycorrhizal indigenous & Rhizobium application; T5: Application of manure; T6: Application of SP-36 chemical fertilizers

indigenous mycorrhiza were able to increase the levels of N and P elements as nutrient factors that affect plant growth, especially plant height (Rao, 1994).

The number of root nodules is an indicator of the success of *Rhizobium* inoculants which are often used to assess their effect on plant growth and yield (Saputro *et al.*, 2019). Activities nodule in the fixation of N_2 will increase plant growth. The following are the results of the number of root nodules in each treatment:

Based on Figure 2, it is known that most root nodules were found in SP-36 fertilizer treatment, followed by indigenous mycorrhizal + Rhizobium treatment, manure, Rhizobium, indigenous mycorrhiza and mycofer mycorrhiza. The treatment of indigenous mycorrhiza and rhizobium double and single Rhizobium inoculation and organic fertilizer showed the formation of nodules on the plant peanuts. It is believed to be the availability of phosphorus and nitrogen in the growth media. While in the mycorrhizal treatment mycofer not indicate a nodule Handayanto and Hairiah, 2007). It is suspected that the absence of rhizobium causes the availability of low N elements so that it cannot spur the formation of root nodules. Whereas indigenous mycorrhizal inoculation promotes root nodule formation due to the presence of indigenous mycorrhiza carrier media which allows the availability of sufficient N elements to spur the formation of root nodules (Azcon *et al.,* 1991).

Plant dry weight reflects the growth of plants and the amount of nutrients absorbed per unit weight of biomass produced. The average dry weight of peanut plants is presented in Figure 3.

Based on Figure 3 applications mycorrhiza indigenous and mycofer inoculated in double or single increase plant dry weight. The element N is an element that acts directly in photosynthesis while the P element involved in energy compounds such as ATP or in protein synthesis. N elements play a role in protein synthesis, increasing the growth of vegetative organs such as roots, stems and leaves. Growth is a manifestation of many processes to provide all the carbohydrates of photosynthetic organs and the provision of water and nutrients by the roots up to the synthesis of new biomass materials or biomass plants. Finally, the increase in the rate of photosynthesis will increase the absorption of nutrients, growth was realized into biomass / dry weight of plants. In the process of phosphorus is closely re-

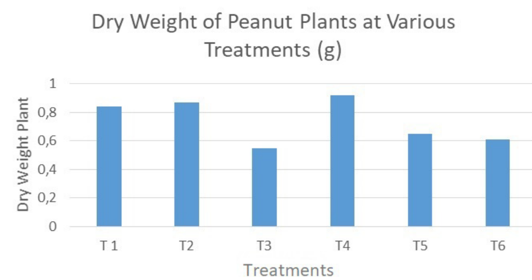

Fig. 3. Dry weight of peanut plants in several treatments of application of mycorrhizal indigenous and rhizobium
Description: T1: Application of indigenous mycorrhiza; T2: Mycorrhizal Mycofer application; T3: Application of Rhizobium; T4: Mycorrhizal indigenous & Rhizobium application; T5: Application of manure; T6: Application of SP-36 chemical fertilizers

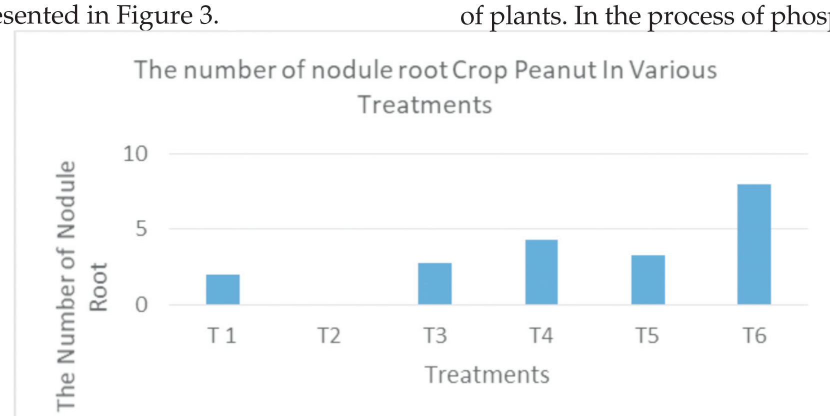

Fig. 2. Height of peanut plants in several treatments of application of mycorrhiza indegenus and rhizobium Description: T1: Application of indigenous mycorrhiza; T2: Mycorrhizal Mycofer application; T3: Application of Rhizobium; T4: Mycorrhizal indigenous & Rhizobium application; T5: Application of manure; T6: Application of SP-36 chemical fertilizers

lated to factors genetic information (DNA and RNA), transfer of energy for biosynthesis of macromolecules such as carbohydrates, proteins and enzymes. P element deficiency results in a decrease in plant growth, especially the canopy, which is closely related to the production of photo-assimilate as an energy source and source of carbon structure. Meanwhile, Rao (1994) reported that nutrient N in the soil become a major limiting factor in the growth and yield. Availability of N in the soil become limiting factors of plant growth, so although conditions other nutrients, such as P and K have enough available in the soil, it still provides the possibility of a dry weight of a plant can be decreased. The condition is common in *Rhizobium* application singly treatment.

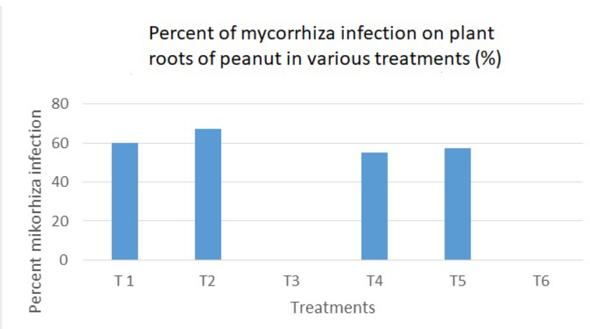

Fig. 4. Percent Infection mycorrhiza Rooting peanut plants in some applications treatment mycorrhiza indigenous and Rhizobium
Description: T1: Application of indigenous mycorrhiza; T2: Mycorrhizal Mycofer application; T3: Application of Rhizobium; T4: Mycorrhizal indigenous & Rhizobium application; T5: Application of manure; T6: Application of SP-36 chemical fertilizers

The percentage of mycorrhizal infection shows the number of mycorrhizae that can symbiosis with the host plant. Host plants that are infected by mycorrhiza can increase their capacity to absorb nutrients and water. It also increases the absorption of phosphate and micro elements such as Cu, Zn, and Bo (Marschner, 1995). Results of mycorrhizal infection on the plant Arachis hypogea are as follows:

Based on Figure 3 it can be seen that the application mycorrhiza mycofer indigenous and inoculated in a double and single and manure have a percent infection of less than 70%. While on treatment without mycorrhiza such as T3 and T6 treatment is not formed mycorrhiza. This suggests that colonization mycorrhiza categorized as low (Bundrett *et al.*, 1996). Peanuts including Leguminosae plants were more responsive to Rhizobium infection compared to mycorrhiza. The low percent of these infections are due to increased competition between microbial exogenous and endogenous microbes, i.e. competition between mycorrhizal with Rhizobium. This was confirmed by the statement of Kramadibrata (1999) that in such circumstances the wild-arbuscular mycorrhizal and Rhizobium vesicles showed no simultaneous infection and colonization in the root Rahman (2006). If the results of host photosynthesis are available in limited quantities, mycorrhizae are usually more competitive in using photosynthetic carbohydrates when compared to Rhizobium, but under normal conditions, where photosynthesis is C abundantly this condition can turn into a tripartite symbiosis (Santoso *et al.*, 2006). Tripartite symbiosis is a beneficial symbiosis between host plants, mycorrhizae, and also Rhizobium.

Conclusion

1. The application of *Mycorrhiza* and *Rhizobium* both singly and doubly has the potential as a biofertilizer.
2. The application of *Mycorrhiza* and *Rhizobium* increases plant height and plant dry weight.
3. Application of inoculant mycorrhiza indigenous be single or double and mycorrhiza mycofer increase the percent of infection mycorrhiza.

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