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Comparative effects of *Glomus mosseae* and P fertilizer on foliar mineral composition of *Acacia senegal* seedlings inoculated with *Rhizobium*

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Summary. A factorial experiment with two controlled factors was conducted in the greenhouse with *Acacia senegal* seedlings. The substrate was a degraded sandy soil (Dior soil) poor in available P (11 ppm - Olsen). The first controlled factor was soil sterilization, with two levels: (A) sterilized soil; (B) non-sterilized soil. The second factor was fertilization, with six levels: (1) uninoculated control; (2) inoculation with *Rhizobium* (ORS 1007); (3) inoculation with *Glomus mosseae*; (4) double inoculation with ORS 1007 and *G. mosseae*; (5) inoculation with ORS 1007 and 30 ppm phosphorus per plant; (6) inoculation with ORS 1007 and 60 ppm phosphours. The combination of the two factors and their levels led to 12 different plant treatments (A1–A6 and B1–B6). Compared to the control B1, the B5 and B6 treatments containing phosphorus increased: nodule dry weight about 7 times; leaf dry weight about 4 times; total N, P and Mg 4–5 times; total K and Ca 3–4 times. The mycorrhizal inoculation had the same positive effect on plant growth and mineral composition but with

sulting in the decline of natural populations of this species. It is necessary to work for the reconstitution of the plant cover of the area and, among other leguminous woody perennials, *A. senegal* could play a major role in reforestation programmes and in agroforestry ecosystems.

In this regard, deeper knowledge is required of the physiology, mineral supply and nitrogen-fixing symbiosis of this tree. This paper deals with the effects of different biological and mineral treatments on the growth and leaf mineral composition of *A. senegal*. Treatments included *Rhizobium* inoculation, *Glomus mosseae* inoculation and phosphorus fertilization.

Materials and methods

Seeds of *A. senegal* were soaked in concentrated sulphuric acid for 14 min, rinsed in sterilized water, pre-germinated in sterilized vermiculite and then transferred to polyethylene bags. Each bag

Table 1. Global effects of soil sterilization (F1) and soil fertilization (F2) on leaf dry weight, leaf mineral mass and mineral contents of *Acacia senegal* seedlings cultivated on "Dior" soil. Means within columns with the same letter are not significantly different ($P=0.05$) by the Newman-Keuls test

	Leaf dry weight[a] mg	Leaf mineral mass[a] and mineral contents (% dry wt.)									
		N		P		K		Ca		Mg	
		mg	%	mg	%	mg	%	mg	%	mg	%
F1: "Soil sterilization" factor											
A – Sterilized soil	1419	52.19 b	3.59 b	2.45 b	0.16 b	17.54 b	1.28 b	39.90	2.83	4.67	0.31 a
B – Non-sterilized soil	1559	61.15 a	3.88 a	2.78 a	0.18 a	22.66 a	1.53 a	35.79	2.43	4.00	0.26 b
F2: "Fertilization" factor											
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

should be comparable to those of treatment A4, which also contains rhizobia and endomycorrhizers. However, the results were in fact consistently inferior for B1 than A4. This indicates that the indigenous symbionts were not well adapted to the plant or that the populations of indigenous microbes suffer from the unfavourable climatic conditions of heat and drought. Even if the plant growth was not yet maximized (leaf dry weight = 573 mg), the leaf nitrogen content (3.5%) here was the lowest observed for the non-sterilized soil treatments. This may indicate an insufficient nitrogen supply due to poor absorption or fixation.

Compared to the "natural conditions" control (B1), the treatment B2 with *Rhizobium* caused the doubling of all the parameters measured (Table 2). Treatment B3 introduced *G. mosseae* inoculum into non-sterilized soil [illegible]

contents tended to be higher in sterilized soil than in non-sterilized soil; the opposite was true for the K content. This fact needs further investigation. The leaf mineral content ranged from 20% to 30%.

Our results show that it would be useless to create performant symbionts by selecting different partners (plant, bacteria, endomycorrhiza) if their new potentialities can not be expressed in the natural environment. In this regard, it is advisable to determine the physiological conditions for optimum functioning and to identify the limiting factors of the environment. Here, the principal limiting factor was the P concentration of the soil. Dual inoculation and the action of endomycorrhizae may partially reduce this deficiency but P fertilization together with rhizobial inoculation was the most efficient treatment.

[illegible]