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# Growth responses of *Acacia angustissima* to vesicular-arbuscular mycorrhizal inoculation

N. Lucena Costa[1] , V.T. Paulino[2] and T.S. Paulino[3]

[1]EMBRAPA - Amapá, , C.P. 10, Macapá, Amapá, 68902-208, newton@cpafap.embrapa.br

[2]Instituto de Zootecnia, Nova Odessa, SP, Brasil, 13460-000

[3]Student - FAEF, Agronomia, Garça, São Paulo, Brasil.

## Abstract

The response of *Acacia angustissima* to VAM species (*Acaulospora laevis*, *A. muricata*, *Entrophosphora colombiana*, *Glomus mosseae*, *G. fasciculatum*, *G. macrocarpum*, *G. etunicatum*, *Gigaspora margarita*, *G. gigantea* and *Scutellospora heterogama*) was evaluated under greenhouse conditions, in a P-deficient clayey Oxisol of pH 5.5. The soil was sterilized at 110$^{o}$C for one hour each day for three days and reinoculated with a soil microbial suspension free of mycorrhizal fungi spores. The several VAM fungi were effective in increasing DM yield, nodulation, and N and P uptake of *A. angustissima* plants. The most efficient species were *E. colombiana*, *A. muricata*, and *S. heterogama*.

**Keywords:** Dry matter, phosphorus, nitrogen, nodulation, root colonization

## Introduction

Tropical forage legumes growing in natural or cultivated environment normally form vesicular-arbuscular mycorrhiza (VAM), which can increase plant growth and P uptake, especially in soils of low nutrient status. Such responses result from the enhanced ability of infected roots to absorb nutrients (translocation and transfer of phosphate ions from soil solution to the root cells) through an extensive network of external mycelium (Mosse, 1981). However, some variability in the effectiveness of VAM has been described between plant species, within species, and even within cultivars of the same crop species (Estaun et al.

1987). In this study we evaluated the effects of ten VAM species (*Acaulospora laevis*, *A. muricata*, *Entrophosphora colombiana*, *Glomus mosseae*, *G. fasciculatum*, *G. macrocarpum*, *G. etunicatum*, *Gigaspora margarita*, *G. gigantea* and *Scutellospora heterogama*).

## Material and Methods

The trial was performed under greenhouse conditions using samples from a P-deficient (2 mg/kg available P by $NH_4F$ + HCl extraction) clayey Oxisol of pH 5.5. A randomized complete block design was utilized, with four replications. The soil was sterilized at 110°C for one hour each day for three days and reinoculated with a soil microbial suspension free of mycorrhizal fungi spores. Each experimental unit was represented by a pot with a 3.0 kg dry soil capacity. No fertilizer was applied. Seeds for sowing were inoculated with specific *Rhizobium* (cowpea group). Hydric control was achieved daily by weighing the pots and keeping soil at 80% field moisture capacity. Six days after emergence, seedlings were thinned to three plants per pot. A hundred and twenty days after thinning, the plants were cut at soil level and oven dried at 65°C for 72 hours. N and P concentrations of above-ground dry matter (DM) were determined. The nodules were detached from the roots, cleaned, oven dried at 65°C for 72 hours, counted, and weighted. VAM root colonization was determined by the gridline intersect method (Giovannetti and Mosse 1980) after clearing roots segments with KOH and staining them with trypan blue (Phillips and Hayman 1970). The data were subjected to analysis of variance and Duncan's multiple range test.

## Results

Species of VAM differed in their effectiveness to enhance growth of *A. angustissima* (Table 1). The fungi more effective in increasing DM yields were *E. colombiana*, *A. muricata*, and *S. heterogama*, which provided increases in the order of 289, 254, and 198%, respectively, in relation to the control. Several reports show the great variation in the

efficiency of the fungi in relation to the host plants (Lopes et al. 1983, Kwo and Huang, 1982, Costa et al. 1991). Jensen (1984) concluded that responsiveness to VAM inoculation differs among plant species and that variability occurs among isolates of the same species.

Mycorrhizal inoculation had a significant positive effect on nodulation (number and weight of nodules) and N content and uptake by *A. angustissima* plants compared with the noninoculated control. The highest nodulation was recorded by *A. muricata*, *E. colombiana*, and *S. heterogama*. VAM are recorded to have important effects on nodulation and N-fixation in forage legumes. Greater N uptake may also stimulate mycorrhizal infection because more fine roots become available for colonization by the obligate simbionte (Daft and El-Giahmi, 1976). In relation to N content, the fungi most effective were *A. laevis* and *G. fasciculatum*. However, plants inoculated with *E. colombiana* and *A. muricata* recorded higher N uptake. According to Munns and Mosse (1980), the principal effect of VAM on nodulation and N uptake is undoubtedly P-mediation, but it is also known to aid other processes involved in nodulation and N fixation such as supply of photosynthate, trace elements, or plant hormones. VAM inoculation significantly increased P concentration. The fungi more effective were *G. fasciculatum*, *G. etunicatum*, *G. gigantea*, and *G. macrocarpum*. In relation to P uptake, the highest values were observed with the inoculation of *E. colombiana* and *A. muricata*.

The percentage of root VAM infection ranged from 47 to 86%. Plants inoculated with *G. etunicatum* and *E. colombiana* recorded the highest levels of root infection. The physiological basis for the inhibition of VAM colonization is not well understood. Menge (1978) showed evidences that it is the concentration of P in the plant tissue that is responsible for inhibition of VAM infection and sporulation. However, Mosse (1972) observed that a correlation between the amount of roots colonized by the fungus and its efficiency does not always exist.

This report showed that several VAM fungi were effective in increasing DM yield, nodulation, and N and P uptake of *A. angustissima* plants. The most efficient species were *E. colombiana*, *A. muricata*, and *S. heterogama*.

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**Table 1 -** Effect of VAM inoculation on dry matter (DM) yield, N and P contents, and uptake, nodulation, and VAM infection of *Acacia angustissima*.

| Treatments | DM yield | Nitrogen | | Phosphorus | | Nodulation | | VAM |
|---|---|---|---|---|---|---|---|---|
| | g/pot | % | mg/pot | % | mg/pot | number[1] | dry wt mg/pot | Infection % |
| Control | 4.08 f | 3.45 a | 140.7 e | 0.142 f | 5.8 f | 12.3g | 0.75 g | --- |
| *Acaulospora laevis* | 7.37 cde | 3.54 a | 260.9 bc | 0.185 bcd | 13.6 de | 17.6 ef | 1.09 f | 65 cd |
| *A. muricata* | 14.44 ab | 2.78 de | 401.4 a | 0.174 de | 25.1 abc | 27.2 a | 1.71 a | 74 bc |
| *Entrophosphora colombiana* | 15.87 a | 2.83 cde | 449.1 a | 0.170 e | 26.9 a | 25.9 ab | 1.61 ab | 79 ab |
| *Glomus mosseae* | 6.14 e | 3.10 b | 190.3 cde | 0.192 ab | 11.8 de | 16.5 f | 1.01 ef | 47 f |
| *G. macrocarpum* | 6.89 de | 2.95 bcd | 203.2 cde | 0.188 bc | 12.9 de | 20.0 de | 1.26 de | 51 ef |
| *G. etunicatum* | 7.35 cde | 3.02 bc | 221.9 cd | 0.197 ab | 14.5 cde | 18.1 ef | 1.18 def | 86 a |
| *G. fasciculatum* | 5.49 ef | 3.35 a | 183.9 de | 0.204 a | 11.2 e | 22.4 c | 1.37 cd | 59 de |
| *Gigaspora margarita* | 8.59 cd | 2.80 de | 240.5 cd | 0.179 cde | 15.4 cd | 19.2 def | 1.21 de | 60 de |
| *G. gigantea* | 9.22 c | 2.65 e | 244.3 cd | 0.194 ab | 17.9 c | 21.7 cd | 1.27 de | 53 ef |
| *Scutellospora heterogama* | 12.16 b | 2.71 e | 329.5 b | 0.186 bcd | 22.6 b | 23.5 bc | 1.48 bc | 55 ef |

Means followed by the same letter in each column are not significantly different at the 5% level of probability by Duncan test

[1]Values analyzed after square root of (x + 1) transformation