Long-term effects of NP applications and farmyard manure on Arbuscular Mycorrhizal Fungal (AMF) communities in Kabete, Kenya

M.N. Muchane[1], T.W. Kuyper[1], J, Jefwa[2] and B. Vanlauwe[2]

[1]Department of Soil Quality, Wageningen University , P.O. Box 47, 6700 AA Wageningen, The Netherlands email: mary.muriithi@wur.nl

[2]Tropical Soil Biology & Fertility Institute (TSBF CIAT), P.O. Box 30677-00100, Nairobi, Kenya

Introduction

Low inherent soil fertility in most African countries causes low and unsustainable crop yields (Okalebo et al., 2007). To restore soil biodiversity and biological function of these depleted soils, organic amendments are proposed (Vanlauwe, 2004). However, little is known on how improved land management (addition of organic amendments) contributes to the restoration of soil biodiversity in particular Arbuscular Mycorrhizal Fungi (AMF) which play an important role in enhancing chemical, physical and biological soil quality. Understanding long-term effects of organic and inorganic fertilization on AMF communities may ensure an opportunity for management. The aim of this study was to investigate community structure and diversity of AMF in a maize-bean rotation system fertilized with 3 levels of organic input (farm yard manure) and NP fertilization in presence or absence of crop residues in a 32 years old field trial. We hypothesized abundance and diversity of AMF are higher after addition of organic amendments.

Materials and Methods

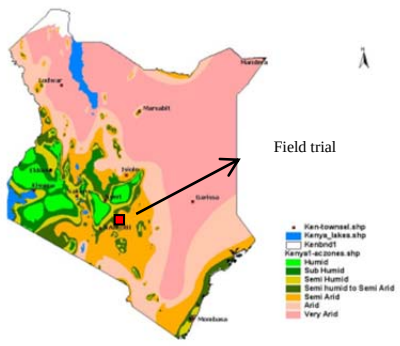

Figure 1: Study area

Figure 2: Kabete field trial

Study area: Long term field trial, Kabete central Kenya, established in 1976 (Figs 1 & 2).

Method

- Study was done during the long (March-September, 2008) and short (October, 2008 – February, 2009) rainy seasons
- Experiment comprised of 3 (manure) x 3 (NP) x 2 (residues) factorial experiment in a complete randomized block design replicated three times.
- The plots received farmyard manure at 0t/ha (FYM0), 5 t/ha (FYM1) and 10t/ha (FYM2) and nitrogen-phosphorus (NP) fertilizer at 0 kg N & P/ha (N0P0), 60 kg N & 26.4 kg P/ha (N1P1) and 120 kg N & 52.8 kg P/ha (N2P2), with (R1) or without (R0) crop residue (maize stover).
- AMF inoculum potential (IP) was assessed using bioassays with undisturbed soil cores and three fast growing crops (Leek, Cow pea and sorghum).
- AMF species composition was assessed in field soil and with the help of trap

Results

16 AMF species from five genera were observed. Most common genus was *Acaulospora* (60% of spores), followed by *Scutellospora* (20%). Species composition was similar in different treatments. NP and manure treatments explained only 3% of total variation in the data set.

Both manure and NP fertilizer negatively affected on AMF species richness and abundance resulting in a decline of 24 and 34% in spore abundance and 9% in species richness. Some species of *Acaulospora* (*A. sp. 1, A. scrobiculata*) showed a significant decline due to manure (Fig 4) and NP (Fig. 5). Manure increased root colonization (Fig. 6). Residue application had only minor effects.

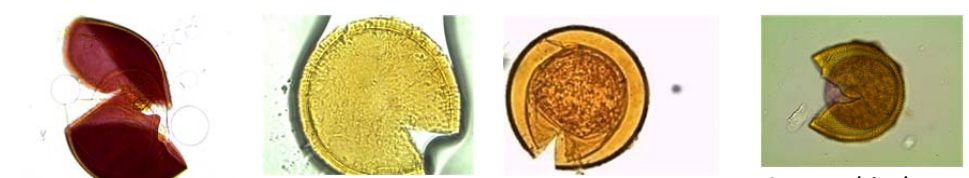

Figure 3: Some AMF species in the study site

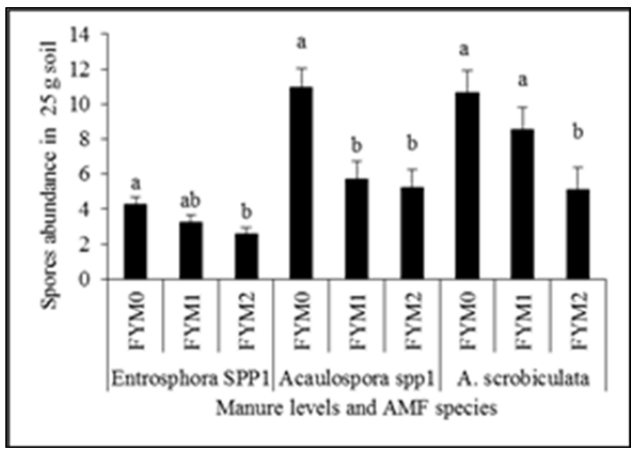

Figure 4: Effect of manure on AMF species

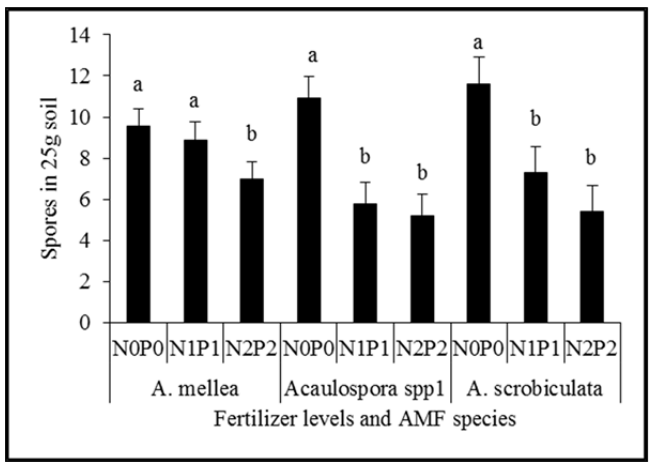

Figure 5: Effect of NP fertilization on AMF species

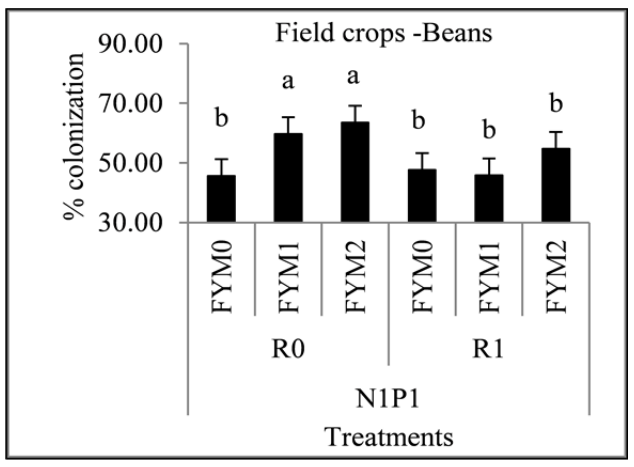

Figure 6: Effect of manure on AMF colonization of field crops

Conclusions

- Unbalanced addition of mineral fertiliser and organic amendments reduced diversity and abundance of AMF communities.
- Long-term field trials provide a unique opportunity to assess effects of treatments to revert low soil fertility on communities of AMF.
- Negative effects of crops residues in some aspects of AMF activity may be associated to phytotoxic effect of un-composted crop residues on growth and functioning of the extra-radical hyphae (Kahiluoto et al., 2012).

References

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