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VESICULAR ARBUSCULAR MYCORRHIZAL STATUS IN RELATION TO DROUGHT TOLERANCE IN COCOA

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ABSTRACT

Vesicular - arbuscular mycorrhizal (VAM) status, characterized by per cent incidence, infection grading and spore density in root zone soils of five drought tolerant and an equal number of susceptible accessions of cocoa revealed that VAM incidence and infection grading in root samples and spore density in soil, was significantly higher in drought tolerant accessions when compared to drought susceptible accessions. With regard to the occurrence of VAM species, *Glomus versiforme* was encountered in higher frequencies and also in the rhizosphere of more number of plants belonging to the drought tolerant group.

INTRODUCTION

Comparative drought tolerance of fourteen cocoa accessions were studied by Balasimha et al. (1988) at CPCRI, Research Station, Vittal. Based on their study, NC 23, 29, 31, 39 and 42 were identified as drought tolerant with effective stomatal regulation capacity. These plants maintained higher leaf water potential than the drought susceptible ones during drier months (Balasimha et al., 1991). They had higher leaf turgor during summer and higher wax deposition on leaves (Bhat et al., 1990).

Mycorrhizal association with plants is known to bestow them with beneficial effects like increasing the nutrient depletion zone for extracting nutrients and moisture. They also help to mine nutrients even when they are present in concentrations far below the critical levels at which they can be absorbed by the roots (Hardie and Leyton 1981). Because of these reasons, mycorrhizal plants can withstand soil moisture stress better than the non-mycorrhizal plants (Levy and Kriven, 1980).

Evidences are available to the fact that mycorrhizal dependency/association is genetically controlled in higher plants (Azcon and Ocampo, 1981; Thomas and Ghai, 1987).

A study was therefore, carried out to understand the qualitative and quantitative differences, if any, occuring in the drought-tolerant and susceptible Nigerian accessions of cocoa characterized earlier by Balasimha et al. (1988). This could serve as a preliminary step to study the contribution, if any, of VAM association in alleviating drought and if so, to use this information in mitigating the drought effects on cocoa.

MATERIALS AND METHODS

Ten plants belonging to the Nigerian accessions were used for the study. Plants NC 23/43, 29/66, 2/95, 31/108 and 39/116 were the drought-tolerant accessions while 24/45, 30/77, 52/34, 52/20 and 55/8 were the drought-succeptible ones.

VAM status was assessed by studying percent incidence and extent of colonization (infection grading percent) in cocoa roots and spore density in root zone soil. Soil samples were collected from 0-25 cm depth and secondary and tetiary roots occuring in this zone were used for the study. Sampling was done once in two months for a year during 1990. Standard methods of VAM infection, and spore density (Philips and Hayman, 1970; Gerdemann and Nicolson 1963; Giovannetti and Mosse 1980) were used and the data was statistically analyzed.

RESULTS AND DISCUSSION

Data collected on per cent incidence, infection grading and spore density revealed that drought tolerant plants had significantly higher incidence, infection grading and spore density than the drought susceptible accessions. All the

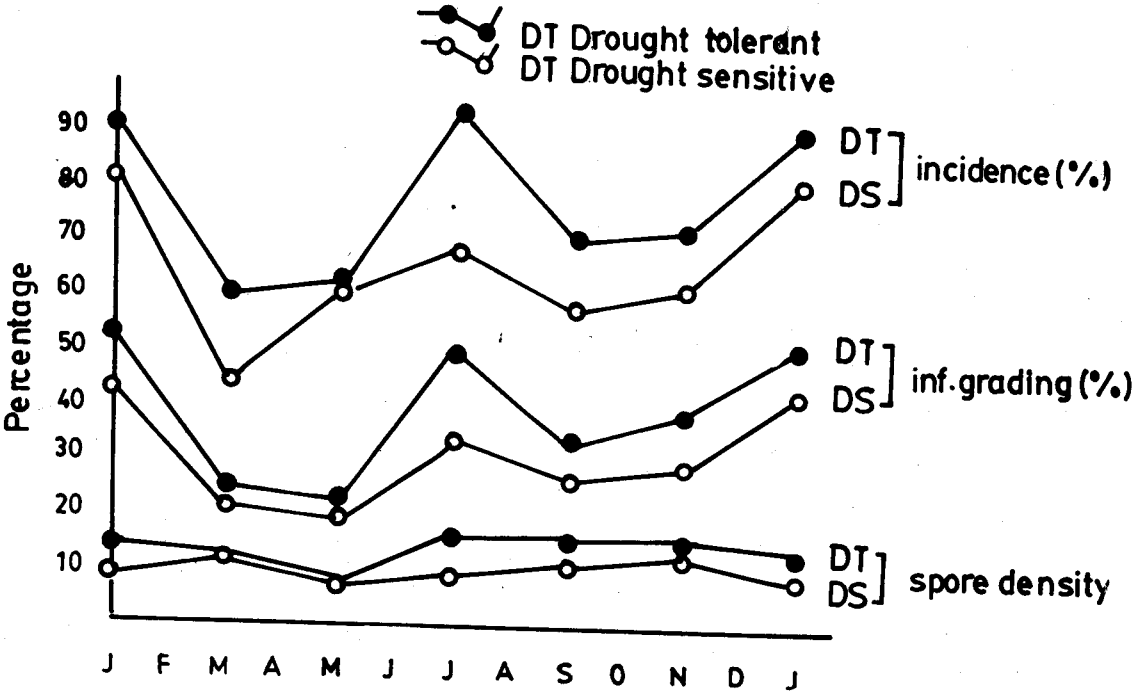

Fig. 1 VAM status of drought tolerant and sensitive accessions of cocoa

parameters were maximum in July in drought tolerant plants while per cent incidence and infection grading were maximum for drought susceptible ones in January. From Fig. 1, it is evident that the trend is similar for both the groups of plants for all the parameters sudied. However, the drought tolerant group had significantly superior VAM status over the susceptible category, a beneficial attribute which helps the host to survive in hostile environments.

Subsequently, the spores collected were

Table I. Prevalence of VAM in the root zone of cocoa

Species of VAM	Drought tolerant		Drought susceptible	
	Number of plants with endophyte	Av. No. of spores/50g soil	Number of plants with endophyte	Av. No. of spores/ 50g soil
Acaulospora laevis	1/5	0.8	0	0
Gigaspora sp	1/5	1.2	2/5	2.6
Glomus clarum	0	0	1/5	1.0
G. fasciculatum	2/5	4.8	1/5	1.6
G. geosporum	0	0	1/5	2.0
G. leptotichum	0	0	1/5	3.6
G. maccrocarpum	1/5	1.2	0	0
G. monosporum	2/5	3.0	1/5	4.0
G. multicaulae	2/5	6.8	3/5	8.6
G. versiforme	4/5	10.4	1/5	1.6
Scutellospora sp.	1/5	0.8	0	0

identified based on Schenck and Perez (1987). A distribution of species is given in Table I. A total of 11 species belonging to four genera were recorded in both groups. *Glomus* spp. was encountered frequently than others. The data reveals that excepting for the predominant presence of *G. versiforme* in the drought tolerant groups, no other fungal species showed any distinct pattern of distibution. It was present in 4 out of 5 drought tolerant accessions. The spore density ranged from 4 to 25, whereas it was recorded in only one accession belonging to the drought susceptible group with a spore density of 8.

The greater prevalence of *G. versiforme* in the drought tolerant group suggests the close association of drought tolerance and occurrence of *G. versiforme*. It is worthwhile to understand the mechanism of drought tolerance induced by VAM infection in cocoa. For this, the culture of *G. versiforme* may be used in further studies to confirm its role in inducing or augmenting drought tolerance in cocoa. Since clonal material from drought tolerance accessions have now been generated and planted in Kidu Seed Farm, this hypothesis can be tested. Once proved successful, mass multiplication and inoculation of this fungus can be attempted right from juvenile stage onwards. In literature there are many reports of the drought alleviation benefit conferred by VAM infection, where they increase the nutrient foraging Zone of the roots, aid in transferring nutrients to the root even at concentrations far below the critical level at which roots can take them (Nelson and Safir, 1982). Thus, the study is relevant in the context of present day crop management.

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