

Seed inoculation with diazotrophic bacteria as affecting upland rice yield

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INTRODUCTION

The use of alternative technologies to reduce N fertilizers in rice crops includes their inoculation with endophytic bacteria (Prakamhang et al., 2009). These bacteria are able to reduce atmospheric N, thus making it assimilable by plants. Biological fixation, performed by diazotrophs, is a process of great importance because it is responsible for the incorporation of considerable amounts of atmospheric N, in both natural ecosystems and in agricultural systems (Guimarães et al., 2010). The objective was to determine the effect seed inoculation with strains of *Azospirillum* spp. in the plant biomass, foliar nutrient concentration, yield components, grain yield and nutrient concentration in grains of upland rice under no-tillage systems in a Cerrado Region.

METHODS

Trial was conducted under rainfed conditions and arranged in a factorial, randomized, complete block design with three replications during growing season 2015/16. The treatments consisted of inoculated seeds of rice containing the strains of *Azospirillum* spp. (*Azospirillum brasilense* 245, *Hernaspirillum seropedicae* Z94, commercial *Azospirillum brasilense* (Ab V5 and Ab V6 strains), and without *Azospirillum*).

RESULTS AND DISCUSSION

There was no effect of microorganism types on the nutrient content in rice shoots (Table 1). Regarding rice leaf concentrations of macro and micro nutrients in the treatments with diazotrophic bacteria in comparison to the control (no bacteria treatment) there were no differences for all nutrients. The only exception was the P concentration in plants treated by Commercial *Azospirillum* that differed from the control treatment.

Shoot dry biomass was affected by bacteria type (Table 2). *Azospirillum brasilenses* strain 245 and *Hernaspirillum seropedicae* strain Z94 did not differ and the *A. brasilenses* strain 245 differed from Commercial *Azospirillum*. Number of panicles per plant, number of grains per panicle, mass of 100 grains, grain yield and nutrients in the grains of upland rice was not affected by the bacteria type. The control treatment did not differ by any of these variables including the shoot dry biomass.

According to our results the use of bacteria was not effective to provide better development of rice plants. This could be because of the high levels of soil organic matter in the soil (39.90 g dm⁻³). The diazotrophs bacteria are known to provide increases in plant development due incorporation of considerable amounts of atmospheric N, in both natural ecosystems and in agricultural systems (Prakamhang et al., 2009; Guimarães et al., 2010). However, in our trial due the high level of soil organic matter, it is likely that the N release to the soil was enough to meet the plant requirement and the N fixed by the bacteria did not provide increases in plant development.

Table 1. Microorganism type *Azospirillum brasilenses* 245 (*Azospirillum* 245), *Hernaspirillum seropedicae* Z94 (Z94) and *Azospirillum* commercial Ab V5 and Ab V6 strains (Commercial *Azospirillum*) as affecting nutrient content in rice leaves at full flowering stage.

| Factors | N | P | K | Ca | Mg | Cu | Fe | Mn | Zn |
|--------------------------------|-------------------------------|-------|-------|--------------------------------|------|------|--------|-------|-------|
| <u>Microorganism (M)</u> | -----g kg ⁻¹ ----- | | | -----mg kg ⁻¹ ----- | | | | | |
| <i>Azospirillum</i> 245 | 14.83 | 3.21 | 17.34 | 2.50 | 2.68 | 6.73 | 121.69 | 75.88 | 68.69 |
| <i>Hernaspirillum</i> Z94 | 15.50 | 3.36 | 17.79 | 2.60 | 2.71 | 6.92 | 179.60 | 74.94 | 67.37 |
| Commercial <i>Azospirillum</i> | 15.20 | 3.82* | 18.23 | 2.41 | 2.63 | 7.12 | 166.86 | 75.90 | 75.44 |
| Control | 14.17 | 3.11 | 17.83 | 2.68 | 2.71 | 7.01 | 174.19 | 90.38 | 79.63 |

* Means followed by the same letter do not differ by Tukey test.

Table 2. Microorganism type *Azospirillum brasilenses* 245 (*Azospirillum* 245), *Hernaspirillum seropedicae* Z94 (Z94) and *Azospirillum* commercial Ab V5 and Ab V6 strains (Commercial *Azospirillum*) as affecting plant biomass (PB), number of panicles per plant (NPP), number of grains per panicle (NGP), mass of 1000 grains (1000M) and grain yield (GY) of upland rice.

| Factors | PB | NPP | NGP | 1000M | GY |
|--------------------------------|-------------------|-------|--------|-------|---------------------|
| <u>Microorganism (M)</u> | g m ⁻² | unit | unit | g | kg ha ⁻¹ |
| <i>Azospirillum</i> 245 | 191.99 a | 87.00 | 105.75 | 23.82 | 3336 |
| <i>Hernaspirillum</i> Z94 | 184.94 ab | 91.25 | 110.13 | 23.49 | 3012 |
| Commercial <i>Azospirillum</i> | 156.13 b | 85.31 | 113.81 | 23.06 | 3421 |
| Control | 179.63 | 91.50 | 107.31 | 24.38 | 3119 |

* Means followed by the same letter do not differ by Tukey test.

CONCLUSION

The use of diazotrophs bacterias in soil with high level of soil organic matter did not provide increases in upland rice development.

REFERENCES

- Guimarães, S. L.; Campos, D. T. S.; Baldani, V. L. D.; Jacob-Neto, J. (2010). Diazotrophic bacteria and nitrogen fertilization in rice cultivars. *R. Caatinga*. 23:32-39.
- Prakamhang, J.; Minamisaw, K.; Teamtaisong, K.; Boonkerd, N.; Teaumroong, N. (2009). The communities of endophytic diazotrophic bacteria in cultivated rice (*Oryza sativa* L.). *Appl. Soil Ecol.* 42:141-149.