

EVALUATION OF DIFFERENT BRADYRHIZOBIUM SP STRAINS ON NITROGEN FIXATION CAPACITY IN FOUR FORAGE LEGUMES

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ABSTRACT

Eleven available strains of *Bradyrhizobium* sp were used to test four forage legumes, *Crotalaria juncea* (Crotalaria), *Cajanus cajans* (Guandu), *Stylobium deerigianum* (Mucuna-Ana) and *Cyamopsis tetragonoloba* (Guar) for symbiotic N-fixation ability. Greenhouse experiments were conducted for nine weeks in order to evaluate shoot, root, and nodule dry weight, nodule number, and shoot nitrogen content. Four strains presented relative nitrogen efficiency (RNE) over 100% with Crotalaria cultivar, whereas only one strain was more efficient with Guandu and Mucuna cultivars. Strain 633 was the only one which presented a high yield with Crotalaria, Guandu and Mucuna-Ana cultivars.

KEYWORDS

Forage legumes, *Bradyrhizobium* sp, inoculation

INTRODUCTION

Green manure crops are frequently forage legumes grown in association with compatible rhizobia and can provide a portion of the succeeding crops' nitrogen requirement in addition to improving soil structure. These two characteristics of forage legumes are of particular importance for developing countries where agricultural production is often limited by an economical supply of nitrogen fertilizer (Pineda and Kipe-Nolt, 1990). More emphasis should be given to comprehensive comparisons of biological nitrogen fixation (BNF) enhancement versus N fertilizer use. This involves not only relative input costs in relation to expected benefits, but also adverse consequences of use of either N source. For example, reliance on N fertilizer can result in soil acidification, N leaching losses and eutrophication of water bodies (Bantilan and Johansen, 1995).

Because of interactions between host genotype and rhizobial strain for nitrogen-fixing potential, it is inappropriate to select genotypes simply for high nitrogen-fixing potential *per se*, because the nitrogen-fixing efficiency is dependent on the rhizobial strain used. (Fernandez and Millar, 1987). Considering this, the objective of this study was to identify effective *Bradyrhizobium* strains for inoculating four forage legumes, Crotalaria, Guandu, Mucuna-Ana and Guar.

METHODS

All *Bradyrhizobium* sp. strains were provided by the Instituto Agronómico de Campinas (IAC-SMS) collection (Campinas, Brasil). Strains were grown in yeast manitol broth (Vincent J.M., 1970) at 30°C with agitation during four days. Inoculation, planting, plant selection and nutritive solution addition were done as described by Hungria and Neves, 1986. The experiments were conducted for nine weeks in Leonard Jars (Vincent J.M., 1970), each of them with two plants. A control (C+N) containing 25 mg N was used for comparative effects. Crotalaria, Guandu, Mucuna and Guar cultivars were obtained from IAC, Campinas Brasil.

Shoots, roots, and nodules for each pot were dried at 68°C for 24 hours and weighed. Nodules were counted when removed from roots and weighed separately after drying. For determining shoot nitrogen, shoots from each pot (each of them with two plants) were ground and analyzed by Kjeldahl method (AOAC).

Relative dry weight efficiency (RDWE) was calculated as plant dry weight/control dry weight. Relative nitrogen efficiency (RNE) was calculated as shoot nitrogen content/control nitrogen content.

RESULTS AND DISCUSSION

Figure 1 shows the relative plant dry weight efficiency (RDWE) of cultivars Crotalaria, Guandu, Mucuna-Ana and Guar with the 11 studied strains. It was observed that strain 138 and strains 138, 21 and 584 presented RDWE higher than the control in cultivars Crotalaria and Guandu, respectively, whereas strain 103 and strains 400, 584 and 177 presented RDWE higher than the control in cultivars Mucuna-Ana and Guar, respectively.

In relation to relative nitrogen efficiency (RNE), some differences were observed between the four cultivars: 4 strains (400, 138, 633, and 177) presented RNE higher than 100 % in the cultivar Crotalaria, whereas with the cultivars Guandu and Mucuna-Ana only strain 633 showed RNE higher than 100 %. With cultivar Guar none strain presented RDWE higher than the control. The least efficient strains for cultivar Crotalaria were the strains, 172, 2 and 131 with RNE lower than 36 % and strains 633, 21, 172, 131 and 2 for the cultivar Guar with RNE lower than 28 % (Figure 2).

With four cultivars the correlation coefficient (r) between nodule dry weight and nodule number was low (r = 0.6152, 0.6088, 0.6878 and 0.1729 for Crotalaria, Guandu, Mucuna-Ana and Guar, respectively) as well as the correlation coefficient between nodule dry weight and total shoot nitrogen (r = 0.5285, 0.7551, 0.7938 and 0.54944 for Crotalaria, Guandu, Mucuna-Ana and Guar, respectively). These results confirm observations in beans (Rennie and Kemp, 1981; Hungria and Neves, 1986), that a higher nodule weight does not always correspond to a higher N accumulation in the plant.

Finally, cultivar Crotalaria presented an efficient nodulation and RNE over 100 % with a higher strains number compared with cultivar Guandu, Mucuna-Ana and Guar. Only strain 633 presented an adequate efficiency with Crotalaria, Guandu and Guar cultivars.

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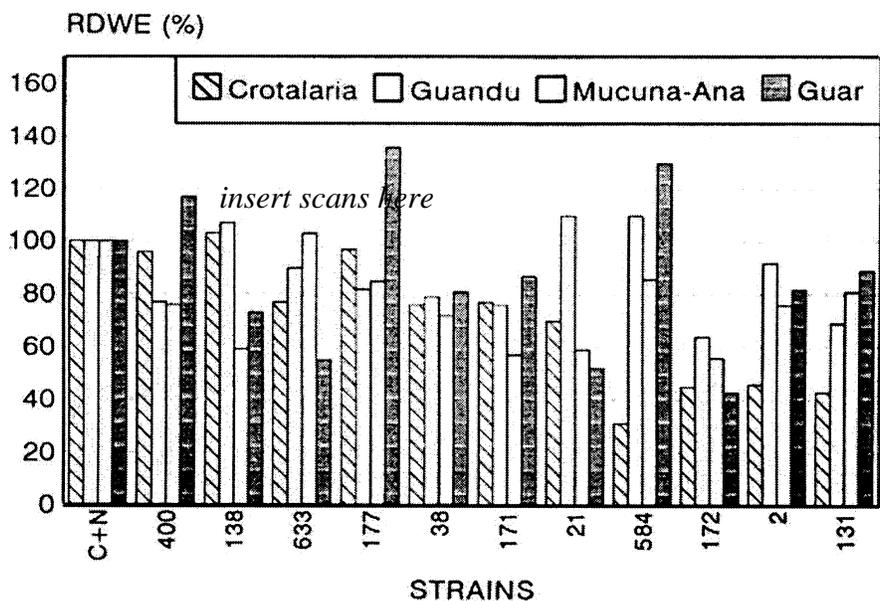


Figure 1
Relative dry weight efficiency in *Crotalaria*, *Guandu*, *Mucuna-Ana* and *Guar* cultivars.

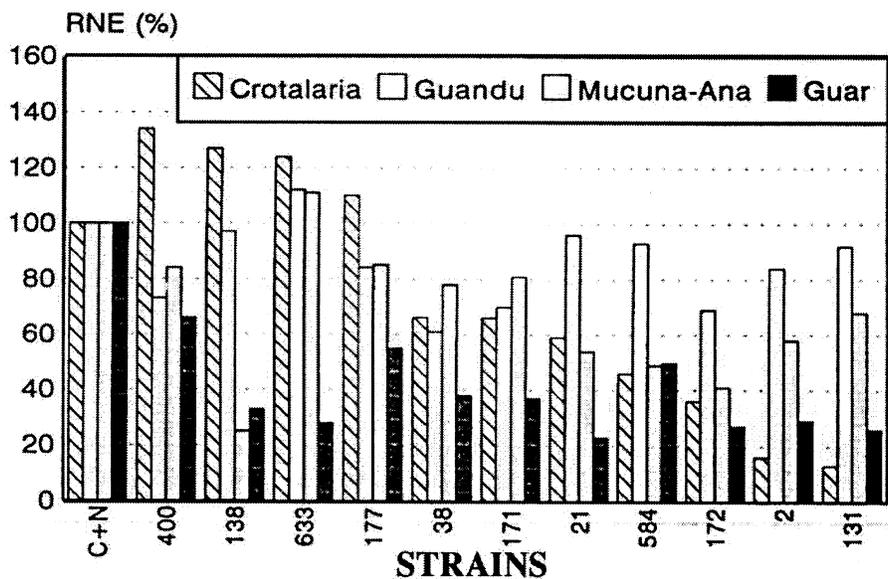


Figure 2
Relative nitrogen efficiency in *Crotalaria*, *Guandu*, *Mucuna-Ana* and *Guar* cultivars.