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Arbuscular mycorrhizae from arid parts of Namibia

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Abstract

Soil and root samples from three arid sites in southern Namibia were analysed for the presence of arbuscular mycorrhizal fungi. Twelve species were recorded, with *Glomus aggregatum* being the dominant spore type. Species composition appeared to be influenced by geographic distance (or abiotic factors that vary with geographic distance) of the study sites but not by land utilization. This is supported by analyses of the nuclear ribosomal genes of glomeromycetes colonizing plant roots. In contrast to that, mycorrhization varied under different land utilization regimes.

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1. Introduction

Arbuscular mycorrhizal fungi (AMF) are known to improve water status and phosphate nutrition of their host plants (Rundel and Nobel, 1991, pp. 349–378; Smith and Read, 1997), and enhance nitrogen nutrition of the host plant to a small degree (Smith and Read, 1997). This makes them an important component of arid

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ecosystems (Bethlenfalvay et al., 1984; Allen and Allen, 1992; Dhillion and Zak, 1993).

For their carbon nutrition, AMF depend on their host plants and are unable to grow in the absence of host plants (Smith and Read, 1997). AMF also depend on abiotic factors: a well-known effect in agro ecosystems is the reduction of mycorrhization under high phosphate- and nitrogen fertilization (Johnson and Pfleger, 1992). Soil acidity influences the number of spores in the soil (Mohammad et al., 2003) as well as species composition (Khan, 1974; Porter et al., 1987). The salt content of the soil (measured as electrical conductivity, Juniper and Abbott, 1993) determines species composition (Sylvia and Williams, 1992) and a higher salt content reduces the number of spores (Khan, 1974; Juniper and Abbott, 1993). Despite the dependence of the plants on AMF and the dependence of AMF on abiotic factors, only few studies (Jacobson et al., 1993; Jacobson, 1997a; Stutz et al., 2000; Uhlmann et al., 2004) have focussed on the arbuscular mycorrhizal fungal community of Namibia.

In arid and semi-arid environments, differences in management can have large impacts on plant cover and plant species diversity (Todd and Hoffman, 1999). Land utilization in southern Namibia includes commercial and communal farming, national parks, as well as mining activities. In commercial farming systems, an individual has property rights and can sell land for individual profit, whereas under communal land tenure, individuals have few rights to own or sell land (Hoffman and Ashwell, 2001).

In several cases, communal farming systems are associated with poor plant cover, especially when institutional control over stocking rates has broken down (Hoffman and Ashwell, 2001). However, in some case studies the plant cover of communally farmed land was comparable to that of commercial farms (Ward et al., 1998; Hoffman and Ashwell, 2001). Different land management is known to influence AMF diversity, at least in Europe (Helgason et al., 1998). Differences in plant cover and plant species diversity can have an impact on the diversity of AMF (Helgason et al., 2002). Conversely, it was also shown (van der Heijden et al., 2003) that AMF could alter plant communities. The importance of AMF in the regeneration of altered dryland has long been recognized, leading to the recommendation by Bainbridge et al. (1995) to use AMF in regeneration studies.

Since the advent of molecular techniques, it became obvious that the AMF spores found most frequently in the soil do not necessarily represent the AMF species most active in plant roots (Helgason et al., 2002). At the same time, it became clear that the diversity of sequences derived from plant roots is much higher than the diversity of morphologically described species (Herman, 2000), rendering a phylogenetic identification of AMF difficult (Vandenkoornhuys et al., 2002).

This study aims at drawing up an inventory of AMF species at three arid sites in southern Namibia, at a comparison of species diversity at sites with different abiotic conditions, and at a comparison of species composition at sites with similar abiotic conditions, but under different management.

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