Mycorrhizal Associations: Important for Cassava Grown on Soils Low in P

In much of the tropics, especially in Latin America, phosphorus (P) deficiency is the main limiting nutritional factor for cassava. Many trials in Colombia and Brazil have shown that root yields can be doubled, tripled, or quadrupled by P application.

Because of its coarse and poorly branched root system cassava is an inefficient absorber of P, having one of the highest P requirements among all crops, when grown in nutrient solution. However, when grown in P-deficient soils, cassava seems less responsive to P fertilizers than many other crops, and high yields are sometimes obtained without P fertilization. For example, yields of 50 t/ha were achieved in CIAT-Quilichao with only 1.5 ppm available soil P.

This ability to grow well on some low-P soils is due to the association of cassava roots with certain soil fungi, called vesicular-arbuscular (VA) mycorrhiza. These fungi live in symbiosis with cassava, utilizing plant carbohydrates as an energy source, but supplying the plant with some essential nutrients, which are absorbed from the soil by the fungal hyphae and translocated to the roots.

This symbiotic source of supply is particularly important in the case of those nutrients that have little mobility in the soil, such as P, Zn, and Cu. Without mycorrhiza a root can absorb P only from an area about 1-2 mm around each root. For a plant with a sparse root system (such as cassava) much of the "available" soil P remains out of reach of the root system. However, mycorrhizal hyphae can penetrate the soil as far as 7 cm away from the root* and thus, increase tremendously the soil volume that can be exploited for P uptake.

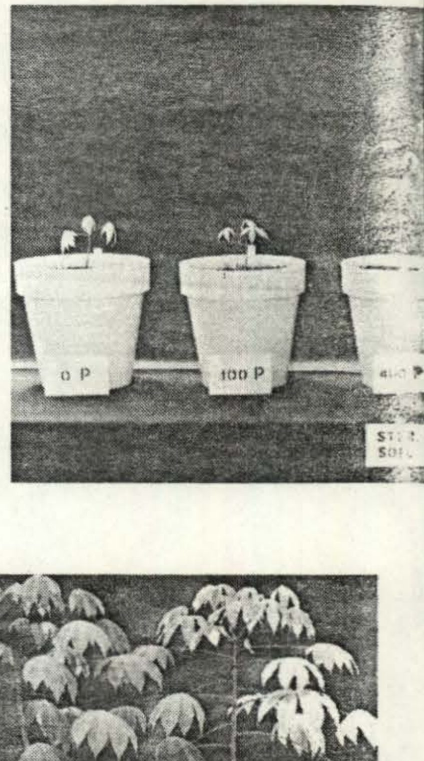
VA mycorrhiza produce hyphae in and around the roots, and form arbuscles and vesicles inside the root cortex. Phosphorus absorbed by the external hyphae of the fungus is released to the plant roots in the arbuscles where interchange of substances between host and fungus occur.

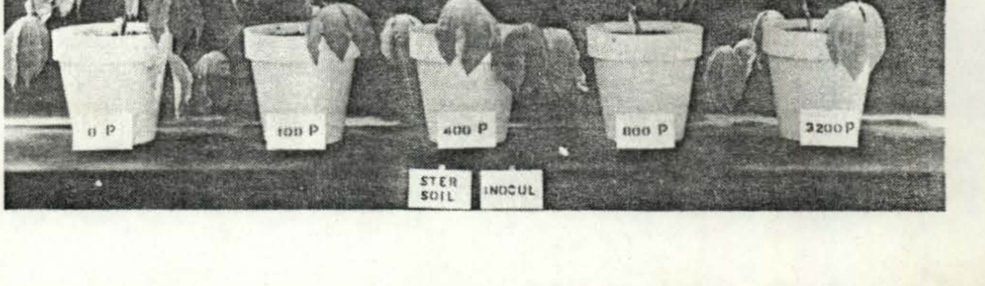
VA mycorrhiza are naturally present in most soils, but large differences in efficiency exist among the 70-odd species that have presently been identified. Some soils may have a low population of VA mycorrhiza or the mycorrhiza present may not be very efficient in absorbing soil phosphorus. Other soils may have a highly efficient mycorrhizal population.

The photos show that when the native mycorrhizal population is eliminated by soil sterilization, cassava needs extremely high P applications for maximum growth. However, if the mycorrhizal association is re-established by inoculation, there is very little response to applied P. This marked response to inoculation in a sterilized soil shows the importance of mycorrhiza in the P nutrition of cassava.

In most natural soils cassava forms an association with the native mycorrhizal strains. For this reason, inoculation with introduced and more efficient strains can only be of practical significance when the introduced strain is well adapted to the conditions in the soil and can compete with native micro-organisms.

Since 1980 the Mycorrhiza Project at CIAT, funded by the German Government (GTZ) and under the leadership of Dr. Ewald Sieverding, has been collecting, purifying, and evaluating the efficiency of large numbers of mycorrhizal strains in





* RHODES, L.H., and GERDEMANN, J.W. 1975. Phosphate uptake zones of mycorrhizal and non-mycorrhizal onions. New Phytologist 75:555-561.

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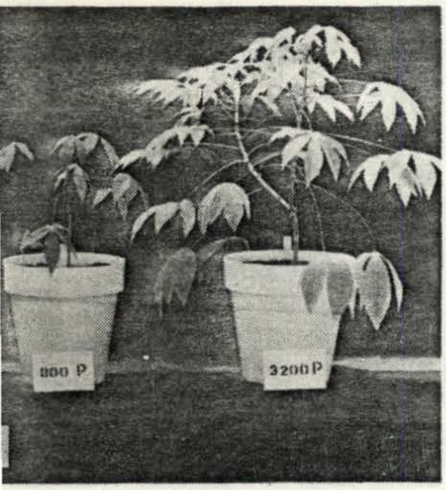
order to identify highly efficient strains for particular soil and climatic conditions. The plant nutrition section of CIAT's Cassava Program has been investigating some of the factors that influence mycorrhizal efficiency, such as use of P fertilizers or fungicides, insecticides, or herbicides. The best methods of inoculum production and inoculum application are also being investigated.

While significant responses to inoculation in field-grown cassava have so far



been obtained only in sterilized soil, it is expected that the use of better strains will make field inoculation in non-sterilized soil an attractive alternative to using high levels of fertilizer P. Even should inoculation prove to be impractical, it is of utmost importance that we appreciate the dependence of cassava on an efficient mycorrhizal association, so that agronomic practices aimed at optimizing the efficiency of the native mycorrhizal population can be implemented. Examples of these practices are rotation, intercropping, use of mulch, as well as limiting the use of chemicals that adversely effect these extremely important soil fungi.

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Thesis Work in Cassava

Rogerio Ramírez T. and **Julio P. Bautista C.** (Undergraduate work) Root diseases caused by *Armillaria* and *Rosellinia* sp. Universidad Técnica de Ambato (Ambato, Ecuador).

Javier Rodríguez B. and **Luis Eduardo Buitrago** (Undergraduate work) Double row planting system in cassava. Universidad Tecnológica de los Llanos (Villavicencio, Meta, Colombia)

Cassava Production Statistics

Cassava, the fourth most important energy staple of the tropics, provides food and income for 750 million people. Total estimated production reached 122 million tons in 1980, with 38% of production in Africa, 36% in Asia, and 26% in America. *(Source, FAO)*

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