STUDIES ON VESICULAR ARBUSCULAR MYCORRHIZAE IN EGYPT

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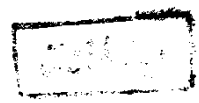

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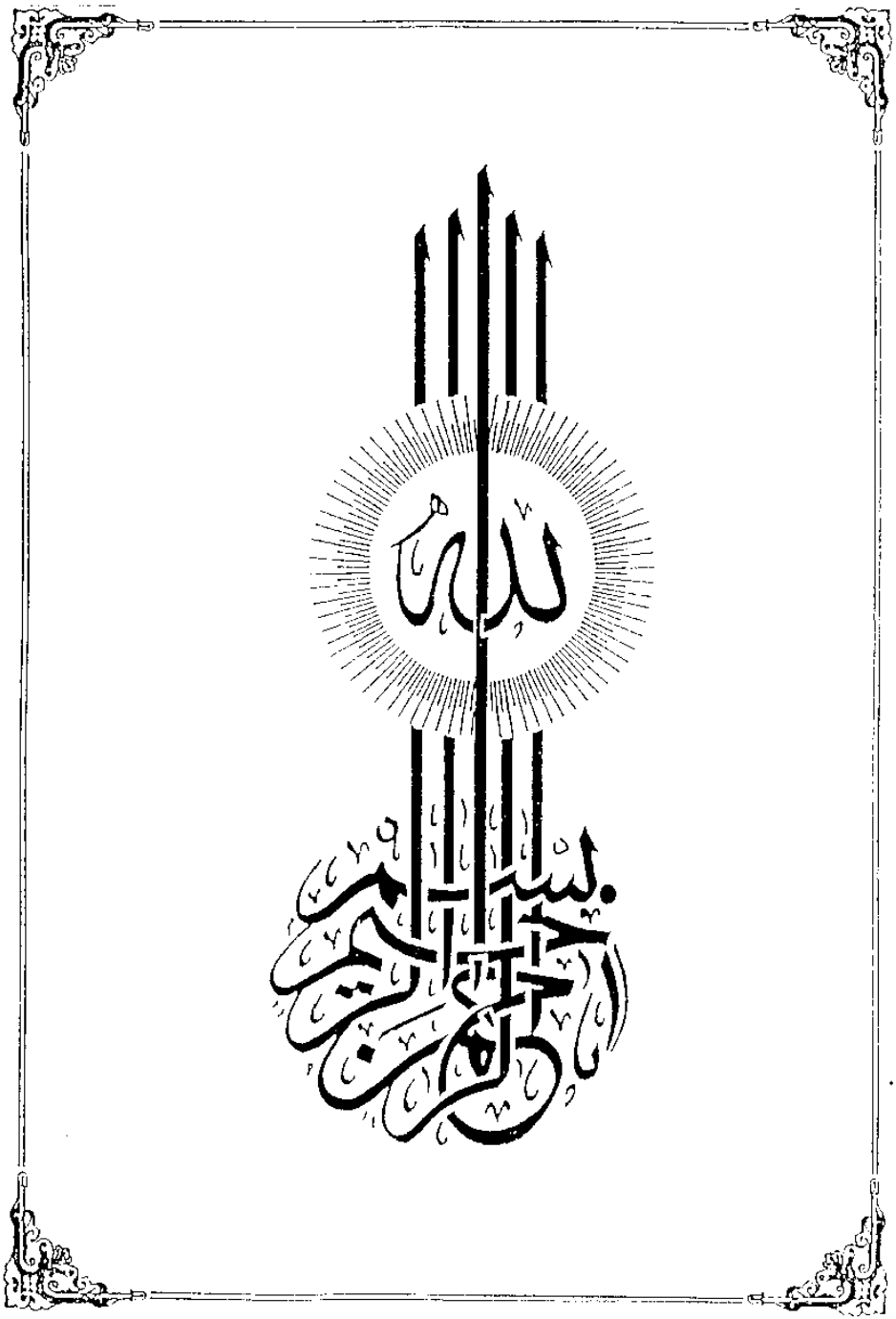

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INTRODUCTION

Among the most widespread relationships between micro-organisms and higher plants are the symbioses known as vesicular-arbuscular mycorrhizas (VAM). In VA mycorrhizas, plant roots and certain species of fungi form an intimate association one which is beneficial, and in some cases essential, to the well-being of each partner.

Recently, this mutualistic association have attracted more attention in agricultural research programmes, largely due to a better understanding of their importance for plant growth and development, and the necessity to use such information to increase agricultural productivity.

Mycorrhizal plants often exhibit much greater growth and higher yields than plants deprived of the mycorrhizal relationship. This growth response has been recorded in many crops particularly cereals and legumes. Mycorrhizal roots associated with diazotroph stimulate N_2-fixation and eventually plant growth. Most researchers agree that although there are number of beneficial effects which may be attributed to mycorrhizas, the primary benefit to plants appears to be that of improved nutrient uptake, particularly phosphorus, from the soil. Such benefit is demonstrated in soils with low available phosphorus contents.

VA mycorrhizas seems to be of particular importance in the Mediterranean area and the semi-arid parts of the world. Environmental conditions prevailing in these areas such as high soil pH, calcium carbonate content, phosphate-fixing capacities, light intensities and low water contents may present the most favourable factors for the interaction between plant host and fungal endophytes. Moreover, VA mycorrhizas could be an important tool to reduce the high costs for locally manufacturing soluble phosphate fertilizers in developing countries.

Little is known on the mycorrhizal status of Egyptian soils and if the endophytes they contain can enhance plant growth (Edrees, 1982, Saad, 1982 and Heggo, 1984). Therefore, there is an urgent need to isolate VA fungi from different types of Egyptian soils and to asses their efficiency for plant growth as well as their interactions with other root associated microorganisms particularly N_2-fixing bacteria.

We report on the occurrence of VA mycorrhizas in Egyptian soils, infection levels in selected crops and manipulation of extracted spores for practical applications under Egyptian conditions. The growth response of economic important crops to dual inoculation with endomycorrhizas and nitrogen fixing bacteria is also investigated.

REVIEW OF LITERATURE

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1. Occurrence of VA Mycorrhizas (VAM):

World-wide interest in vesicular-arbuscular mycorrhizas (VAM) has increased at a phenomenal rate.

1.1. Presence of VAM in cultivated and uncultivated soils:

VA mycorrhizas populations in cultivated soils are affected by the soil type, the plants population and the environmental conditions. All of these factores influence VAMs in the natural ecosystems together with the various agricultural and horticultural practices employed in cultivation. Most crop species are mycorrhizal. Some are heavily infected such as maize, phaseolus,beans and grapevine, variable infected such as olives but tomatoes consistently fairly lightly infected even when present at the same sites as the first three. (Hayman et al. 1976).

According to Butler's review (1939), VAM root infections may be more abundant in orchard and plantation crops than in annual field crops. This may be explained by Hayman et al. (1975) suggested a selection pressures on mixed VAM populations that favour those endophytes able to survive as spores during the fallow periods between crops and at least a year with a non-host crop. On the other hand, more VAM spores recorded in annual field crops than orchard crops. Hayman(1978).

At a single site in Florida, Schenck and Kinloch, (1980) found marked differences in populations of VAM fungi between different crops grown in mono-culture for seven years on a newly cleared woodland site. There were more spores after soybean than with the other crops and fewest in the woodland, Three species in the genus Gigaspora were most numerous around the soybean roots, whereas two Glomus species were most prevalent with Bahia grass and Acaulospora spp. with cotton and peanut plants. Sorghum had the largest number of VAM species. This last mentioned paper is one of the most detailed reports on the selective effects of host species under field conditions.

Mason (1964) and Hayman (1970) reported that more spores are found towards the middle or end than at the begining of the growing season. VAM roots infections usually reach a maximum towards the end of the growing season Hayman (1970). Mejstrik (1972) estimated the approximate degree of infection of 45 species of a Molinietum coenuleae association in April, June and September. In most cases, the infection levels were lowest in the spring and highest in the autumn, presumbly dropping during the winter. Conversely, Sparling and Tinker, (1978) found that in three contrasting grassland types in the Pennines, (Northern England) infection levels showed little change throughout most of the year, but were significantly

higher during the winter. Rabatin (1979) worked on grasses in field and pasture situations. She found that it was possible to show both seasonal and spatial variation in root infections by the VAM fungus, Glomus tenuis. The highest levels of the fungal infection occurred in the finer grass roots in the spring and decreased slowly through the summer and autumn.

The species composition of VAM populations are also affected by soil factors. Even so, in adjacent fields at Rothamsted (U.K.) with the same crop, soil type and similar fertility contained very different endophyte composition (Hayman, 1970). In Pakistan, reticulate spore types seemed most common in sand soils and vaculate types in clay loam (Khan, 1971). The distribution of honey coloured sessile and yellow vacuolate spore types in western Australia was related to soil pH (Abbott and Robson ,1977). Nitrogen fertilizers depressed the numbers of white reticulate spore type more than laminate types in a sand loam (Hayman, 1978). In Welsh hill-grasslands, populations of indigenous endophytes were reduced more than introduced Glomus mosseae and G. fasciculatus by addition of lime and phosphate fertilizer (Hayman and Mosse, 1979).