

**TABULARBUSCULAR MYCORRHIZAL FUNGI OF UGANDAN BANANA  
PLANTATION SOILS**

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by  
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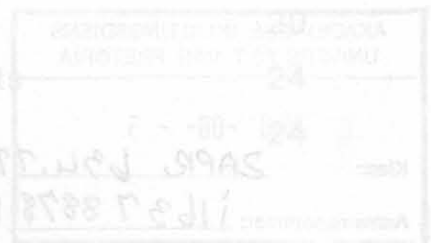
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**SUMMARY** Gerdemann were isolated under glasshouse conditions using sudan grass a host plant.

## ARBUSCULAR MYCORRHIZAL FUNGI OF UGANDAN BANANA

**PLANTATION SOILS** indigenous AMF to colonize micropropagated banana plantlets

was evaluated at the *in vitro* and weaning phase of growth. Surface sterilized *G.*

This first study of arbuscular mycorrhizal fungi in Uganda involved (1) the assessment of the mycorrhizal inoculum potential of banana farm soils, (2) isolation of AMF species and (3) determination of the potential of a selected AMF among the isolated indigenous species to colonize micropropagated banana plantlets. 10% of the weaning phase plantlets were mycorrhizal and 50% of the weaning phase plantlets were mycorrhizal.

A greenhouse bioassay was conducted to assess the arbuscular mycorrhizal (AM) fungi inoculum potential of 18 different banana farm soils. Sudan grass was used as a host plant. Root colonization by AMF occurred in all the 18 sites analyzed. The highest mycorrhizal inoculum potential was recorded at Ntugamo district. The mycorrhizal inoculum potential of Ugandan soils was found to be higher in soils containing the banana type *Musa* AAA than soils containing banana type *Musa* ABB. However, it was found that site was the main factor influencing the mycorrhizal inoculum potential of Ugandan soils.

Banana rhizospheric soils were retrieved for single morphotype pot culture production of some individual species of AMF. Pure cultures of *Glomus mosseae* (Nicolson & Gerdemann) Gerdemann and Trappe and *Glomus etunicatum*

Becker and Gerdemann were isolated under glasshouse conditions using sudan grass a host plant.

## ARBUSKULÊRE MIKORISALE SWAMME IN UGANDESE

The ability of the indigenous AMF to colonize micropropagated banana plantlets was evaluated at the *in vitro* and weaning phase of growth. Surface sterilized *G. mosseae* spores were used as inoculum. Mycorrhization was demonstrable at 10 weeks post-inoculation for both *in vitro* phase and weaning phase banana plantlets under misting tunnel conditions. Root colonization levels ranged from 0-5% of the test plant for both stages of banana growth. Thirty percent of the *in vitro* plantlets were mycorrhizal and 50% of the weaning phase plantlets were mycorrhizal.

In Glashuisbiotoets is uitgevoer om die arbuskulêre mikorissale (AM) swaminokulum potensiaal van 18 verskillende piesangplaas-gronde te bepaal. Sudan gras is as gasheerplant gebruik. Wortelkoloniserings deur AMS het in al 18 van die persele ontfeet, plaasgevind. Die hoogste mikorissale inokulumpotensiaal is in die Ntugamo distrik opgeteken. Die mikorissale inokulumpotensiaal van Ugandese gronde is gevind om hoër te wees in gronde met die piesangtipe *Musa* AAA as gronde met die piesangtipe *Musa* ABB. Dit is nie gevind dat ligging die belangrikste invloed op die mikorissale inokulumpotensiaal van Ugandese gronde gehad het.

Piesang risosfeergronde is versamel vir enkel-morfotipe produksie in potte van sommige individuele spesies van AMS. Suiwer kulture van *Glomus mosseae*

## OPSOMMING

### ARBUSKULÊRE MIKORISALE SWAMME IN UGANDESE

### PIESANGPLANTASIE GRONDE

Hierdie eerste studie van arbuskulêre mikorisale swamme (AMS) in Uganda het ingesluit: (1) die bepaling van die mikorisale inokulumpotensiaal van piesanggronde, (2) isolasie van AMS spesies en (3) bepaling van die potensiaal van 'n geselekteerde inheemse spesie om piesangplante in weefselkultuur te koloniseer.

'n Glashuisbiotoets is uitgevoer om die arbuskulêre mikorisale (AM) swaminokulum potensiaal van 18 verskillende piesangplaas-gronde te bepaal. Sudan gras is as gasheerplant gebruik. Wortelkolonisering deur AMS het in al 18 van die persele ontleed, plaasgevind. Die hoogste mikorisale inokulumpotensiaal is in die Ntugamo distrik opgeteken. Die mikorisale inokulumpotensiaal van Ugandese gronde is gevind om hoër te wees in gronde met die piesangtipe *Musa* AAA as gronde met die piesangtipe *Musa* ABB. Dit is nietemin gevind dat ligging die belangrikste invloed op die mikorisale inokulumpotensiaal van Ugandese gronde gehad het.

Piesang risosfeergronde is versamel vir enkel-morfotipe produksie in potte van sommige individuele spesies van AMS. Suiwer kulture van *Glomus mosseae*

(Nicolson & Gerdemann) Gerdemann & Trappe en *Glomus etunicatum* Becker & Gerdemann is onder glashuistoestande, met sudan gras as gasheerplant, geïsoleer.

Die vermoë van die inheemse AMS om piesangplante in weefselkulture te koloniseer is in die *in vitro*- en speengroei fases bepaal. Oppervlak-ontsmette *G. mosseae* spore is as inokulum gebruik.

Mikorisering is 10 weke na inokulering vir beide die *in vitro*- en speengroei fases onder mistonneltoestande aangedui. Wortel koloniseringsvlakke het van 0-5% van die toetsplante in beide groeifases, gewissel. Dertig persent van die *in vitro* plante en 50% van die speengroeifase plante was mikorisaal.

Dr. Robert Sinclair and Beatrix Bouwman for guidance and encouragement.

Agricultural Research Council-Plant Protection Research Institute (ARC-PPRI) Mycorrhizal Unit staff, Dorothy Mthimunya and Harry Boroko for technical assistance and support; library staff, Louise, Thembu and Hannelie for obtaining literature review material.

ARC-PPRI, Dr. Johan Mohr for translating the abstract into Afrikaans.



## ACKNOWLEDGEMENTS

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Sampling in Uganda was supported by a highly appreciated grant from the Swiss Development Corporation.

Figure 2: *Musa acuminata*, genotype AAA showing two suckers less than 50 cm

I am grateful to the staff at the Nematology laboratory, IITA-Namulonge, Uganda for all the assistance rendered.

Figure 4: *Arum* type root colonization of sorghum. The fungus spreads in the root

Agricultural Research Council and University of Pretoria for financial assistance.

and branch dichotomously to produce characteristic arbuscules (A). Bar = 9.5µm.

African Biotechnologies for providing micropropagated banana plantlets and facilities to run the trial free of charge. Special thanks to Dr. Blessed Okole for all the assistance rendered.

Figure 5: *Paris* type AMF root colonization. Intracellular hyphae spread

Dr Robert Sinclair and Beatrix Bouwman for guidance and encouragement.

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Figure 6: *Paris* type AMF root colonization. Intracellular hyphae spread

ARC-PPRI, Dr. Johan Mohr for translating the abstract into Afrikaans.

Figure 7: *Paris* type AMF root colonization. Intracellular hyphae spread

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**Figure 1:** *Musa acuminata*, genotype AAA (East African highland banana).

**Figure 2:** *Musa acuminata*, genotype AAA showing two suckers less than 50 cm in height.

**Figure 3:** *Musa acuminata*, genotype ABB (*Pisang awak*).

**Figure 4:** *Arum* type root colonization of sorghum. The fungus spreads in the root cortex via intercellular hyphae (i). Short side branches penetrate the cortical cells and branch dichotomously to produce characteristic arbuscules (A). Bar = 9.5µm.

**Figure 5:** Penetration of sorghum root by AMF. The hypha entered the epidermis (E), penetrated a hypodermal cell, in which it formed a tightly packed coil (C), and then formed another coil in the adjacent cortical cell (C). This photograph represents typical *Paris* type AMF root colonization. Intracellular hyphae spread directly from cell to cell within the cortex. Bar = 9.5µm.

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**Figure 1:** *G. mosseae* (Nicolson & Gerdemann) Gerdemann & Trappe spore showing funnel-shaped hypha (FH), tightly fused laminate wall layer (LL) and fragment of outer wall (SW). Bar = 23 µm.

**Figure 2:** *G. etunicatum* Becker & Gerdemann spore showing laminate wall layer (LL). Spore contents consist of lipid droplets that have coalesced into a

single large oil vacuole (C). The outer wall has completely sloughed off. Note thickening of laminate layer at point of hyphal attachment. Bar = 19.6  $\mu\text{m}$ .

**Figure 3:** *G. mosseae* (Nicolson & Gerdemann) Gerdemann & Trappe spore showing funnel-shaped hypha (FH) and fragment of outer wall layer (SW). Spore contents consisting of lipid droplets of different sizes (C). Bar = 13  $\mu\text{m}$ .

**Figure 4:** *G. mosseae* (Nicolson & Gerdemann) Gerdemann & Trappe spore showing funnel-shaped hypha. Bar = 16  $\mu\text{m}$ .

**Figure 5:** *G. etunicatum* Becker & Gerdemann spore showing outer hyaline wall layer (HW) that is sloughing off (SW) and inner laminate wall layer (LL). Bar = 16.8  $\mu\text{m}$ .

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**Figure 1 and 2.** *G. mosseae* (Nicolson & Gerdemann) Gerdemann & Trappe in roots of weaning phase banana plantlets showing darkly staining vesicles (V). Note the abundant root hairs (R) of Grande Naine (*Musa acuminata* AAA). Bar = 21  $\mu\text{m}$ .

**Figure 3 and 4:** *G. mosseae* (Nicolson & Gerdemann) Gerdemann & Trappe in roots of *in vitro* banana plantlets showing intraradical spores (S) and intraradical foraging hyphae (i) growing parallel to each other and the root axis. Vesicles are seen in figure 3. Bar = 14.4  $\mu\text{m}$ .

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## CHAPTER 1

### ABBREVIATIONS

### INTRODUCTION

s	second
min	minute(s)
ml	millilitre
cm	centimeter
g	gram
mm	millimeter
µm	micrometer
AMF	Arbuscular mycorrhizal fungi
AF	Acid fuschin
SDH	Succinate dehydrogenase