Tropical Life Sciences Research, 27(Supp. 1), 9–13, 2016

Environment and Host Affects Arbuscular Mycorrhiza Fungi (AMF) Population

Norahizah Abd Rahim, Hasnah Md Jais and Hasnuri Mat Hassan*

School of Biological Sciences, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia

Published date: 1 November 2016
To cite this article: Norahizah Abd Rahim, Hasnah Md Jais and Hasnuri Mat Hassan. (2016). Environment and host affects arbuscular mycorrhiza fungi (AMF) population. *Tropical Life Sciences Research* 27(Supp. 1): 9–13. doi: 10.21315/tlsr2016.27.3.2
To link to this article: http://dx.doi.org/10.21315/tlsr2016.27.3.2

Abstract: The association of arbuscular mycorrhiza fungi (AMF) and roots undoubtedly gives positive advantages to the host plant. However, heavily fertilised soil such as in oil palm plantation, inhibit the growth of mycorrhiza. Thus, the aim of this research is to distinguish and quantify the availability of AMF population and propagules at different sites of an oil palm plantation by Most Probable Number (MPN) assay. In addition, root infection method was employed to observe host compatibility through the propagation of AMF using two different types of hosts, monocotyledon (*Echinochloa cruss-galli*) and dicotyledon (*Vigna radiata*). Three different locations at an oil palm plantation were chosen for sampling. Each location was represented by a distinctive soil series, and were further divided into two sites, that is canopy and midway area. Midway site had a greater population of AMF compared to canopy. The result showed that different environments affect the availability of AMF in the soil. Higher number of AMF infection observed in monocotyledon host suggests that the fibrous root system provide a better association with mycorrhiza.

Keywords: Arbuscular Mycorrhiza Fungi, Mycorrhiza, Oil Palm

INTRODUCTION

Arbuscular mycorrhizal fungi (AMF) are mutualistic symbiotic association between the roots of most plant and fungi in the new phylum Glomeromycota (Schüßler *et al*. 2003). The association between AMF and root gives many advantages to the host plants, including improvement of plant growth and intake of nutrients, enhance tolerance to diseases and stress (Meharg & Cairney 2000). Oil palm has been one of the most important cash crops in Malaysia. An estimation of the increase in the growth of oil palm draws a big concern as the demand is correlated to the amount of fertiliser being applied to the crops. As suggested by Phosri *et al.* (2010), the root morphological limitation of oil palm, signify that oil palm are mycorrhizal dependent. Owing to that the growth of

*Corresponding author: hasnurimh@usm.my

mycorrhiza will degenerate as more fertilizers are being applied to the soil. Thus, the objectives of this research are to distinguish and quantify the availability of AMF population and propagules using Most Probable Number (MPN) assay and observation for host compatibility through the propagation of AMF by root infection method using soil collected from an oil palm plantation.

MATERIALS AND METHODS

Soil Sampling

Sampling was done using randomised complete block design (RCBD). Three different locations at Ladang Bukit Kota 2, Setiawan, Perak, were chosen and each block represented different types of soil: Block 35 (B35) chat soil, Block 39 (B39) peat soil, and Block 40 (B40) local alluvial. The locations were further divided into 2 different sites; canopy-C and midway-M.

Experiment 1: Most Probable Number (MPN) Assay

The experiment used a 2-fold dilution series of soil. There were 3 treatments represented by the block of each soil samples and were replicated 3 times. The host *Echinochloa cruss-galli* was grown for six weeks. Roots from each dilution factors were divided equally into 5 petri dishes for propagule observation. A plus (+) sign was assigned for mycorrhizal propagules, whereas minus (-) for non-mycorrhizal propagules. Calculation of most probable number was done according to Table VIII of Fisher (1965). Calculation was done using formula according to Sieverding (1991).

Experiment 2: Propagation of Two Types of Hosts for Mycorrhizal Root Infection

Two different types of host, *E. cruss-galli* (monocotyledon) and *Vigna radiata* (dicotyledon) were grown in pot culture for six weeks. After harvested, roots were soaked in 0.05% w/v trypan blue in lactoglycerol overnight. The percentage of infection was quantified by counting the amount of infected roots intersecting horizontally and vertically with grid lines on a 9 cm diameter petri dish. The sum of overall infection was then divided by the total amount of roots.

Statistical Analysis

Data collected from both experiments were analysed using a two-way ANOVA analysis on PASW 18 software, IBM® SPSS® Statistics. Post hoc analyses were performed using Tukey's multiple comparison test at 95% confidence interval ($p<0.05$).

RESULTS AND DISCUSSION

MPN Assay

B35 recorded the greatest number of infective propagules with 43.9 meanwhile B39 with the lowest number of infective propagules with 19.6. Number of infective AMF propagules was similar in all sites except in canopy soil of B39 where it was significantly lower than midway soil of B40 (Fig. 1).

There was a clear indication of higher infective AMF propagules in midway area using MPN assay. This could be due to the lesser exposure to fertilisers compared to the canopy area. In this study, canopy is regarded as the area surrounding the basal of oil palm trees where it is a common region for the application of chemical fertilisers and herbicides. A study by O'Connor *et al.* (2002) showed that mycorrhizal colonisation was significantly reduced in field plots with application of benomyl. Therefore similar practices could be the reason for the low amount of AMF found in this study. Consequently, according to Ortega (2001), soil with high available P has a lower AMF population as can be referred to Figure 1.

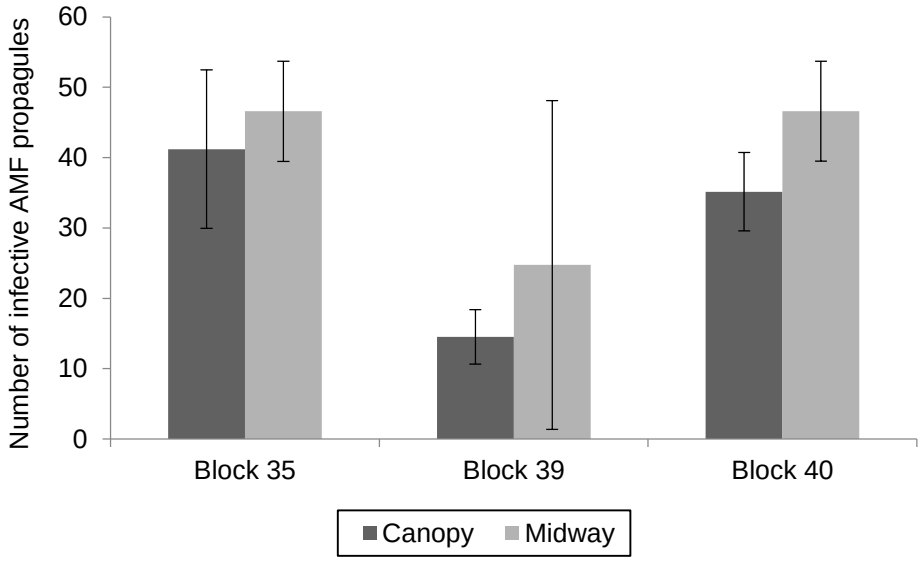

Figure 1: Number of infective AMF propagules through MPN assay in soil sample at two different sites from three different blocks using roots of *E. cruss-galli.*
Note: Bars represent mean; different letters showed significant difference at $p<0.05$ by Tukey multiple comparison test.

Mycorrhizal Root Infection

There was a higher preference of infection in the monocotyledon than dicotyledon host (Fig. 2). Nonetheless, in monocotyledon there was a significant difference in percentage of root infection between B35 and B40. Root infection on monocotyledon host ranged from 20% to 60% meanwhile, root infection on a dicotyledon host ranged from 14% to 26%. It was prominent that the monocotyledon host plant has a higher percentage of root infection then dicotyledon host plant could be due to the root system. According to Sieverding (1991), plant species with fibrous root system are highly dependent on AMF. This result is in agreement with Tahira *et al.* (2012) stating that the degree of infection and development of symbiotic agents dominantly affected by plant signals and root geometry.

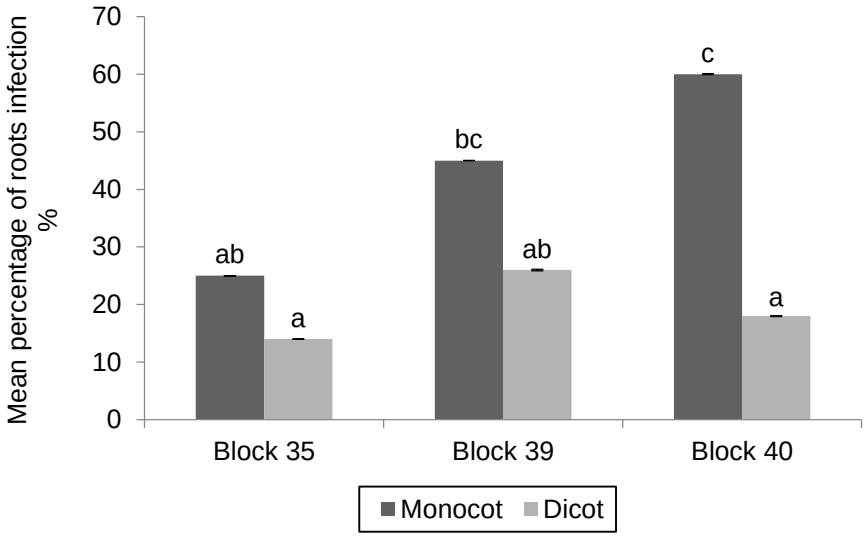

Figure 2: Root infection (%) of *E. cruss-galli* (monocotyledon) and *V. radiata* (dicotyledon) as host plant in different types of soil.
Note: Bars represent mean; different letters showed significant difference at $p<0.05$ by Tukey multiple comparison test.

CONCLUSION

In conclusion, the population of AMF is greater in the midway than the canopy area thus justifies that different sites and environment affects the infectivity and availability of AMF. Moreover, *E. cruss-galli* (monocotyledon) is a better host than *V. radiata* (dicotyledon) and has the potential to maximise the propagation of AMF. However, the method of spore propagation needed to be improved in future and further optimised for application involving the beneficial roles of AMF.

ACKNOWLEDGEMENT

This study was funded by Universiti Sains Malaysia Incentive Grant (304/JPNP/600004) for young lecturers. The authors would like to thank Universiti Sains Malaysia for laboratory facilities and ESPEK Sdn. Bhd., Research and Advisory Services (ERAS) for sampling and analysis throughout the study.

REFERENCES

Fisher R A and F Yates. (1965). Statistical tables for biological, agricultural and medical research. 6. Aufl. Oliver & Boyd, London 1963.146 S. Presis 30s. *Biometrische Zeitschrift* 7(2): 124–125. http://dx.doi.org/10.1002/bimj.19650070219

Meharg A A and Cairney J W G. (2000). Ectomycorrhizas – extending the capabilities of rhizoshere remediation? *Soil Biology and Biochemistry* 32(11–12): 1475–1484. http://dx.doi.org/10.1016/S0038-0717(00)00076-6

O'Connor P J, Smith S E and Smith F A. (2002). Arbuscular mycorrhizas influence plant diversity and community structure in a semiarid herbland. *New Phytologist* 154(1): 209–218. http://dx.doi.org/10.1046/j.1469-8137.2002.00364.x

Ortega M P L. (2001). Arbuscular mycorrhizal fungi (AMF) spore abundance is affected by wastewater pollution in soil of Mezquital Valley in Centar Mexico. In D E Stott, R H Mohtar and G C Steinhardt (eds.). *Sustaining the global farm*. *10th International Soil Conservation Organization Meeting.* Purdue University and USDA-ARS National Soil Erosion Research Laboratory, 24–29 May 1999, 676–681.

Phosri C, Rodriguez A, Sanders I R and Jeffries P. (2010). The role of mycorrhizas in more sustainable oil palm cultivation. *Agriculture, Ecosystems and Environment* 135(3): 187–193. http://dx.doi.org/10.1016/j.agee.2009.09.006

Schüβler A, Schwarzott D and Walker C. (2001). A new fungal phylum, the Glomeromycota: Phylogeny and evolution. *Mycological Research* 105(12): 1413–1421. http://dx.doi.org/10.1017/S0953756201005196

Sieverding E. (1991). *Vesicular-arbuscular mycorrhiza management in tropical agrosystem* (K Mulhern, trans.). Eschborn, Germany: Technical Cooperation-Federal Republic of Germany.

Tahira Y, Sohal H M, Tariq and Javed I. (2012). *Vigna radiata* root associated mycorrhizae and their helping bacteria for improving crop productivity. *Pakistan Journal of Botany* 44(1): 87–94.