

## Natural nodulation of cowpea plants in lowland soil in south-western Amazonia

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### ABSTRACT

“Beach farming” is an activity practiced in Amazonia in the lowland soil of muddy rivers, with headwaters in the Andes. In the Juruá Valley (Acre), south-western Amazon, this production system contributes to the conservation of traditional cowpea cultivars. The present report describes the natural occurrence, on river beaches (flood plain areas), of nitrogen-fixing native microorganisms in symbiosis with cowpea plants. The report was carried out in 2018 on a private property on the beaches of the Juruá River, in Cruzeiro do Sul, Acre. The reported case deserves special attention and encourages future research that can contribute to family agricultural production.

**Keywords:** Biological nitrogen fixation. Organic system. Traditional agriculture.

## Nodulação natural de plantas de feijão-caupi em solo de várzea na Amazônia sul ocidental

### RESUMO

Na Amazônia existe o sistema de cultivo de praia, praticado em áreas de várzeas de rios de água barrenta, com nascentes nos Andes. No Vale do Juruá (Acre), Amazônia sul ocidental, este sistema de produção contribui com a conservação *onfarm* de cultivares tradicionais de feijão-caupi. O presente trabalho descreve a ocorrência natural, nas praias fluviais (áreas de várzeas), de microrganismos nativos fixadores de nitrogênio em simbiose com plantas de feijão-caupi. A observação ocorreu o ano de 2018 em uma propriedade particular a margem do Rio Juruá, em Cruzeiro do Sul, Acre. O caso relatado merece atenção especial e incentiva futuros trabalhos de pesquisas que podem contribuir com o incremento da produção tradicional familiar.

**Palavras-chave:** Fixação biológica de nitrogênio. Sistema orgânico. Agricultura tradicional.

### INTRODUCTION

In the state of Acre, farmers use lowland areas along muddy rivers, such as beaches and ravines, for the cultivation of short cycle crops, especially beans and maize (MARTINS; COSTA, 2009). According to Mattar et al. (2016), the “beach growing

system” is predominantly used in traditional agriculture and has the potential to be classified as organic. Furthermore, this cultivation system is also present in other basins in the Amazon (MARTINS; COSTA, 2008; BRANDÃO et al., 2010).

Specifically considering the beach areas, the predominant soils in this system are entisols. This soil class has a territorial extension greater than 180 thousand ha<sup>-1</sup>, which corresponds to 1.12% of the territory in Acre (AMARAL et al., 2006). Entisols are from alluvial sediments, so their fertility is directly related to the amount of sediment deposited (DOS ANJOS et al., 2013).

According to Dos Anjos et al., (2013) entisols demonstrate great agricultural potential, as they have high levels of calcium, magnesium, and base saturation and, on the other hand, low levels of aluminum. However, despite the potential of this soil, the main limitation of cultivation in these areas is the seasonal floods.

As already mentioned, cowpea beans are planted in this class of soil in the Amazon region. It is worth mentioning that the Juruá valley (Acre) is a relevant *on farm* conservation center for this species (OLIVEIRA et al., 2016; MATTAR et al., 2016). Cowpea is an important food legume, capable of symbiosis with nitrogen-fixing bacteria.

There are several factors that can compromise biological nitrogen fixation – BNF, including pH, temperature, nutritional deficiency, and hydric stress (REIS, 2008). According to Reis (2008) the selection pressure exerted by the environment, selects organisms more adapted to the conditions of the place of origin, especially when the soil in question has some type of limitation. This was evidenced by Xavier et al. (2007), who showed that bacteria isolated from the countryside were more tolerant to high temperatures.

In this context, the report describes the natural occurrence of native microorganisms on river beaches (floodplain areas) nodulating cowpea individuals.

## **MATERIAL AND METHODS**

The work describes the occurrence of natural nodulation of cowpea individuals cultivated in river beach soil (floodplain). The observation occurred in 2018, during the dry season in the Amazon, on a private property located in the Praia Grande community (7°39'59.8 "S 72°40'04.8" W) on the banks of the Juruá River in the municipality of

Cruzeiro do Sul, Acre. The case was recorded through photographs and the images demonstrate the area where the case was recorded (Figure 1).

**Figure 1** - Area where the case was reported in Cruzeiro do Sul, Acre.



Soil physicochemical characterization was carried out in the 0-20 cm layer. The soil was classified as Eutrophic Entisol Tb (BARDALES et al., 2017) and presented the characteristics shown in Table 1.

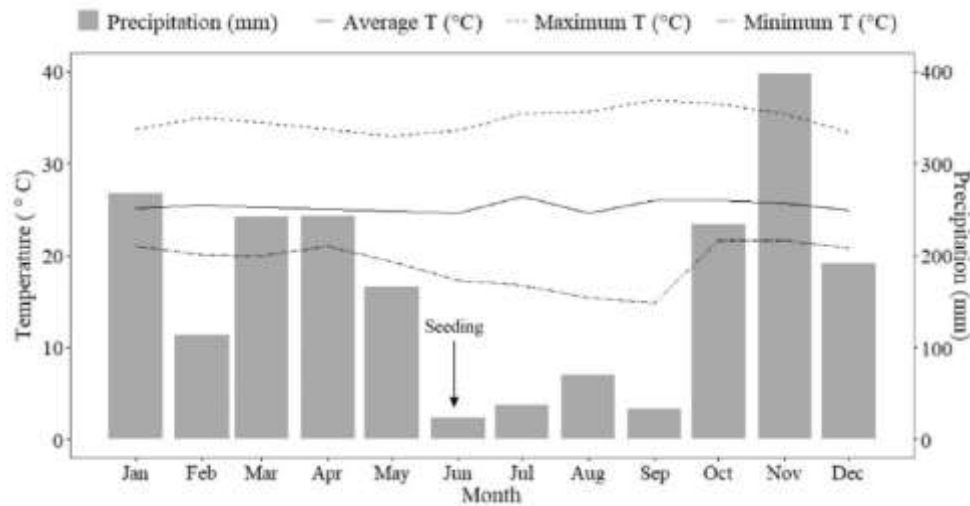
**Table 1** – Physical and chemical characteristics of the experimental soil located in the Praia Grande community.

<b>Soil attribute</b>	
<i>Chemical</i>	
pH (H <sub>2</sub> O)	5,83
P (mg dm <sup>-3</sup> )	20,42
K (cmol <sub>c</sub> dm <sup>-3</sup> )	0,14
Ca (cmol <sub>c</sub> dm <sup>-3</sup> )	5,91
Mg (cmol <sub>c</sub> dm <sup>-3</sup> )	0,92
Al (cmol <sub>c</sub> dm <sup>-3</sup> )	0,00
H + Al (cmol <sub>c</sub> dm <sup>-3</sup> )	1,65
<i>Physical</i>	
Sand (g kg <sup>-1</sup> )	855
Silt (g kg <sup>-1</sup> )	45
Clay (g kg <sup>-1</sup> )	100
<i>Additional</i>	
SB (cmol <sub>c</sub> dm <sup>-3</sup> )	6,97
T (cmol <sub>c</sub> dm <sup>-3</sup> )	8,62
V (%)	80,86

The records were obtained 52 and 76 days after planting, in individuals collected from the beach cultivation. The plants were from the traditional cultivar “Quarentão”,

commonly used in family farming in crops in lowland soils (MATTAR et al., 2016). Additionally, the 2018 monthly climatic variables from the Cruzeiro do Sul weather station were organized, made available by the National Institute of Meteorology – INMET (Figure 2).

**Figure 2** - Main climatological occurrences in the year of implementation of the experiment in the Praia Grande community, Cruzeiro do Sul, Acre. Source: National Institute of Meteorology – INMET.



## RESULTS AND DISCUSSION

According to the Köppen-Geiger climate classification, Cruzeiro do Sul is located in an environment with a tropical monsoon climate (Am) (DUBREUIL et al., 2018). In Acre, the rainy season occurs from October to April and the dry season from June to August, with May being the month of transition to the dry season and September the month of transition to the rainy season (DUARTE, 2006).

Cultivation on the beach is performed in the dry season, in the period of ebbing rivers (MATTAR et al., 2016). However, it is worth mentioning that in Cruzeiro do Sul, June 2018 had reduced rainfall, which harmed crops on some properties (Figure 3).

**Figure 3** - Cowpea plants in the Praia Grande community, Cruzeiro do Sul, Acre.



Although hydric stress compromised the development of the crop, at 52 and 76 days after sowing (DAS), it was possible to observe the formation of nodules on the roots of cowpea plants (Figure 4). This drew attention because nodulation in sand is not common, and this evidence may indicate the presence of natural strains of nitrogen-fixing microorganisms with the potential to be selected and multiplied.

Brazil is a reference when it comes to the production of inoculants containing strains of nitrogen-fixing microorganisms. According to the Ministry of Agriculture, Livestock and Supply - MAPA, there are currently four recommended strains of cowpea, two from Embrapa Agrobiologia (BR 3267 and BR 3262) and two from UFLA (UFLA 3-84 and IMPA3-11B). Herein, we highlight the potential of testing these inoculants already registered, in the different traditional cultivars of the Vale do Juruá, cultivated in the beach system.

**Figure 4** - Presence of nodules in cowpea plants in lowland soil, in Cruzeiro do Sul, Acre.



## CONCLUSION

The presence of nodules reported in cowpea crops in lowland cultivation deserves special attention and encourages future research, since little is known about the microorganisms native to these areas. Strains adapted to the beach system could be selected that will serve to create inoculants adapted to conditions of hydric stress and

sandy soils. It is important to mention that the use of this technology is consistent with organic production systems.

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