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PRELIMINARY STUDIES ON FOUR NITROGEN FIXING TREES
FROM SENECALESE SOILS

par

Ousmane DIAGNE et Mamadou GUEYE

Micr obiol ogi es à l'Institut Sénégalais
de Rec:herches Agricoles BP. 3120 Dakar

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PRELIMINARY ON FOUR NITROGEN FIXING TREES
FROM SENEGALESE SOILS

O. DIAGNE¹ and M. GUEYE²

(1) : ORSTOM Laboratoire de Microbiologie BP. 1386 Dakar (Sénégal)

(2) : MIRCEN/CNRA BP. 53 Bambey (Senegal)

SUMMARY

Because of the destruction of forests for agricultural needs, there is a continuous degradation of soils. To reforest these soils, it is necessary to use trees that can thrive in wasted soils, fortunately such trees exist : they are Nitrogen Fixing Trees (NFT).

We studied four species of NFT : Prosopis africana, Prosopis juliflora, Albizia lebeck and Leucaena leucocephala.

Prosopis africana and Albizia lebeck were well nodulated in South Senegal soils whereas Prosopis juliflora and Leucaena leucocephala were not nodulated in this area.

Rhizobium strains were isolated from those NFT species and their host spectrum was determined. Nitrogen fixation was estimated in the laboratory by measuring of the shoot and nodules dry weight and shoot total N content.

The four NFT species studied fell into two categories :

- 1) NFT for which nitrogen fixation could significantly be increased by inoculation with the strains we had isolated : Prosopis africana and Albizia lebeck; Rhizobium strains Al₁₀ and Pa₇, were most effective strains on Prosopis africana and Albizia lebeck.
- 2) NFT for which nitrogen fixation could not significantly be increased by inoculation with our strains : Prosopis juliflora and Leucaena leucocephala. The reason of this failure is probably that strains native to Senegalese soils were not effective on Prosopis juliflora and Leucaena leucocephala.

1. INTRODUCTION

Our first objective was to study the nodulation of four Nitrogen Fixing Trees (NFT), Prosopis africana, Prosopis juliflora, Albizia lebbek and Leucaena leucocephala, then to isolate Rhizobium strains from these NFT and finally to estimate nitrogen fixation in the laboratory.

2. MATERIALS AND METHODS

For isolating Rhizobium strains from the five different soils we studied (table 1), we planted germinated seeds of the four species in plastic 24 x 11 cm pouches filled up with the different soils. The seeds had been sterilized by immersion in concentrated sulfuric acid (table 2), a treatment which was also necessary to allow the germination (chemical scarification).

The experiment were conducted with three seedlings per pouche for the four NFT and fifteen replicates per treatment. Rhizobium were isolated from the nodules that appeared after 55 days. Isolates were plated in Petri dishes containing the routine YEMA medium (VINCENT, 1970).

Infection plant tests were carried out in GIBSON tube (1963) containing agar JENSEN medium (1942). Seedlings were inoculated with a 7-day-old culture of the isolated Rhizobium strains and the ORS 911 and CB 756 Rhizobium as reference strains.

Nitrogen fixation was estimated by difference between the total N content of non inoculated and inoculated plants. In addition, nodules and shoots were weighted after being oven dried.

3. RESULTS

3.1. Modulation of the NFT

Prosopis africana and Albizia lebbek nodulated in all soils used. The number of nodules was higher in Dabo soil. Prosopis juliflora and Leucaena leucocephala did not nodulate in any soil (table 3).

3.2. Isolation of Rhizobium strains and study of their host range

Ten strains were isolated, all of them from Prosopis africana

Prosopis africana and Albizia lebbek and most of them were effective on both hosts. Only two of these strains (Pa1 from Prosopis africana and Al6 from Albizia lebbek) were able to effectively nodulate Leucaena leucocephala. None of the ten strains isolated was able to nodulate Prosopis juliflora.

Interestingly ORS 911 (isolated from Acacia farnasiana) was able to nodulate Leucaena leucocaphala (table 4). The effectivity of the strains was determined only with Prosopis africana and Albizia lebbek, the best strains being Al10 and Pa7 (Fig. 1, 2, 3).

CONCLUSION

Our preliminary investigations of the four species of NFT showed that these species fell into two inoculation groups according to the Rhizobium that nodulated them : the first group including prosopis africana and Albizia labbeck which nodulated readily with Rhizobium strains distributed in the five senegalese soils studied (which are probably ubiquitous strains) . Interestingly, some of the Rhizobium strains were fast growing, other were slow growing, the two categories of Rhizobia. There was no relation between the efficiency of these strains and their growth rate.

The second group including Prosopis juliflora and Leucaena leucocephala which did not nodulated with the native Rhizobium strains from these soils, which suggest that the Rhizobium requirements of Prosopis juliflora and Leucaena leucocephala are more specific than the ones of the first group. It appears necessary to initiate investigations in that field.

Table 1 - Characteristics of South Senegal soils

Soils	Clay %	Fine Loam %	Coarse Loam %	Fine Sand %	Coarse sand %	Organic matter %	pH KCl
Diouloulou	6,9	6,3	1,6	52,2	32,7	1,3	4,0
Djibélor	9,1	6,8	3,5	43,4	36,5	1,3	4,5
Bayottes	11,8	5,3	3,3	52,0	27,3	1,8	4,3
Dabo	10,2	6,3	4,8	29,8	47,3	1,5	4,8
Botou	13,1	17,5	9,3	31,9	27,4	1,3	4,9

Sols	C %	N %	P ₂ O ₅ assimilable
Diouloulou	7,4	0,50	0,012
Djibélor	7,4	0,5°	° 017
Bayottes	10,7	0,6°	0,01°
Dabo	8,9	0,5°	0,012
Botou	7,4	0,53	0,010

Table 2 - Sterilization of the seeds and germination test.

NFT species	Duration of sterilization (mn)	Duration of immersion in H ₂ O (mn)	Duration of seeds germination (h)		Percentage of germination
			on agar	on sand	
<i>Prosopis africana</i>	120	120	48	72	40 to 60
<i>Prosopis juliflora</i>	15	60	24	48	90 to 95
<i>Albizia lebbek</i>	60	60	24	48	90 to 95
<i>Leucaena leucocephala</i>	30	60	24	48	80 to 100

Table 3 - Nodulation of four NFT in five senegalese soils

Plante piège	DIO		DJI		S		DAB		BOT	
	ants dula	Nod /pl	Plants nodula	N p nt	Plants nodula	N p nt	ants dula	Nod d/pla	ants dula	Nod d/p
Prosopis africana	8 (15)	3,12	1° (15)	1,1°	14 (15)	2,21	15 (15)	4,00	12 (15)	3,40
Prosopis juliflora	0 (15)	0,00	0 (15)	0,0°	0 (15)	0,00	0 (15)	0,0°	0 (15)	0,00
Albizia lebbeck	12 (15)	1,75	1° (15)	1,3°	12 (15)	3,33	15 (15)	4,6°	12 (15)	3,08
Leucaena leucocephala	0 (15)	0,00	0 (15)	0,0°	0 (15)	0,0°	0 (15)	0,0°	0 (15)	0,00

Table 4 - Host spectrum of ten Rhizobium strains isolated
From prosopis africana and Albizia lebbeck.

<u>Straine</u> <u>tested</u>	<u>Growth</u> <u>rate</u>	<u>prosopis</u> <u>africana</u>	<u>Albizia</u> <u>lebbeck</u>	<u>Leucaena</u> <u>leucocephala</u>	<u>Prosopis</u> <u>juliflora</u>
pa ₁	fast	E	E	E	n.i.
pa ₃	fast	e	E	e	n.i.
pa ₅	slow	E	E	n.i.	n.i.
pa ₇	slow	E	E	n.i.	n.i.
pa ₉	slow	E	E	n.i.	n.i.
Al ₂	fast	E	e	e	e
Al ₄	fast	E	E	E	n.i.
Al ₆	slow	E	E	n.i.	n.i.
Al ₈	slow	E	E	n.i.	e
Al ₁₀	fast	E	E	n.i.	n.i.
ORS 911	fast	E	E	E	e
CB7 56	slow	*	e	n.i.	n.i.

E = effective ; e = ineffective ; n.i. = non infective

* = Plants of this treatment were contaminated.

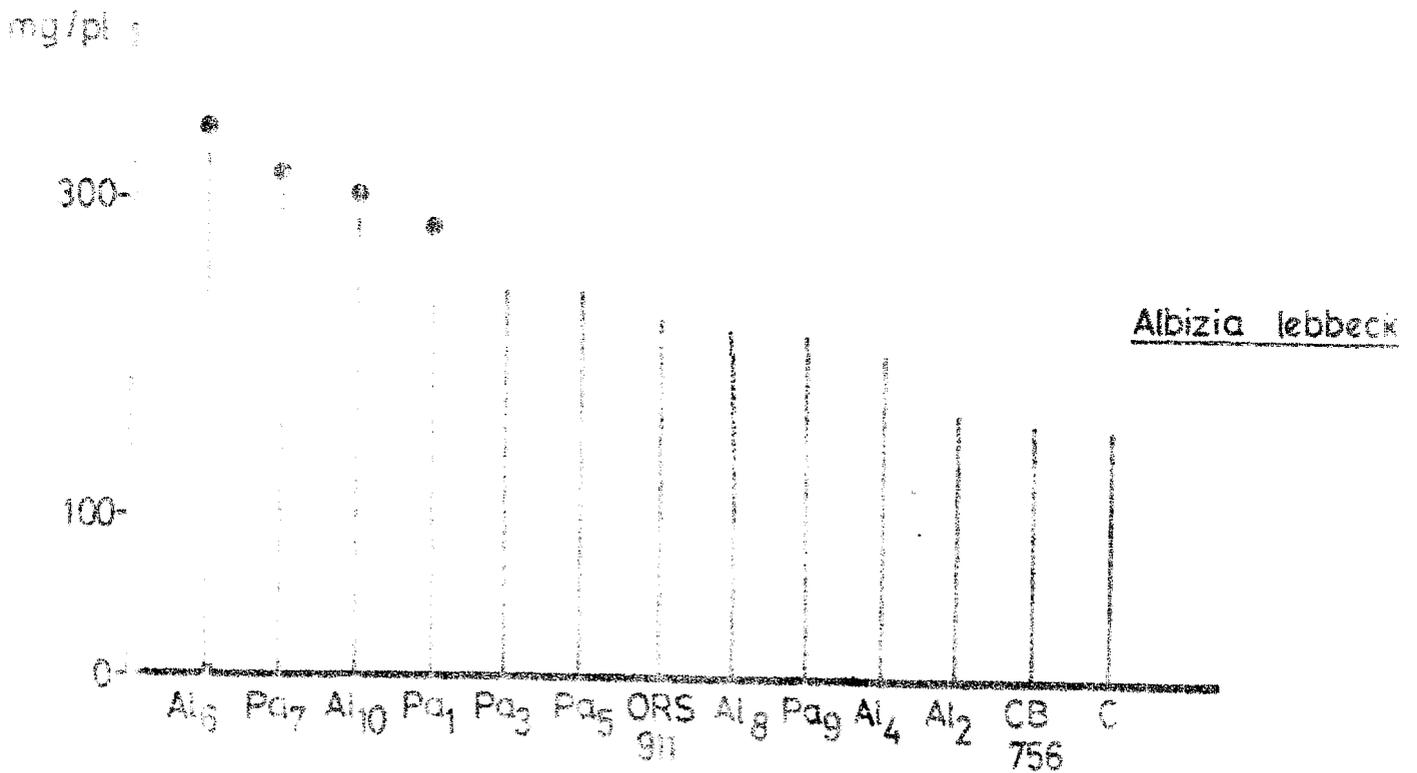
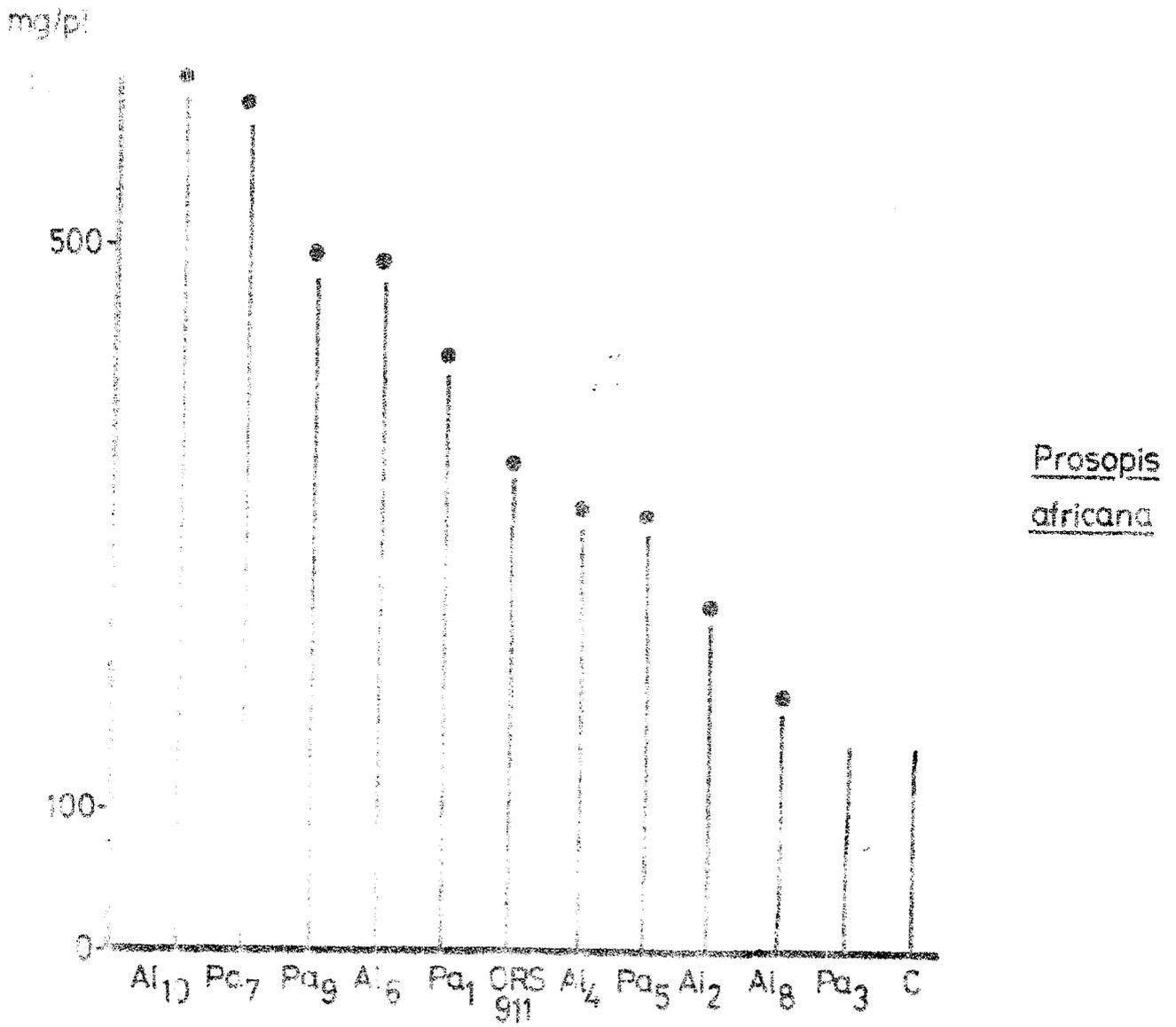


FIG. 1 Shoot dry weight of P. africana and A. lebeck

• These treatments were significantly different from control (C)

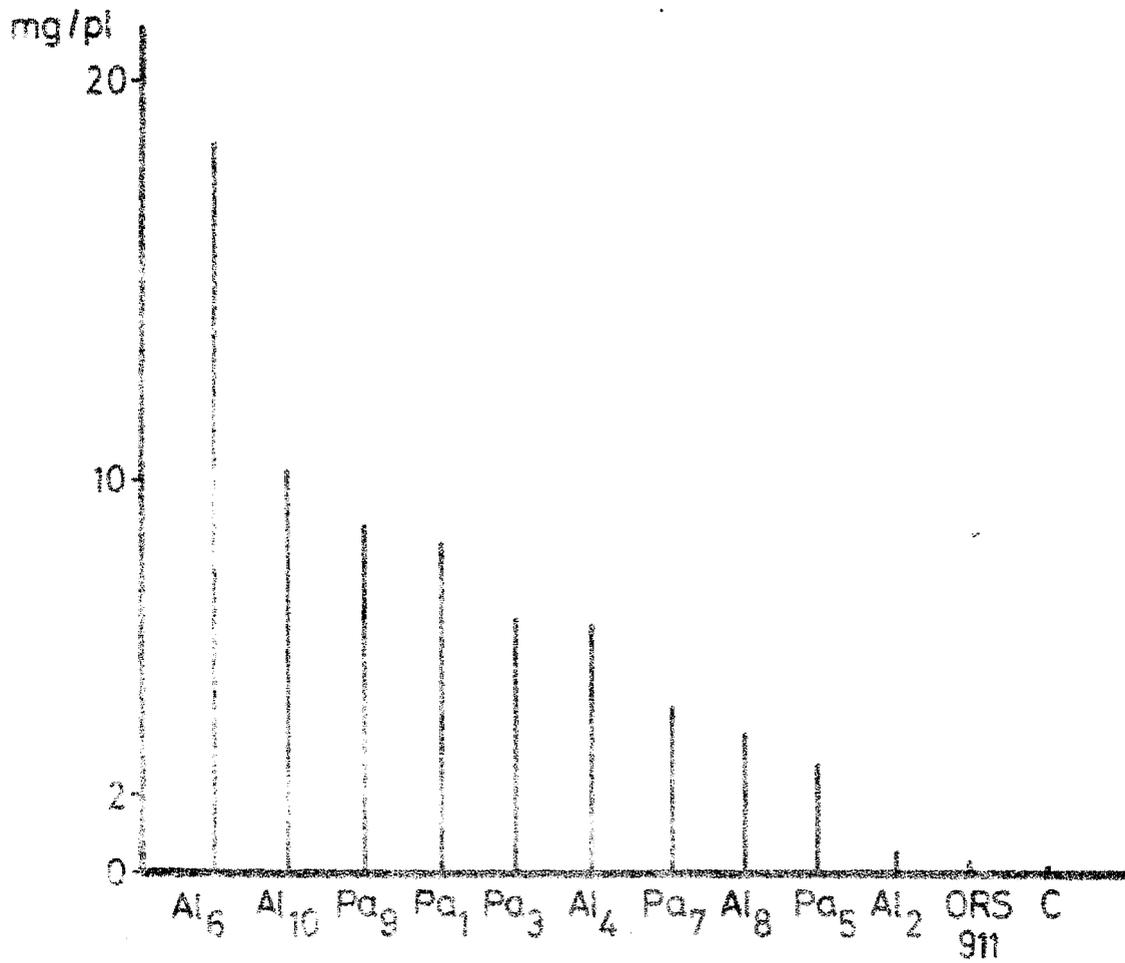


Fig 2A Nodules dry weight of P. africana

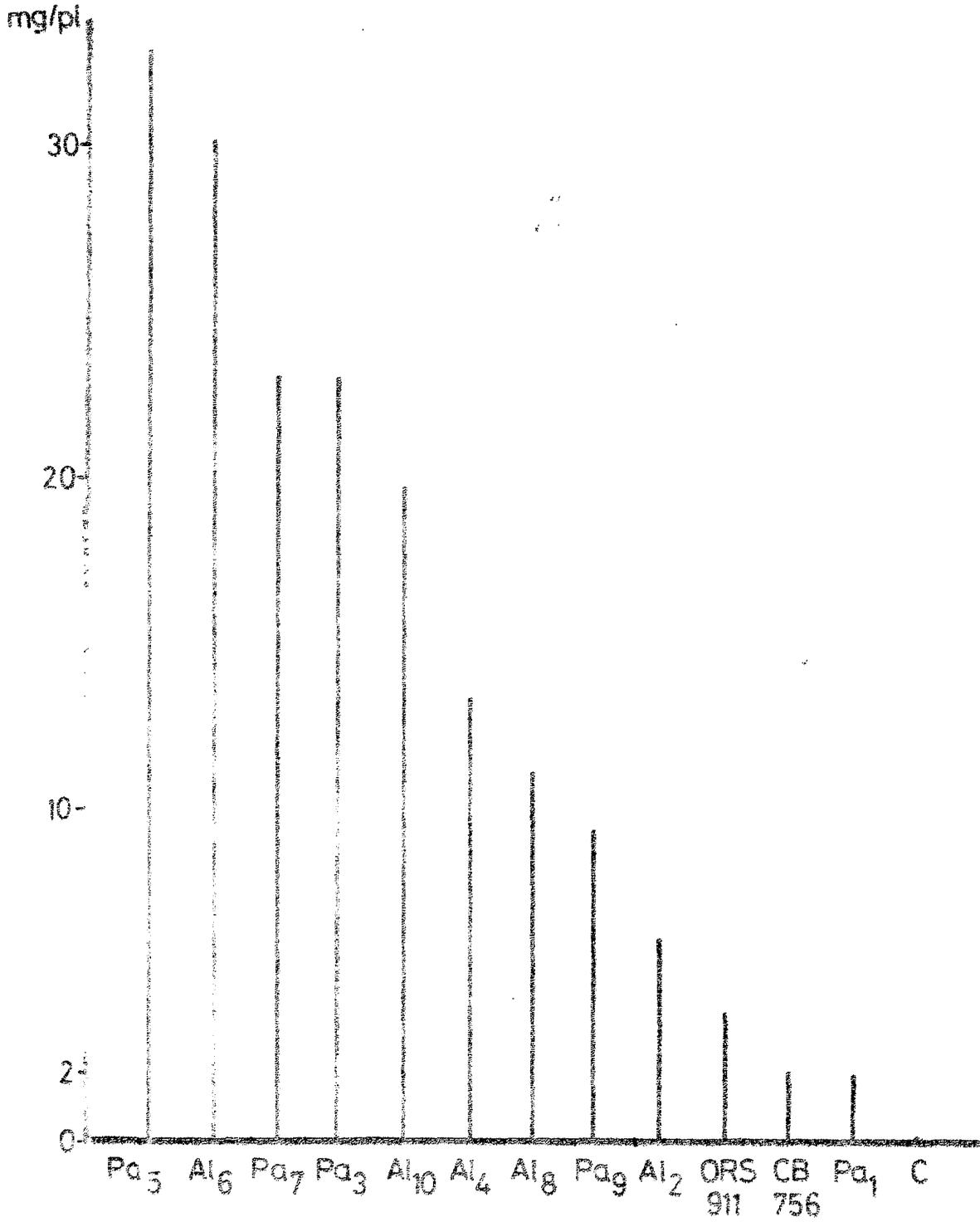


Fig 2B Nodules dry weight of A. lebeck

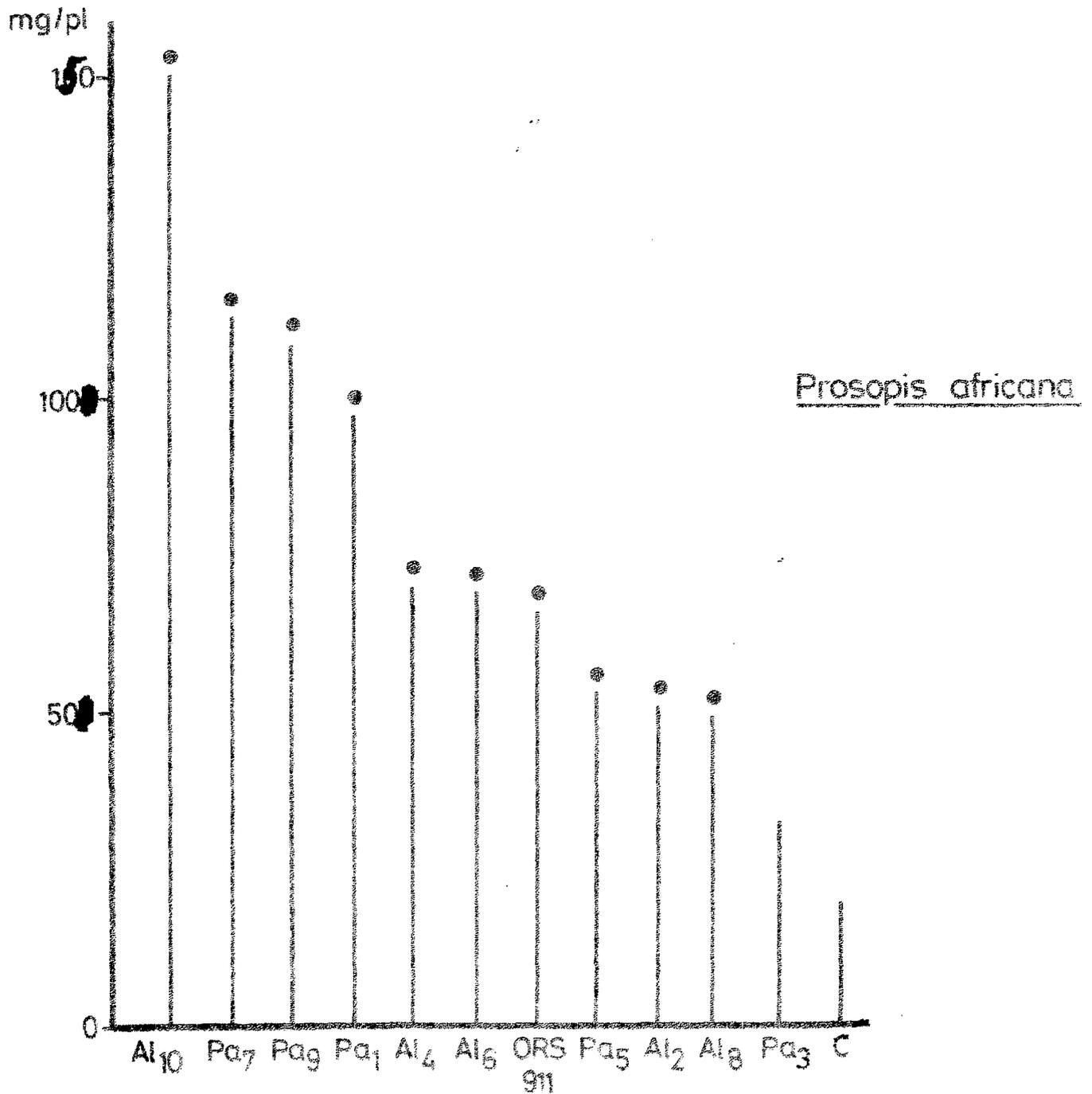


Fig 3A. Total N content of P. africana

* These treatments were significantly different from control (C)

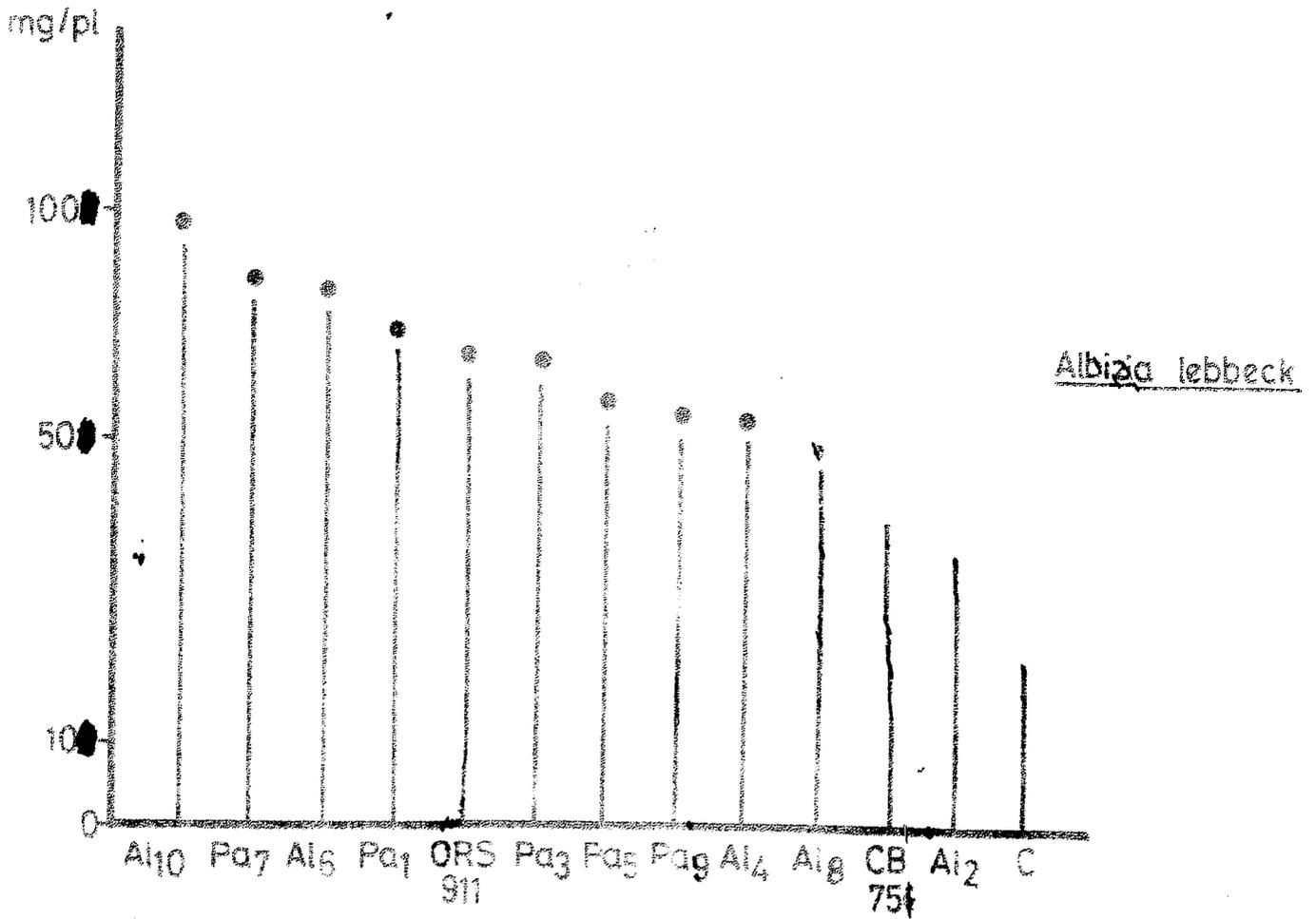


Fig 3 B Total N content of A. lebeck

- These treatments were significantly different from control (C)

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