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Antibacterial Potential of Arbuscular Mycorrhizal Fungi - A Rewiew

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Abstract

Arbuscular mycorrhizal Fungi (AMF) constitutes a heterogeneous group of fungal species. It forms mutualistic interaction with the roots of more than 90% of all plant species. AMF can improve the growth, nutrition, water supply and tolerance to biotic and abiotic stresses of host plants. These fungi are recommended as biofertilizers for sustainable agriculture and act as biocontrol agents. They protect plants from pathogens and their colonization increases pathogen resistance. The present article highlights the key role of the AM symbiosis and an antibacterial potential of AMF based on available research. The authors aim to explore the antibacterial studies with dominant AMF species from Melghat region associated with some medicinal plants.

Keywords: AMF, Role of AMF, Antibacterial Potential, comparative study.

Introduction

Plants associate with other living forms like animals, bacteria or fungi to complete their life cycle, to fight against pathogens or to survive in adverse environmental condition. The Mycorrhiza is one of the best examples of symbiotic association between plants and fungi. Mycorrhizal association help the host plants to survive in adverse soil condition and drought situation by increasing the root surface and mineral uptake efficiency. The plants with mycorrhizal fungi association also benefit from fungal detoxification system. Hence mycorrhizal fungi help in improving the soil health by phytoremediation. The fundamental importance of mycorrhizal association is restoration and revegetation of sterile lands. The mycorrhiza has great molecular and ecological importance for agriculture, horticulture, forestry, and soil remediation. Hence the development of mycorrhizal biotechnologies may be a better, eco-friendly and alternative for chemical fertilizers. It can also help long in maintaining a sustainable environment for our future generations (Barman *et al*., 2016).

Antibacterial potential of Mycorrhiza

AMF induces inhibition of root pathogens and stimulation of plant growth-promoting microorganisms (Kapoor and Mukerji, 1998). AM fungal hyphae grow into the soil and create a skeletal structure to hold primary fine soil particles together by the physical enlargement. The higher carbon demand of AM fungi competitively stops the growth of plant pathogens. With AMF formation plant can produce defence chemicals like phenolic substances, phytoalexins, and chitinases are increased. Symbiotic processes are not affected by these chemicals but defend host plants from other harmful pathogens (Barman *et al*., 2016).

The growth of both the AM fungi and root pathogens depends on host photosynthates and that they compete with each other for the carbon compounds reaching the root (Smith 1987; Linderman 1994). If AM fungi have primary access to photosynthates then the higher carbon demand may inhibit pathogen growth (Nath and Meena, 2018)

The different aqueous, ethanolic, methanolic and hexane extract of the mycorrhizal fungi used for the investigation of antibacterial and antifungal properties against the tested organisms using both well-plate method and disc diffusion method. The result confirms that mycorrhizal fungi show antimicrobial activities and capable of attracting industrial investment in sustainable agriculture (Fapohunda *et al*., 2013).

Discussion

Olawuyi *et al*. (2013) studied the AMF associations benefit plants survival, nutrition and growth due to their enhanced exploitation of soil nutrients. The AMF reduces the pathogenic activities of the soil-borne fungi and parasitic weeds hence AMF is the suitable biocontrol measures. Fapohunda *et al.* (2013) reported that methanolic extract of *Glomus clarum* produced the large area of inhibition (10mm) in *Proteus vulgaris* and *Klebsiella pneumoniae*, followed by ethanolic and distilled water extracts. While hexane extract of *Glomus clarum* produced the large area of inhibition for *A. flavus* (20mm), its antibacterial activity on the test bacteria was low. Aqueous and methanolic extracts of *Gigaspora gigantea* had the lowest antimicrobial activity against test organisms. The highest antibacterial inhibitory activities (10mm) were noted for methanolic extract of *Glomus clarum* against *Proteus vulgaris* and *Klebsiella pneumoniae*. The potent antibacterial activity exhibited by *Glomus clarum* against *Proteus vulgaris* is a confirmation of the earlier report of Oso (1981), Thomson *et al*. (1986), Gianinazzi-Pearson *et al.* (1996), Dar *et al*. (1997) and Kasiamdari *et al*. (2002) in host-pathogen interactions of plants. Some root endophytic fungi like ERM fungi act as additional sources of new antimicrobial agents in drug and food preservation because the antibacterial activity of *Leohumicola incrustata* against some bacterial species. Adioyo *et al*. (2019) carried out screening of antibacterial activity by using a well-dilution method. Plates showing antibacterial activity were confirmed by visualisation and measurement of inhibition zones. The average of three repeated trials was taken to observe the antibacterial activity, The crude extract of fungus isolates inhibited two Gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) and had mild activity against a Gram-negative bacterium (*Proteus vulgaris*).

Conclusion

It is evident from the studies on AMF that it could be used to enhance the quality as well as quantitative products of plants. Hence AMF keeps plant healthy and conserve its properties from environmental issues. AMF also inhibit the bacterial pathogen and shows antibacterial potential. The present review provides an overview of the role of AM fungi and their antibacterial potential. This review would also explore the Arbuscular Mycorrhizal fungi as Biocontrol agent against specific bacteria. AMF Species i.e., *Glomus clarum* showed more inhibition zone for *Proteus vulgaris* and *Klebsiella pneumoniae* than *Gigaspora gigantea.* This review was evaluating and screening efficient AM fungal species as antibacterial agent. The future scope of this study is to use mycorrhizal species as biocontrol agent to protect the plant from bacterial diseases and to reduce loss of plant yield in agriculture and horticulture.

References

1. Adeoyo, O. R., Pletschke, B. I. and Dames, J. F. (2019). Molecular identification and antibacterial properties of an ericoid associated mycorrhizal fungus. BMC Microbiology, 19:178.
2. Barea, J. M., Andrade, G., Bianciotto, V. V., Dowling, D., Lohrke, S., Bonfante, P., O'gara, F. and Azcon-aguilar C. (1998). Impact on arbuscular mycorrhiza formation of pseudomonas strains used as inoculant for biocontrol of soil-borne fungal plant pathogen. Appl. Environ Microbiol 64: 2304-2307.
3. Barman, J., Samanta, A., Saha, B., and Datta, S. (2016). Mycorrhiza: The oldest association between plant and fungi. Resonance, 21(12), 1093–1104.
4. Dar, G.H., Zargar, M.Y. and Beigh, G.M. (1997). Biocontrol of Fusarium root rot in the common bean (Phaseolus vulgaris L.) by using symbiotic Glomus mosseae and Rhizobium leguminosarum. Microbial Ecology 34, 74- 80.
5. Fapohunda, S. O., Olawuyi, O. J., and Okei, C. P. (2013). Antimicrobial and phytochemical potentials of arbuscular mycorrhizal fungi in Nigeria. The South Pacific Journal of Natural and Applied Sciences, 29, 21-25.
6. Gianinazzi-Pearson, V., Dumas-Gaudot, E., Gollotte, A., Tahiri- Alaouia, A., Gianinazzi, S. (1996). Cellular and molecular defense related root responses to invasion by arbuscular mycorrhizal fungi. New Phytopathology 133, 45-57.

7. Kasiamdari, R.S., Smith, S.E., Smith, F.A., and Scott, E.S. (2002). Influence of the mycorrhizal fungus, *Glomus coronatum*, and soil phosphorus on infection and disease caused by binucleate. Rhizoctonia and *Rhizoctonia solani* on mung bean (*Vigna radiata*). Plant Soil 238, 235-244
8. Linderman, R.G. (1994). Role of VAM fungi in biocontrol. In: Pfleger F.L., Linderman R.G. (eds) Mycorrhizae and plant health. APS, St Paul, pp 1–2.
9. Nath, N. and Meena V. S. (2018). Mycorrhizae: A potential microorganism and its implication in agriculture. Role of Rhizospheric Microbes in Soil, pp.251-276.
10. Olawuyi, O. J., Odebode, C. A., Oyewole, I. O., and Akanmu, A. O. (2013). Effect of arbuscular mycorrhizal fungi on *Pythium aphanidermatum* causing foot rot disease on pawpaw (Carica papaya L.) seedlings. Archives Of Phytopathology and Plant Protection.
11. Smith, G. S. (1987). Interactions of nematodes with mycorrhizal fungi. In: Veech JA, Dickon DW (eds) Vistas on nematology. Society of Nematology, Hyattsville, pp 292–300.