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# Filling the Gaps: Arbuscular Mycorrhizal Fungi Biodiversity in the Tropical Ecosystems

**Geofrey E Soka***

*Department of Wildlife Management, Sokoine University of Agriculture, Tanzania*

***Corresponding author:** Geofrey E Soka, Department of Wildlife Management, Sokoine University of Agriculture, P.O. Box 3073, Tanzania, East Africa

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## Introduction

For a long time it was inequitably assumed that Arbuscular Mycorrhizal Fungi (AMF) was poorly represented in the tropics, so this area remained rather unexplored. However, recent research suggests that the tropics contain a treasure of unknown species of AMF. AMF are more widely distributed and can associate with a wide range of plant species [1-3]. Arbuscular Mycorrhizal (AM) symbioses can be formed with as many plant species as 250,000 [3]. To date, only 150-200 species of AM fungi have so far been distinguished on the basis of morphology [4]. However, DNA-based studies suggest that the true diversity of these symbionts may be much higher [5].

AMF are important microbial symbioses for plants in nutrients poor soils [6-8], and are significant in the maintenance of soil health and fertility, plant community development, nutrient uptake and above the ground productivity [1,2,9]. Plants exchange carbon (C) for fungal phosphorus (P) and nitrogen (N) [10-12]. AM fungi release signals molecules, which trigger a series of symbiotic plant genes; this activity prepares the intracellular root environment for colonization and arbuscule formation inside the root cortex [13,14].

Mycorrhizal fungi are known to influence plant diversity patterns in a variety of ecosystems globally [15]. Studies have been undertaken on the distribution and diversity of AMF species in relation to individual plant species and plant communities in farming systems in temperate regions [16-18]; and recently, there is emerging interest in the role of mycorrhizae in ecosystem processes [19-21]. Although AMF have been extensively studied in temperate regions, the effects of land management and land cover changes on their abundance and their contributions to plant productivity in nutrient-poor tropical soils is still unclear [22]. It is well recognized that humans keep on changing the global environments at an unprecedented rate. These changes are known to have an impact on global climate and biota; however, the implications of these changes to communities and ecosystems are not known [23]. Understanding of the mycorrhizal responses to anthropogenic environmental changes can therefore help to predict the trajectories of future communities and ecosystems in a changing world [24-25]. Soil has been reported to be a complex system wherein chemical, physical and biochemical factors are held in dynamic equilibrium [26]. Studies of AM hyphal abundance provide information on the biochemical processes occurring in soil [8,22]. There is growing evidence that soil biological parameters may be potential and sensitive indicators of soil fertility [27] and management induced changes in soil quality [28].

It is crucial to assess the effects of conversion of natural vegetation for agriculture to determine the effects of land use and cover transitions in AMF abundance in nutrient-poor tropical soils. Studies carried out in agricultural systems both in the tropical and temperate regions have suggested that AMF abundance may decline as a result of tillage [17,22]. Whilst reports of AM hyphal abundance in agricultural soils are becoming increasingly common [29], our knowledge of them in natural ecosystems remains scant. Knowledge about mycelial abundance is important in comprehending the potential roles of fungi in nutrient cycling, and plant symbionts. At present, little is known about the control of abundance and diversity of AMF in nutrient-poor tropical soils and; given the increasing importance attached to mycorrhizal fungal diversity for maintenance of ecosystem functioning, a better understanding of the causes of AMF diversity and its loss is deemed necessary.

## The Way Forward

Since little is known about host specificity among AMF in tropical savanna soils, it is important to understand whether different plant species associate with unique communities of AMF, and how increasing plant diversity affects the composition of AMF communities. Therefore, further research into plant host effects and AMF community diversity needs to be disentangled experimentally. Understanding how plant hosts affect AMF communities can also inform restoration and conservation projects, allowing researchers to better understand the contribution of different mycorrhizal communities in plant productivity [30].

Fire can affect AM fungi by changing the soil conditions and by directly altering AM proliferation. No study has been conducted to examine the effects of fire on AMF abundance in tropical savanna soils. Therefore, the assessment of the effect of fire on AMF abundance is clearly needed. Future studies should endeavour to use molecular methods to determine AMF species diversity in tropical savanna. Use of fungal operational taxonomic units (OTU) would help to detect the diversity of Glomeromycota in tropical savanna soils. The assessment of AMF using molecular-based approach is necessary to affirm AMF diversity in tropical ecosystems. Albeit, environmental sequencing in the tropics is emerging, still solid taxonomic data essential to interpret the genomic datasets resulting from these studies are lacking. Therefore, there is a to bridge the gap between data generated by environmental ecologists and the knowledge gathered by taxonomists, in order to make a full assessment of biodiversity possible by linking above ground diversity to below ground diversity.

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