Significant Potential of Arbuscular Mycorrhizae Fungi to Increase on Yield of Shallot

by Mahmudah Hamawi

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Abstract. Evaluation of Arbuscular Mycorrhizae Fungi application on shallot (*Allium cepa* L. aggregatum group) is extremely important to instead of Phosphorus synthetic fertilizer. The experiment was laid out in randomized completely block design with three replications as block. The experiment consisted of Arbuscular Mycorrhizae Fungi (AMF) application, AMF and Phosphorus application, Phosphorus application and without any treatment. The experiment resulted that there were no difference on plant height and number of leaves among treatments. In total chlorophyll content, AMF application is lower than Phosphorus synthetic application. In contrast, AMF application was showed the highest of yield.

Keywords: *significant potential, arbuscular mycorrhizae fungi, yield, shallot.*

1. Introduction

In Indonesia, shallot demand is increasing every year [1]. In order to meet the shallot need, farmers generally use excessively of synthetic fertilizer [2]. The dependence has been associated with problems, such as environment pollution, disturbance of beneficial biological in soil, and disruption of natural nutrient cycling [3].

In last decade, beneficial microorganisms are generally applicated as biofertilizer to increase growth and yield of crops [4]. Those include a wide range of symbiotic and non-symbiotic organisms [5][6]. The most important microorganisms which associated with the plant rhizosphere is Mycorrhizae Arbuscular [7]. Previous study reported that Mycorrhizae Arbuscular claimed to enhance crop growth and yield by increasing Phosphorus availability [8][9]. Therefore, evaluation of Mycorrhizae Arbuscular application on shallot (*Allium cepa* L. aggregatum group) is extremely important to instead of synthetic fertilizer.

There are many reports concerning the use of Mycorrhizae Arbuscular for increase on growth and yield of crops such as rice (*Oryza sativa* L.)[10], maize (*Zea mays* L.) [11], *Glycine max* L. [12]**,** and *Petunia hybrid* [13]. However, few studies concerning of phosphate-solubilizing microorganisms on shallot have been reported.

This study was undertaken to evaluate the effect of Arbuscular Mycorrhizae Fungi on growth and yield of shallot. It is expected that the findings of Arbuscular Mycorrhizae Fungi applicated on shallot would give useful information for further effectiveness of phosphorus source on shallot.

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2. Materials and Methods

2.1 Experimental Design

The experiment was conducted in Research Field, Department of Agrotechnology, University of Darussalam Gontor, Siman, Ponorogo, Indonesia from June 2018 to August 2018. The experiment was laid-out in randomized completely block design with three replications as block. The experiment consisted of Arbuscular Mycorrhizae Fungi (AMF) application, AMF and Phosphorus application, Phosphorus application and without any treatment.

2.2 Procedure

The land was prepared by plugging once and harrowing to break the clods and bring the soil. The plots were 2.0 m × 1.0 m. The fresh bulb was hand planted at a spacing of 10 cm × 20 cm. The field was irrigated depending on the soil moisture content.

In AMF application, we applied 250 g of AMF 'Glomus mosseae' inoculums at two weeks before planting. In AMF and Phosphorus application, we applied 250 g of AMF at two weeks before planting followed by the basal dose 50 kg per ha (half dose) in the form of SP-36 at two weeks after planting. In Phosphorus application, we applied the basal dose 100 kg (full dose) per ha in the form of SP-36 at two weeks after planting. The basal dose of 300: 300 kg nitrogen and potassium chloride per ha were applied in the form of ZA and KCl. Nitrogen was applied 3 times at 12, 23 and 35 days after planting whereas KCl was applied at 12 days after planting.

2.3 Measurments

Growth parameters

The data recorded consist of plant height and number of leaves per plant. The maximum plant height was measured from ground level to tip of longest leaf (when held vertically) at 4 weeks after planting. The numbers of leaf were counted manually at 4 weeks after planting.

Estimation of photosynthetic pigments

Photosynthetic pigments (chlorophyll *a*, chlorophyll *b* and total chlorophyill) in leaves were determined by an extracting method using acetone [14] with modification.

Yield parameters

The bulb separated from each plot was weighed of bulb yield per plot. Each yield plot was 2.0 m × 1.0 m.

2.4 Statistical analysis

All data were statistically analyzed using the analysis of variance procedure to assess the differences of treatments. Duncan's Multiple Range Test would be tested to determine the significant differences among treatment means.

3. Result

This study evaluated effect of Arbuscular Mycorrhizae Fungi (AMF) on growth and yield of shallot under different Phosphorus source. According to Figure 1, there was no difference on different kind of Phosphorus source on plant height. The plant height ranged from 27.7 to 30.1 cm. Likewise, sum of leaves were not difference among treatments. It ranged from 14.33 to 19.33 leaves per plant.

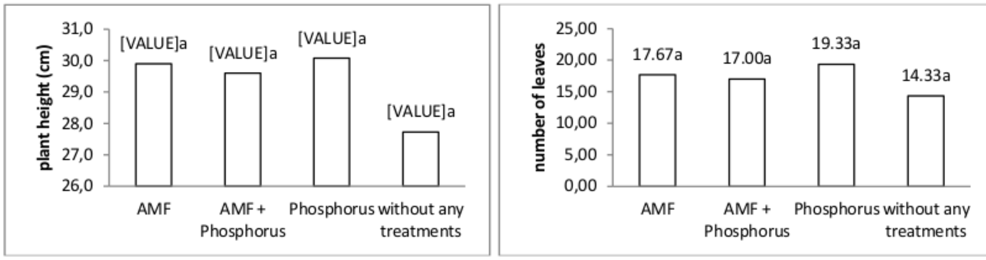

Figure 1. Plant height and number of leaves of shallot under different treatments

Figure 2 shows that total chlorophyll in different Phosphorus source. The highest of chlorophyll *a* content was showed by Phosphorus synthetic application. Chlorophyll *a* content of AMF application was lower than Phosphorus synthetic application. AMF application mixed to Phosphorus synthetic was resulted lower of chlorophyll *a* content than Phosphorus but it was showed the highest of chlorophyll *b* content. In total chlorophyll content, AMF application was lower than Phosphorus. Also, AMF mixed to Phosphorus application was lower than AMF application. It is so clear that AMF application could not increase total chlorophyll as well as Phosphorus application. Moreover, AMF mixed to Phosphorus application reduced slightly on total chlorophyll.

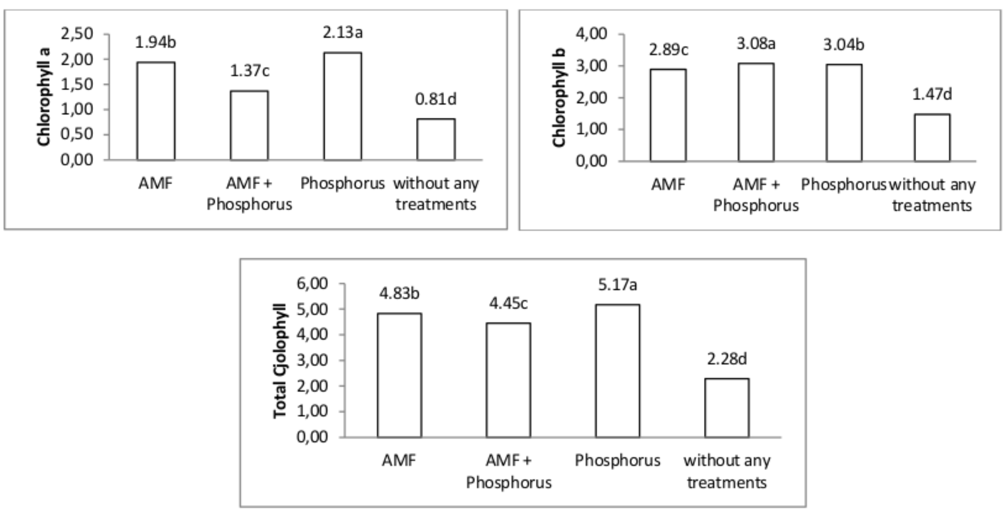

Figure 2. Chlorophyll content of shallot on different treatments

AMF application was highest of yield followed by Phosphorus application. It peaks at 8.93 kg/plot. In contrast, the yield of AMF mixed to Phosphorus application was lower than AMF application. It decreased 11.20 % compared to AMF application.

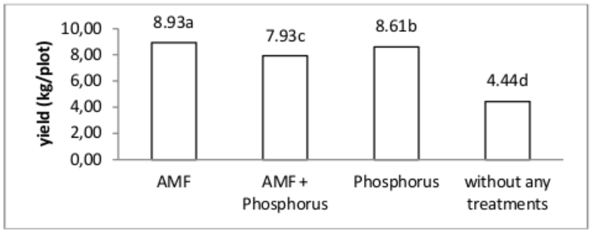

Figure 3. Yield of shallot on different treatments

4. Discussion

Understanding how shallot responds to the presence of AMF under different levels of Phosphorous is essential for further effectiveness of phosphorus source on shallot. Shallot showed that there is no differ among treatments on plant height and number of leaves per plant. This resulted agreed with Liang *et al.*, 2018 who reported that plant height did not differ with AMF treatments without nutrient addition. Therefore, there is no differ on plant height and leaves numbers per plant of Sorghum which were grown under some of native Arbuscular mycorrhizal fungi species [16].

Chlorophyll *a* and *b* content of AMF application is lower than Phosphorous synthetic application. In addition, total chlorophyll content of Phosphorus synthetic is the highest. It is so clear that AMF application reduce of total chlorophyll. This resulted agreed to previous research which reported that chlorophyll content of leaves of rice was significantly reduced when roots were inoculated with AMF [17]. Phosphorus application under AMF condition decreased chlorophyll content compared to AMF application.

The highest of yield was showed significantly by AMF application. According to [18] P uptake significantly increased when it inoculated by mycorrhizal compared to non-mycorrhizal plants. In addition, AMF inoculation increased the effectiveness of fertilizer application in soybean. These results reflect in a higher yield of Soybean [19], rice (*Oryza sativa* L.)[10], maize (*Zea mays* L.) [11], *Glycine max* L. [12]**,** and *Petunia hybrid* [13]. In contrast, AMF application mixed to Phosphorus synthetic decreased 11.20% of yield. The obtained results indicated that AMF activity was disturbed by chemical Phosphorus in soil. In addition, chemical content in soil can distract of biological in soil and disrupt of natural nutrient cycling [3].

5. Conclusion

In conclusion, although there is no effect on plant height, number of leaves, and chlorophyll content, AMF application was significantly increased yield of shallot. However, it is not clear whether AMF application could increase the yield under Phosphorus regime. Therefore, further studies about AMF application under different soil nutrient regime on shallot required for effectiveness of fertilization.

Acknowledgments
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References

[1] L. Nuryati and Noviati, "Outlook Komoditas Pertanian Subsektor Hortikultura (Bawang Merah)," *Pus. Data dan Sist. Inf. Pertan. Kementeri. Pertan.*, p. 11, 2015.
[2] H. De Putter, "Improving the shallot and hot pepper cultivation system in the coastal plain of Northern Java," pp. 1–18, 2013.
[3] S. Savci, "Investigation of Effect of Chemical Fertilizers on Environment," *APCBEE Procedia*, vol. 1, no. January, pp. 287–292, 2012.

[4] E. Malusá, L. Sas-Paszt, and J. Ciesielska, "Technologies for beneficial microorganisms inocula used as biofertilizers," *Sci. World J.*, vol. 2012, 2012.

[5] R. Paradiso, R. Buonomo, M. A. Dixon, G. Barbieri, and S. De Pascale, "Effect of bacterial root symbiosis and urea as source of nitrogen on performance of soybean plants grown hydroponically for Bioregenerative Life Support Systems (BLSSs)," *Front. Plant Sci.*, vol. 6, no. October, pp. 1–12, 2015.

[6] V. V. S. R. Gupta, S. J. Kroker, M. Hicks, C. W. Davoren, K. Descheemaeker, and R. Llewellyn, "Nitrogen cycling in summer active perennial grass systems in South Australia: Non-symbiotic nitrogen fixation," *Crop Pasture Sci.*, vol. 65, no. 10, pp. 1044–1056, 2014.

[7] V. S. Meena, P. K. Mishra, J. K. Bisht, and A. Pattanayak, "Agriculturally important microbes for sustainable agriculture," *Agric. Important Microbes Sustain. Agric.*, vol. 2, pp. 1–374, 2017.

[8] R. W. Rice, L. E. Datnoff, R. N. Raid, and C. A. Sanchez, "INFLUENCE OF VESICULAR-ARBUSCULAR MYCORRHIZAE ON PHOSPHORUS-USE EFFICIENCY," vol. 25, no. 8, pp. 1839–1853, 2002.

[9] X. Li, G. Wang, X. Li, P. Christie, and J. Zhang, "Response of arbuscular mycorrhizal fungi to soil phosphorus patches depends on context," *Crop Pasture Sci.*, vol. 67, no. 10, pp. 1116–1125, 2016.

[10] S. Zhang, L. Wang, F. Ma, X. Zhang, and D. Fu, "Arbuscular mycorrhiza improved phosphorus efficiency in paddy fields," *Ecol. Eng.*, vol. 95, pp. 64–72, 2016.

[11] V. Cozzolino, V. Di Meo, and A. Piccolo, "Impact of arbuscular mycorrhizal fungi applications on maize production and soil phosphorus availability," *J. Geochemical Explor.*, vol. 129, pp. 40–44, 2013.

[12] G. M. Abdel-Fattah, A. A. Asrar, S. M. Al-Amri, and E. M. Abdel-Salam, "Influence of arbuscular mycorrhiza and phosphorus fertilization on the gas exchange, growth and phosphatase activity of soybean (Glycine max L.) plants," *Photosynthetica*, vol. 52, no. 4, pp. 581–588, 2014.

[13] E. Nouri, F. Breuillin-Sessoms, U. Feller, and D. Reinhardt, "Phosphorus and nitrogen regulate arbuscular mycorrhizal symbiosis in petunia hybrida," *PLoS One*, vol. 9, no. 3, 2014.

[14] N. Sumanta, C. I. Haque, J. Nishika, and R. Suprakash, "Spectrophotometric Analysis of Chlorophylls and Carotenoids from Commonly Grown Fern Species by Using Various Extracting Solvents," vol. 4, no. 9, pp. 63–69, 2014.

[15] J. F. Liang, J. An, J. Q. Gao, X. Y. Zhang, and F. H. Yu, "Effects of arbuscular mycorrhizal fungi and soil nutrient addition on the growth of Phragmites australis under different drying-rewetting cycles," *PLoS One*, vol. 13, no. 1, pp. 1–10, 2018.

[16] P. S. Nakmee, S. Techapinyawat, and S. Ngamprasit, "Comparative potentials of native arbuscular mycorrhizal fungi to improve nutrient uptake and biomass of Sorghum bicolor Linn," *Agric. Nat. Resour.*, vol. 50, no. 3, pp. 173–178, 2016.

[17] R. Hajiboland, N. Aliasgharzad, and R. Barzeghar, "Phosphorus mobilization and uptake in mycorrhizal rice (Oryza sativa L.) plants under flooded and non-flooded conditions," *Acta Agric. Slov.*, vol. 93, no. 2, pp. 153–161, 2009.

[18] M. Heidari, "Effects of different mycorrhiza species on grain yield , nutrient uptake and oil content of sunflower under water stress," *J. Saudi Soc. Agric. Sci.*, vol. 13, no. 1, pp. 9–13, 2014.

[19] M. V. T. Cely *et al.*, "Inoculant of Arbuscular Mycorrhizal Fungi (Rhizophagus clarus) Increase Yield of Soybean and Cotton under Field Conditions," vol. 7, no. May, pp. 1–9, 2016.

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