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## Arbuscular Mycorrhizal Residues Decline with Prolonged Arable Cropping: a Chronosequence Study on Glomalin-related Soil Protein in Sandy Soils of the South African Highveld

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### Abstract

In coarse textured soils with little biomass input and low capacity to conserve soil organic matter, residues of arbuscular mycorrhizal fungi (AMF) may play an important role for agroecosystem functioning due to their ability to promote soil aggregation. Our aim was to assess the fate of AMF residues with prolonged arable cropping in subtropical savannah soils following the hypothesis that glomalin-related soil protein (GRSP), especially the MAb32B11-immunoreactive fraction, constitutes material of largely AMF origin. In three agroecosystems on the South African Highveld, surface soils with a history of up to 98 years of cropping after conversion from grassland were sampled. We measured four GRSP fractions: Bradford-reactive soil protein (BRSP) and immunoreactive soil protein (IRSP), and easily extractable fractions of both. The primary grassland sites exhibited generally low contents of soil organic matter (SOM) and low GRSP contents. Prolonged arable land use of former grassland soils reduced the content of GRSP further. The decline could be described well with a single exponential function with rate constants ranging from 0.04 to 0.41 y<sup>-1</sup>. Depending on the GRSP fraction, steady-state conditions were reached after 11 to 92 years on a level of 39 % to 69 % of the initial contents. We conclude that even though GRSP fractions had the same hypothesised origin, they comprised pools with different stability or replacement rate, with easily extractable IRSP being lost most rapidly. Despite potentially negative management effects on AMF, GRSP contents were not reduced below a certain equilibrium content and coincided with low, but stable crop yields. Ongoing research on secondary grassland sites with a cropping history shows that an at least partly restoration of SOM takes place. The next step will be to assess the extent of GRSP restoration and its effects on SOM and soil structure stabilisation in the secondary grassland soils on the South African Highveld.

**Keywords:** Arable land use, arbuscular mycorrhizal fungi, biomarker, glomalin, soil organic matter