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**CENTRE DE RESSOURCES MICROBIOLOGIQUES  
(MIRCEN)**

F0000856

**SOIL AMELIORATION WITH NITROGEN-FIXING  
ACACIA SPECIES**

**First progress report of IAEA contract no. 6375/R1/RB**

# FIRST PROGRESS REPORT

**CONTRACT NUMBER : 6375/R1/RB**

## **TITLE OF PROJECT**

Soil amelioration with nitrogen fixing *Acacia albida* and *Acacia seyal*

## **INSTITUTE WHERE RESEARCH IS BEING CARRIED OUT**

Institut Senegalais de Recherches Agricoles (ISRA) : Programme MIRCEN

**CHIEF SCIENTIFIC INVESTIGATOR : Mamadou GUEYE**

## **ADDITIONAL SCIENTIFIC STAFF :**

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**TIME PERIOD COVERED : June 1992 -- June 1993**

## **FIRST EXPERIMENT**

### ***DESCRIPTION AND CARRYING OUT THE EXPERIMENT***

The experiment was carried out from July to December 1992 with seven provenances of *Acacia albida* from Senegal (5) and Burkina Faso (2) and one *Parkia biglobosa* from Senegal.

The isotope dilution technique and the A-value method were used.

All grounded samples of leaves, stems and roots were sent to the agency.

### ***ISOTOPE DILUTION TECHNIQUE (ID)***

#### *Treatments*

- *A. albida* provenances at 20 Kg N/ha
- *Parkia biglobosa* provenance at 20 Kg N/ha

Number of replicates : 8

Number of pots

- (7 pr. A. albida + 1 P. biglobosa) x 8 reps = 64

Calculation of nitrogen requirement

Ammonium sulfate (AS) with 10.09%  $^{15}\text{N}$  a.e. was applied at 200 mg N/pot.

Total N requirement : 200 mg N x 64 = 12800 mg N

Total AS requirement : 12800 x 100/21.2 = 60377.3 mgN

Volume of solution needed : 50(ml/pot) x 64 = 3200 ml

We used 3300 ml because of spillage. Thus, the required amount of AS for 3300 ml is :

$$60377.3 \times 3300/3200 = 62264 \text{ mg AS}$$

Dilution

$$m_1 + m_2 = 62264 \text{ mg AS}$$

$$M_1 = 132.3338 \text{ g/mole of AS } 10.09\% \text{ }^{15}\text{N a.e.}$$

$$M_2 = 132 \text{ g/ mole of ordinary AS}$$

$$a' = 10\% \text{ }^{15}\text{N a.e. desired in final dilution}$$

$$a_1 = 10.09\% \text{ }^{15}\text{N a.e. of AS to be diluted}$$

Then,

$$m_1 = \frac{62264 \times 132.3338 \times 10}{(132.3338 \times 10.09) + (132.3338 - 132) \times 10}$$

$$m_1 = 61554.74 \text{ mg,}$$

$$m_2 = 709.26 \text{ mg}$$

Summary

$$m_1 = 61.50 \text{ g of AS with } 10.09\% \text{ }^{15}\text{N a.e.}$$

$$m_2 = 0.71 \text{ g of ordinary AS}$$

Total volume of solution : 3300ml

Number of pots : 64

Application rate : 50 ml

Remaining solution : 100 ml.

## A-VALUE METHOD

Treatments

*Parkia biglobosa* at 100 Kg N/ha in comparison with *A. albida* treatments described in ID section.

Number of replicates : 8

Number of pots : 1 *P. biglobosa* x 8 reps = 8 pots

Calculation of nitrogen requirement

Ammonium sulfate (AS) with 10.09%  $^{15}\text{N}$  a.e. was applied at 1000 mg N/pot.

Total N requirement : 1000 mg N x 8 = 8000 mg N

Total AS requirement : 8000 x 100/21.2 = 37735.85mgN

volume of solution needed : 50(ml/pot) x 8 = 400 ml

We used 500 ml because of spillage. Thus, the required amount of As for 500 ml is :

$$37735.85 \times 500/400 = 47169.81 \text{ mg AS}$$

### Dilution

m1 + m2 47169.81

M1 = 132.3338 g/mole of AS 10.09%  $^{15}\text{N}$  a.e.

M2 = 132 g/ mole of ordinary AS

a' = 2%  $^{15}\text{N}$  a.e. desired in final dilution

a'1 = 10.09%  $^{15}\text{N}$  a. e. of AS to be diluted

Then,

$$m1 = \frac{47169.81 \times 132.3338 \times 2}{(132.3338 \times 10.09) + (132.3338 - 132) \times 2}$$

$$m1 = 9345.14 \text{ mg,}$$

$$m2 = 37824.67 \text{ mg}$$

## Summary

m1 = 9.35 g of AS with 10.09%  $^{15}\text{N}$  a.e.  
m2 = 37.80 g of ordinary AS  
Total volume of solution : 500ml  
Number of pots : 8  
Application rate : 50 ml  
Remaining solution : 100 ml.

## **SECOND EXPERIMENT : GRAFTING EXPERIMENT**

### ***DESCRIPTION AND CARRYING OUT THE EXPERIMENT***

The experiment will be carried out from May to October 1993 with the senegales provenances of *A. albida* and *P. biglobosa* described in the first experience. In addition, one *A. seyal* provenance from Senegal will be used for grafting the *A. albida*.

### ***TREATMENTS***

The *Bradyrhizobium* MAO 488 will be used for inoculating the five *A. albida* provenances.

The *Rhizobium* strain ORS 1088 will be used for inoculating the five *A. albida* grafted on the *A. seyal* provenance.

The *Rhizobium* strain **ORS** 1088 will be used for inoculating the *A. seyal* provenance.

The *P. biglobosa* will serve as reference crop.

***NUMBER OF REPLICATES : 8***

***NUMBER OF POTS : 12 treatments x 8 reps = 96***

### ***CALCULATING THE NITROGEN REQUIREMENT***

Amount of AS with 10.09%  $^{15}\text{N}$  a.e. will be applied at 200 mg N/pots.

Total N requirement : 200 mg N x 96 = 19200 mg N

Total AS requirement : 19200 x 100/21.2 = 90566.0377 mg AS

Volume of solution needed : 50(ml/pot) x 96 = 4800 ml  
 We will use 5000 ml because of spillage. Thus, the required amount of AS for 5000 ml is :

$$90566.0377 \times 5000/4800 = 94339.62 \text{ mg AS}$$

#### *Dilution*

$$m_1 + m_2 = 94339.62$$

$$M_1 = 132.3338 \text{ g/mole of AS } 10.09\% \text{ } ^1\text{ } ^5\text{N a.e.}$$

$$M_2 = 132 \text{ g/mole of ordinary AS}$$

$$a' = 10\% \text{ } ^1\text{ } ^5\text{N a.e. desired in final dilution}$$

$$a_1 = 10.09\% \text{ } ^1\text{ } ^5\text{N a.e. of AS to be diluted}$$

Then,

$$m_1 = \frac{94339.62 \times 132.3338 \times 10}{(132.3338 \times 10.09) + (132.3338 - 132) \times 10}$$

$$m_1 = 93264.98 \text{ mg AS}$$

$$m_2 = 1074.63 \text{ mg AS}$$

#### *Summary*

$$m_1 = 9.32 \text{ g of AS with } 10.09\% \text{ } ^1\text{ } ^5\text{N a.e.}$$

$$m_2 = 1.07 \text{ g of ordinary AS}$$

Total volume of solution : 500 ml

Number of pots : 96

Application rate : 50 ml/pot

Remaining solution : 200 ml.

### **THIRD EXPERIMENT : FIELD EXPERIMENT**

#### ***DESCRIPTION AND CARRYING OUT THE EXPERIMENT***

The experiment will be carrying out in the field from May 1993 to April 1994 with one senegalese *A. albida* provenance and the *P. biglobosa* provenance.

#### ***TREATEMENTS***

The *Bradyrhizobium* MAO 488 will be used for inoculating the *A. albida* provenance in the nursery before transplanting into the field. Three, 6, 9 and 12 months after transplantation, the fixed nitrogen will be estimated.

The *P. biglobosa* will serve as reference tree.

**NUMBER OF REPLICATES : 4**

**NUMBER OF PLOTS :**

2 provenances x 4 samplings x 4 reps = 32 plots

Plot size : 8 m x 3 m = 24 m<sup>2</sup>

Subplot size : 4 m x 2 m = 8 m<sup>2</sup>

Spacing : 2 m on the row ; 1m between rows.

### **CALCULATING THE NITROGEN REQUIREMENT**

Amount of AS with 10.09% <sup>15</sup>N a.e. will be applied at 20 KgN/ha, i.e. 16 gN/subplot.

Total N requirement : 16 g N x 32 = 512 g N

Total AS requirement : 512 x 100/21.2 = 2415.09 g AS

Vol. of solution needed :(500 ml/m<sup>2</sup>) x 10 x 32 = 160000ml =160l

We shall use 170 l because of spillage. Thus, the required amount of AS for 100 l is :

$$2415.09 \times 170/160 = 2566.03 \text{ g AS} = 2.6 \text{ Kg AS.}$$

#### *Dilution*

ml + m2 = 2.6 Kg AS

M1 = 132.3338 g/mole of AS 10.09% <sup>15</sup>N atom excess

M2 = 132 g/mole of ordinary AS

a' = 5% <sup>15</sup>N a.e. desired in final dilution

a'1 = 10.09% <sup>15</sup>N a.e. of AS to be diluted

Then,

$$\text{ml} = \frac{2.6 \times 132.3338 \times 5}{(132.3338 \times 10.09) + (132.3338 - 132) \times 5}$$

m1 = 1.29 Kg AS,

m2 = 1.31 Kg AS

*Summary*

m1 = 1.30 Kg of As with 10.09% 15N a.e.

m2 = 1.30 Kg of ordinary AS

Total volume of solution : 170 l

Number of subplots : 32

Application rate : 500 ml/subplot

Remaining solution : 10 l