Effect of vesicular-arbuscular mycorrhizal fungi on pineapple [*Ananas comosus* (L.) Merr.] in the Canary Islands.

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EFFECT OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI ON PINEAPPLE [*ANANAS COMOSUS* (L.) MERR.] IN THE CANARY ISLANDS.

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ABSTRACT - The effects of the VAM fungi *Glomus mosseae*, *Glomus fasciculatum* and *Acaulospora* sp. on micropropagated plantlets of pineapple, were studied. Transplant survival percentages were higher for VAM groups, and *G. mosseae* and *G. fasciculatum* in particular showed important increases in biomass production and N.P.K. content.

EFFET DE CHAMPIGNONS MYCORHIZOGENES A VESICULES-ARBUSCULES SUR L'ANANAS [*ANANAS COMOSUS* (L.) MERR.] AUX ILES CANARIES.

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RESUME - Etude de l'effet, sur le développement de plantules micropropagées d'ananas, de trois champignons à l'origine de mycorhizes vésiculaires-arbusculaires (M.V.A.), *Glomus mosseae*, *Glomus fasciculatum* et *Acaulospora* sp. On a obtenu, avec les espèces essayées, un pourcentage de reprise lors de la transplantation plus élevé que chez le témoin.
En outre, ont été enregistrés des accroissements importants de la production de la biomasse ainsi que des teneurs en N, P, K chez les plantes inoculées avec *G. mosseae* et *G. fasciculatum*.

INTRODUCTION

The increasing interest in the agricultural use of mycorrhizal fungi has resulted in intensive research in recent years on the relationship of these fungi to several important food crops (Powell and Bagyaraj, 1984). To date, little attention has been given to their role in tropical crops such as pineapple (Mourichon, 1981 a, b ; Jaizme and Azcón, 1988), a promising alternative to the banana in some localities in the Canary Islands (Galán Sauco *et al.*, 1988).

In order to achieve a better understanding of the pineapple's dependence on endomycorrhizal fungi, greenhouse trials were begun using *in vitro* produced plants and three vesicular-arbuscular mycorrhizal (VAM) fungi.

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MATERIAL AND METHODS

All phases of the trial were carried out in greenhouse, using cv. Smooth Cayenne tissue-cultured plantlets. After rooting in sterile substrate, the plantlets were transferred to individual pots containing 500 g of a 4:1 soil/sand mixture (previously steam-sterilized at 100°C during 1 h for 3 consecutive days) inoculated with a filtrate consisting of the natural microbial population free of Endogonaceae propagules ; the soil used was low in available P (12,7 ppm P Olsen) and had a 7.6 pH.

Inocula of each one of three species of VAM fungi - *Glomus mosseae*, *Glomus fasciculatum* and *Acaulospora* sp. - were placed 5 cm below the soil surface. Inocula were rhizosphere soil from the respective stock cultures, rich in spores and infected root fragments. Control plants were not inoculated. Both inoculated and control plants received 25 ml/pot of a P-free nutritive solution every 15 days (Hewitt, 1966).

After six months, fungal presence on the roots of inocu-

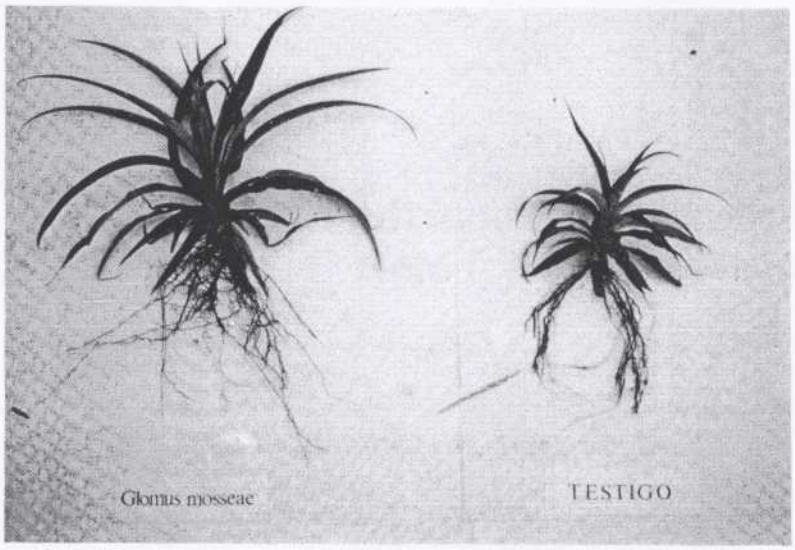

Photo 1 - Development of plants inoculated with *Glomus mosseae* at trial conclusion.

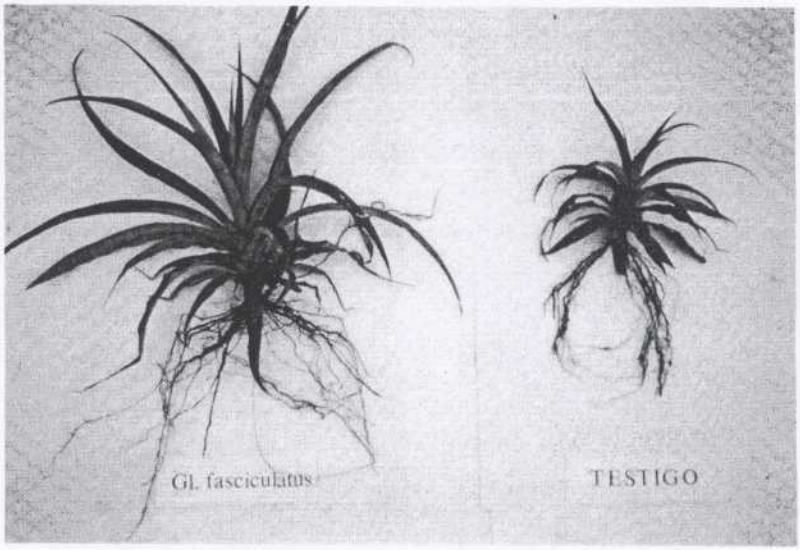

Photo 2 - Development of plants inoculated with *Glomus fasciculatum* at trial conclusion.

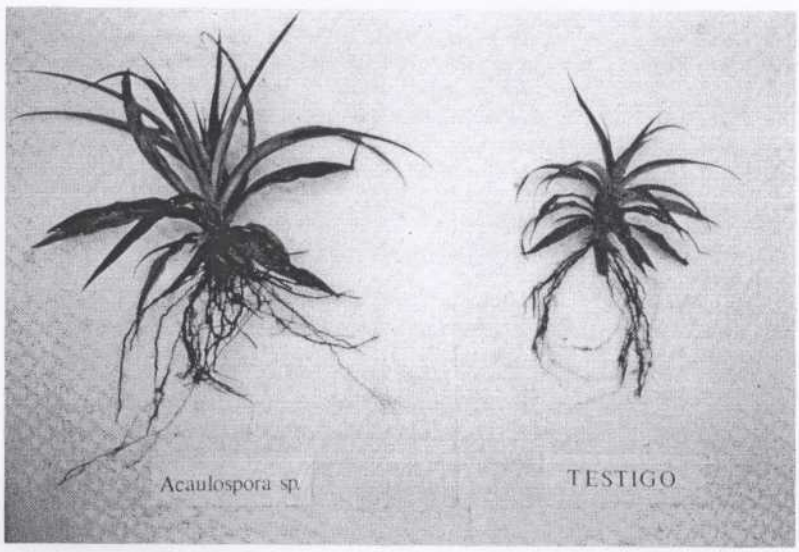

Photo 3 - Development of plants inoculated with *Acaulospora* sp. at trial conclusion.

lated plants was confirmed using a specific coloration (Philipps and Hayman, 1970) and plants were transplanted to 40 l containers (one per treatment) filled with natural untreated soil of the type normally used for pineapple cultivation. Some analytical characteristics of this soil were : pH 8.5, 2% organic matter, 32.6 ppm P, 0.9 meq/l K, 14.4 meq/l Na, 2.1 meq/l Mg, and 2.3 meq/l Ca.

The plants were kept in this soil for 12 months, under normal irrigation but without fertilizers and phytosanitary treatments of any type. On uprooting the following data were recorded to evaluate mycorrhizal association effect : fresh and dry weight of shoots and roots, N, P, K content of shoots, and percentage of mycorrhizal colonization.

RESULTS AND DISCUSSION

Final evaluation showed (Table 1) that the VAM inoculated plants withstood transplanting better than the controls, reaching survival values of 40% in the control block, 100% for *Acaulospora* sp., and 80% for both *G. mosseae* and *G. fasciculatum*. Mycorrhizal inoculation enhanced plant biomass production. Aerial development increases were 55% for *Acaulospora* sp., 142% for *G. fasciculatum* and 148% for *G. mosseae*. *Acaulospora* sp. stimulated root development in 102%, *G. fasciculatum* in 100%, and *G. mosseae* in 78%. Regarding aerial N, P, K contents, results showed (Table 2) that *Acaulospora* sp. gave increases of 39%, 33%, and 74% for these elements : *G. fasciculatum* increased their content in 152%, 241%, and 210% ; and *G. mosseae* in 270%, 133%, and 192%.

The ability of *G. mosseae* to enhance plant nitrogen uptake, is an interesting nutritional and physiological fact which recently has been proved using a isotopic technique (Barea *et al.*, 1987). Data on percentage of VAM root infection (Table 3) suggest that *Acaulospora* sp. and *G. mosseae* colonized roots did not permit further infection by autochthonous endophytes. Natural VAM fungi show a high infective potential but low effectivity ; in contrast, *G. mosseae* was the most effective endophyte tried for pineapple plants, despite its limited level of colonization.

In conclusion, these results show the efficiency of these mycorrhizal-forming species in the survival, development, and nutrition to pineapple plants.

TABLE 1 - Effects of three VAM fungi on shoots and roots weight (g) and survival (%) of pineapple plants grown in non sterile soil.

Myccorhizal treatments	Shoot	Root	Transpl. survival
Control	64.64 b	7.66 a	40 %
G. mosseae	159.59 a	13.65 a	80 %
G. fasciculatum	166.07 a	15.36 a	80 %
Acaulospora sp.	96.82 b	15.51 a	100 %

Means followed by the same letter are not significantly different ($P \leq 0.05$) according to Duncan's Multiple Range Test.

TABLE 2 - N, P, K, shoot nutrient content (mg/plant) in mycorrhizal and non mycorrhizal pineapple plants grown in non sterile soil.

Mycorrhizal treatments	N	P	K
Control	74 b	12 b	245 b
G. mosseae	235 a	25 ab	727 a
G. fasciculatum	180 a	37 a	780 a
Acaulospora sp.	96 b	13 b	436 b

Means followed by the same letter are not significantly different ($P \leq 0.05$) according to Duncan's Multiple Range Test.

TABLE 3 - VAM infection (percentage and total) of micorrhizal pineapple plants

Treatments	Mycorrhizal colonization (%)
Control	59.5
G. mosseae	30.0
G. fasciculatum	65.7
Acaulospora sp.	15.5

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REFERENCES

BAREA (J.M.), AZCÓN AGUILAR (C.) and AZCÓN (R.). 1987.
Vesicular-arbuscular mycorrhiza improve both symbiotic N_2 fixation and N uptake from soil as assessed with a N_{15} technique under field conditions.
New Phytologist, 106, 717-725.

GALÁN SAUCO (V.), CABRERA CABRERA (J.) and RODRIGUEZ PASTOR (C.). 1988.
Cultivo de la piña tropical (*Ananas comosus* L. Merr.) en Canarias. I.- Introducción.
Fruits, 43 (1), 35-42.

HEWITT (E.J.). 1966.
Sand and water culture methods used in the study of plant nutrition.
Tech. Comm. n° 22 (2nd ed. revised), Commonwealth Agric. Bureau, London., 547 p.

JAIZME VEGA (M.C.) and AZCON (R.). 1988.
Effect of VAM fungi on tropical fruit-trees.
Abstract 2nd European Symposium on Mycorrhizae. Prague, Czechoslovakia, August 14-20.

MOURICHON (X.). 1981 a.
Mise en évidence d'une association endomycorhizogène chez l'ananas en Côte d'Ivoire.
Fruits, 36, (12), 745-749.

MOURICHON (X.). 1981 b.
Dynamique saisonnière de l'association endomycorhizogène de l'ananas.
IRFA/CIRAD, R.A. 86, Doc. 9, Thème 5.

PHILLIPS (J.M.) and HAYMAN (D.S.). 1970.
Improved procedures for clearing roots and staining parasitic and vesicular-arbuscular mycorrhizal fungi of rapid assessment of infection.
Trans. Br. Mycol. Soc., 55, 158-161.

POWELL (C.L.I.) and BAGYARAJ (D.J.). 1984.
VA Mycorrhiza.
CRC Press, Florida, 234 p.

EFECTO DE LAS MICORRIZAS VESICULO-ARBUSCULARES SOBRE PINA TROPICAL [*ANANAS COMOSUS* (L.) MERR. EN LAS ISLAS CANARIAS.

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RESUMEN - Se estudia el efecto sobre el desarrollo de plantulas micropropagadas de piña tropical de tres hongos formadores de micorrizas vesiculo-arbusculares (MVA), *Glomus mosseae*, *Glomus fasciculatum* y *Acaulospora* sp., obteniendo con las especies ensayadas un mayor porcentaje de supervivencia en el transplante frente al control, además de importantes incrementos en la producción de biomasa y en el contenido de N, P, K en las plantas inoculadas con *G. mosseae* y *G. fasciculatum*.