



University of Kentucky
UKnowledge

International Grassland Congress Proceedings

XIX International Grassland Congress

Growth Responses of *Acacia angustissima* to Vesicular- Arbuscular Mycorrhizal Inoculation

N. Lucena Costa
EMBRAPA, Brazil

Valdinei T. Paulino
Instituto de Zootecnia, Brazil

T. S. Paulino
Faculdade de Ensino Superior e Formação Integral, Brazil

Follow this and additional works at: <https://uknowledge.uky.edu/igc>



Part of the [Plant Sciences Commons](#), and the [Soil Science Commons](#)

This document is available at <https://uknowledge.uky.edu/igc/19/4/33>

This collection is currently under construction.

The XIX International Grassland Congress took place in São Pedro, São Paulo, Brazil from February 11 through February 21, 2001.

Proceedings published by Fundacao de Estudos Agrarios Luiz de Queiroz

This Event is brought to you for free and open access by the Plant and Soil Sciences at UKnowledge. It has been accepted for inclusion in International Grassland Congress Proceedings by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

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

N. Lucena Costa¹, V.T. Paulino² and T.S. Paulino³

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

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

³Student - 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°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 $\text{NH}_4\text{F} + \text{HCl}$ 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 symbionte (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*.

References

- Costa, N. de L.; V.T. Paulino, E.A. Veasey and F. das C. Leônidas.** (1991). Growth responses of leucaena to vesicular-arbuscular mycorrhizal inoculation. *Leuc. Res. Rep.* **12**:12-13.
- Daft, M.I. and A.A. El-Giahmi.** (1976). Effect of vesicular-arbuscular mycorrhiza on plant growth. VII. Effect of defoliation and light on selected host. *New Phytologist*, **80**:365-372.
- Estaun, V.; C. Calvet and D.S. Hayman.** (1987). Influence of plant genotype on mycorrhizal infection: Response of three pea cultivars. *Plant and Soil*, **103**:295-298.
- Giovannetti, M. and B. Mosse.** (1980). An evaluation of technique for measuring vesicular-arbuscular mycorrhizal infection in roots. *New Phytologist*, **84**:489-500.
- Jensen, A.** (1984). Response of barley, pea, and maize to inoculation with different vesicular-arbuscular mycorrhizal fungi in irradiated soil. *Plant and Soil*, **78**:315-323.
- Kwo, C.G. and R.S. Huang.** (1982). Effect of vesicular-arbuscular mycorrhizae on the growth and yield of rice-stubble cultured soybean. *Plant and Soil*, **64**:325-330.
- Lopes, E.S.; E. Oliveira, A.M.L. Neptune and F.R.P. Moraes.** (1983). Efeito da inoculação do cafeeiro com diferentes espécies de fungos micorrízicos vesículo-arbusculares. *Rev. Bras. Ci. Solo*, **7**:137-141.
- Menge, J.A.; D. Steirle; D.J. Bagyaraj; E.L.V. Johnson and R.T. Leonard.** (1978). Phosphorus concentration in plants responsible for inhibition of mycorrhiza infection. *New Phytologist*, **80**:575-578.

- Mosse, B.** (1972). The influence of soil type and *Endogone* strain on the growth of mycorrhizal plants in phosphate deficient soils. *Ver. Ecol. Biol.*, **9**:529-537.
- Mosse, B.** (1981). Vesicular-arbuscular mycorrhiza research for tropical agriculture. Hawaii Institute of Trop. Agric. and Human Resources. Univ. of Hawaii Res. Bull., n° 194. 82p.
- Munns, D.N. and B. Mosse.** (1980). Mineral nutrition of legumes crops. In: Summerfield, R.J. and A.H. Bunting (eds.) *Advances in legumes science*. Reading, UK. University of Reading Press. p.115-125.
- Phillips, J.M. and D.S. Hayman.** (1970). Improved procedures for clearing and staining parasitic and vesicular-arbuscular mycorrhizal fungi for rapid assessment of infection. *Trans. Brit. Mycol. Soc.*, **55**:158-161.

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

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