STUDIES ON INDIGENOUS ARBUSCULAR MYCORRHIZAL FUNGI FROM A FALLOW FIELD IN ILE-IFE

BY

MOBOLAJI ADENIKE ADENIYI

B.Sc (OAU, ILE-IFE)

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....

Prof. G.O. Babalola Date

(Supervisor)

....

Prof. (Mrs.) A.O. Salami Date

(Co-Supervisor)

....

Dr. D.A. Akinpelu Date

(Ag. Head of Department)

DEDICATION

This work is dedicated to my late father, Rev. (Canon). F.O. Adeniyi, and my mother, Mrs. I.O. Adeniyi.

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ABSTRACT

Arbuscular Mycorrhizal (AM) fungi spore abundance and species composition were assessed on a fallow field in Obafemi Awolowo University Teaching and Research Farm, Ile-Ife, Nigeria. This was with a view to evaluating their potentials for the enhancement of crop yield.

Soil samples were collected randomly from nine (9) different points within the field in March, 2012, before the onset of the rainy season. The soil samples were air-dried and processed for AM fungi spore abundance and species composition. The isolated AM fungi species were affiliated with already described species. The isolated AM fungi species were used to develop AM fungi inoculum and used in simulated trial experiment singly and in combination using tomato cultivar (*Lycopercium* sp.) as test plant. The chemical analysis of the different pot soil was carried out before and after harvest to determine the enrichment of soil nutrient by the different treatments applied.

The AM fungi spore density observed in the field of study ranged between 5 – 9 spores/g of soil. Three AM fungi spore types, *Glomus mosseae, Glomus luteum* and *Glomus viscosum* were isolated from all the soil samples. *G. mosseae* was the most abundant of the three spores with total relative abundance of 66.59 ± 7.05%. *G. luteum* and *G. viscosum* had mean relative abundance of 16.89 ± 5.18% and 16.52 ± 3.86% respectively. Mycorrhiza inoculation improved plant growth and fruit yield (g) of tomato cultivar. All the single inoculated mycorrhizal treatments improved fruit yield (g) (*G. mosseae* (63.83 g); *G. luteum* (85.58 g); *viscosum* (66.38 g)) than the other treatments. However, not all combinations of AM inoculum were effective in improving plant crop yield. The combination of *G. mosseae* and *G. luteum* was the best combination (56.35 g) and the worst of the combination treatments was the treatment with the

combination *G. mosseae* and *G. viscosum* (24.63 g). The result of this study also revealed that, AM fungus/fungi differ in their ability to enhance soil nutrient enrichment depending on the soil nutrient element being considered and the AM fungus or fungi in combination.

This study concluded that AM fungi improved plant crop yield and also contributed to soil nutrient enrichment.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Mycorrhizal fungi are ubiquitous in the terrestrial ecosystem (Thorunn and Alastair, 2009) and the most dominant organism among the many microbial community components of the rhizosphere (Chubo *et al.*, 2009). They are symbiotic association of fungi with plants that benefit both partners (Dalpe and Monreal, 2004). Arbuscular Mycorrhiza (AM) fungi are obligatory biotrophic symbionts that occur in nearly all natural and arable soils and commonly colonize roots of many plant species (Smith *et al.*, 1997).

The most commonly known underground symbiotic association between members of phylum Glomeromycota and roots of 80 % of all plant species are arbuscular mycorrhiza fungi. They are essential constituent of the microbial soil community (Schüßler *et al.*, 2001; Wang *et al.*, 2008). Arbuscular mycorrhiza fungi connect plants into a functional web (Hegalson *et al.*, 1998), they extend plant root systems and also, assist plants uptake of soil nutrient of poor mobility, especially phosphorus (Smith and Read, 2008). van der Heijden and Horton (2009) reported that, mycorrhiza fungal networks act as a prospective channel for plant-to-plant transfer of resources. Also, AM fungi aid plant fitness by improving seedling establishment, plant fecundity, tolerance to some root pathogens, water relations and formation and stability of soil aggregates (Newsham *et al.*, 1995; Read, 1999).

The major effect of AM fungi on their host plant is a boost in plant growth and soil nutrient acquisition (Ortas *et al*., 2001). Plants with mycorrhiza are more effective at soil nutrient uptake and water acquisition (Koide, 1991). According to Ryan and Angus (2003), phosphorus, zinc and copper uptake from soil are increased in plants with mycorrhiza association. Also, mycorrhizal plants are less predisposed to disease causing soil micoorganisms (Salami, 2002).

Inoculation of chilli pepper with native AM fungi decreased transplanting stress, accelerated the maturation stage of plants, and resulted in higher and better yield quality (Claudia *et al.,* 2009). Also, the use of AM fungi inoculum in combination (consisting of both *Glomus etunicatum* and *G. intraradices*) benefit tomato seedling transplants in a soilless nursery condition (Oseni *et al*., 2010). The addition of arbuscular mycorrhiza inocula, for example, *G. mosseae, G. calendonium*, E3 endomycorrhizal fungi spores to plantations of vegetables including carrots, onions, parsnips and potatoes, among others have been found to increase the uptake of trace elements in certain conditions. They also improved crop yield (Ward *et al*., 2001). Salami *et al*. (2007) and Oyetunji and Osonubi (2007) reported increased cassava yield in mycorrhizal treatment when compared to the uninoculated treatment. Also, Douds *et al*. (2008) reported that strawberry plants inoculated with AM fungi prior to planting produced 17 % more fruit than uninoculated controls.

Tomato, which is readily colonized by AM fungi (Edathil *et al*., 1996; Bryla and Koide, 1998; Iqbal and Mahmood, 1998), is one of the most widely cultivated fruits in the world. The fact that tomatoes and tomato products are increasingly becoming commodities (Foreign Agricultural Service, 2003; Foreign Agricultural Service, 2004), improving agricultural sustainability through the use of AM fungi could play an important role in increasing the yield of tomato production.

1.1 Problem Statement

The increasing demand for food security and other agricultural products has led to continuous cultivation of available farmland and application of inorganic fertilizer to improve soil productivity. In some cases, such fertilizer has impacted negatively on the ecosystem, particularly the water bodies, through run-offs. In addition, they are not readily available, and where available, are expensive. There is, therefore, the need to seek for sustainable alternatives to inorganic fertilizers, hence, this study.

1.2 Expected Contribution to Knowledge

This research is expected to provide information on the feasibility of the development of mycorrhiza inoculum as a biological resource for the enhancement of agricultural productivity.

1.3 Objectives of Study

The objectives of this study are to:

a) screen for and isolate indigenous Arbuscular Mycorrhizal (AM) fungi spores in a selected fallow field;

b) characterize the isolated AM fungi;

c) develop mycorrhiza inoculum and apply same to simulate AM on tomato plants;

d) study and compare growth rate of tomato plants treated with mycorrhiza inoculum and inorganic fertilizer; and

e) compare the yield performance of tomato plants treated with mycorrhiza inoculum and inorganic fertilizer.

For more information, please contact **ir-help@oauife.edu.ng**