SESBANIA ROSTRATA AS A GREEN MANURE FOR RICE IN WEST AFRICA

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Summary

We compared the effect of four treatments upon the yield and nitrogen (N) content of rice grown in 1 m^2 irrigated microplots: PK fertilization + inoculated *Sesbania rostrata* plowed in as green manure; PK fertilization + uninoculated *Sesbania rostrata* plowed in as green manure; PK fertilization + ammonium sulphate (60 kg N/ha); and PK fertilization alone (control). The effects of the first two treatments were not significantly different from each other. Both treatments dramatically increased grain and straw yield compared to the control and significantly increased the N content of both grain and straw.

INTRODUCTION

Nitrogen (N) inputs into rice fields can be increased by the cultivation of a green manure crop in rotation with, or intercropped with, the rice. This has already been done with winter vetch in California, and with *Astragalus sinicus* and the N_2-fixing nonlegume *Coriaria sinica* in Japan, Korea, and China (Watanabe & App, 1979; I. Watanabe, personal communication), as well as with *Sesbania cannabina* and *S. paludosa* in Vietnam and other Asian countries (D.T. Tuan, personal communication).

Recently Dreyfus & Dommergues (1981a) reported that *Sesbania rostrata*, a tropical legume colonizing waterlogged soils in the Senegal Valley, forms N_2-fixing nodules with *Rhizobium* on both the roots and the stem. Due to its profuse stem nodulation, this plant has five to ten times more nodules than most nodulated crop plants. Moreover, and because of its stem nodulation, *S. rostrata* could fix N_2 even when the N content of the nutrient medium was high (Dreyfus & Dommergues, 1980).

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This paper reports an experiment to determine the effect of *S. rostrata* as a green manure on yield and N uptake of rice.

MATERIALS AND METHODS

The experiments were carried out on microplots, each 1 m² (see Figure 1), during the rainy season at the ORSTOM Bel-Air Station in Dakar, Senegal. Soil characteristics are shown in Table 1. Twelve microplots were sown with *Sesbania rostrata* (seeds had been pre-treated in H_2SO_4 for 30 min.) on June 19, 1980; then later thinned to only 40 seedlings per microplot. All seedlings were treated with an insecticide, Curacron (Ciba-Geigy S.A.), to avoid insect attacks.

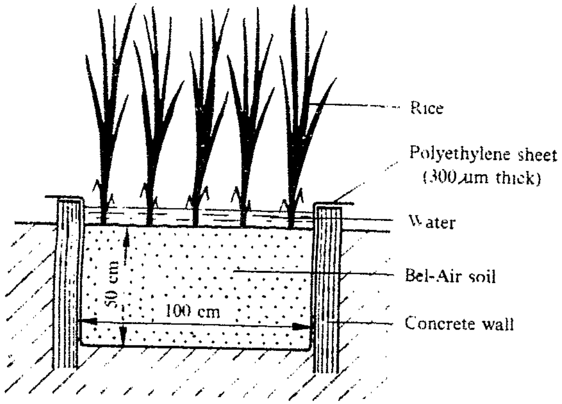

Figure 1: Section of a microplot. Each plot contained 560 kg homogenized Bel-Air soil.

Plants in 6 of the 12 microplots were inoculated by spraying the stems with a 2-day-old culture of the ORS 551 strain (Dreyfus & Dommergues, 1981b) on July 10 and 19. The remaining plots were not inoculated, but progressively developed stem nodules, indicating either native soil rhizobia or cross-contamination. A further 12 microplots were kept in bare fallow. All microplots were kept waterlogged until August 4.

On August 11, when the *Sesbania rostrata* plants were about 1.5 m tall, their stems were cut just above the soil; then chopped in 10 cm pieces and incorporated in the 0-30 cm horizon. All the plots were unirrigated until August 30, when 2-week-old rice (*Oryza sativa*) seedlings cv. Moroberekan were planted, with 25 hills per microplot. All microplots were then broadcast fertilized with K_2HPO_4, 17.44 g/m² and six plots received $(NH_4)_2SO_4$, 28.32 g/m². At this stage all the plots were waterlogged again. The rice was harvested on December 29-30, when it was 120 days old (excluding the seedling stage in the nursery). The straw and grains were weighed, and the water content determined after drying at 65°C until a constant weight was obtained. N content was estimated using the Kjeldahl method.

TABLE 1: Characteristics of Bel-Air soil.[1]

pH (KCl, N)	7.0
Total C	0.4
Total N	0.025
Total P	0.037
Clay (0-2 µm)	3.8
Loam (2-50 µm)	2.1
Fine sand (50-200 µm)	48.4
Coarse sand (200-2000 µm)	44.5

[1] Ustropept.

RESULTS AND DISCUSSION

Microplots that had received *Sesbania rostrata* green manure yielded more than double the control plots and significantly more than microplots receiving the equivalent of 60 kg N/ha (see Table 2). The effect of stem inoculation was not significant, presumably because of the natural nodulation of uninoculated plants. The N content of the grain and straw of rice plants green manured with *S. rostrata* was significantly higher than that of control or +N plots. Thus, green manured rice contained four times the total N of control plots supplied only K_2HPO_4, and twice that of plots receiving 60 kg N/ha equivalent.

If we assume that an extrapolation to the field of the data reported here is valid, we can conclude that the use of *Sesbania rostrata* as green manure would allow us to obtain yields of rice grain as high as 6.0 t/ha in a soil with a lower-than-average fertility. However, more investigations are needed, especially in the field, to determine the best management practices, especially the timing for seeding and for plowing in *Sesbania rostrata* stems; the delay between plowing in *Sesbania rostrata* stems and rice planting; and the economic feasibility at the farmer's level.

Soil analyses are underway. These should allow us to establish a precise nitrogen balance, which will probably generate other useful information on the effect of *Sesbania rostrata* green manure on the soil nitrogen status in rice fields.

TABLE 2: Influence of *Sesbania rostrata* green manure on the yield and total N content of rice.[1]

Plot numbers	Treatments	Average dry yield (g/m^2)		N content (%)		Average N yield ($g\ N/m^2$)		
		Grain	Straw	Grain	Straw	Grain	Straw	Total
1 to 6	PK +green manure, inoculated	596 a	772 a	1.80 a	0.94 a	10.73 a	7.44 a	18.17
7 to 12	PK +green manure, uninoculated	571 a	762 a	1.73 a	0.98 a	9.90 a	6.92 a	16.82
13 to 18	PK +$(NH_4)_2SO_4$ (60 kg N/ha)	381 b	484 b	1.27 b	0.49 b	4.83 b	2.38 b	7.21
18 to 24	PK (control)	212 c	276 c	1.14 b	0.58 b	2.42 c	1.60 c	4.02

[1]Figures followed by the same letter do not significantly differ, P = 0.01.

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Biological Nitrogen Fixation Technology for Tropical Agriculture

Based on papers presented at a
workshop held at the
Centro Internacional de Agricultura Tropical
March 9-13, 1981

Edited by

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1982

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