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## Presence Of Arbuscular Mycorrhizae In Saline Soils On Livestock Farms

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### ABSTRACT

*The present study consisted of determining the percentage of colonization of arbuscular mycorrhizal fungi (AMF) associated with roots of Angletón grass (Dichanthium aristatum) Benth from cattle farms belonging to the sub-region of the Gulf of Morrosquillo, department of Sucre, Colombia. A total of 35 cattle farms were sampled, from which 10 soil samples with roots were taken per farm at a depth of 20 cm. AMF spores were isolated from each sample, and morphospecies were separated and identified using taxonomic keys. The percentage of colonization of the collected roots was determined using staining methods. Results. The multifactorial ANOVA between the variables spore density/100 g soil and percentage of colonization as a function of livestock farms showed highly significant differences. The results reported a colonization percentage of  $22 \pm 76\%$  and a mean of 41.4%. For the number of spores/100 g of soil, values of  $353 \pm 2137/100$  g of soil and a mean of 931,8 spores/100 g of soil were reported. Conclusions. This preliminary study carried out in the Colombian Caribbean shows the diversity, population density and percentage of AMF colonization associated with Angletón grass in soil conditions of cattle farms in the Gulf of Morrosquillo sub-region.*

**Keywords.** Fungi, soil, roots, grass, colonization, spores.

### 1. INTRODUCTION

According to Perez and Peroza, (2013), in the department of Sucre, Colombia, the main source of bovine food is the grazing of native and introduced grasses and legumes, in this sense the animal productivity per unit area is determined by the nutritional value and forage production offered. Amongst the introduced species, the Angletón grass (*Dichanthium aristatum*, Benth) represents the third species with the largest sown area in the department of Sucre, reaching an

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extension of approximately 56,200 hectares (ha), distributed in 19 municipalities. The municipality of Santiago de Tolú, whose main economic activity is semi-intensive livestock farming, has the second largest area planted with this species in the department, representing 9,400 hectares.

Likewise, Perez and Peroza (2013). They argue that the livestock soils of the municipality of Tolú are located in the sub-region of the alluvial coastal plain or the Gulf of Morrosquillo and are characterized by flat topography, subject to flooding, chemically they have medium to high base saturation, their effective depth varies from shallow to moderate, limited by fluctuations in the water table, they have variable amounts of sodium, medium to high phosphorus levels, low to medium organic matter content, slightly acid to slightly alkaline pH and medium to high fertility. These soils are suitable for crops that tolerate the presence of sodium salts and flooding.

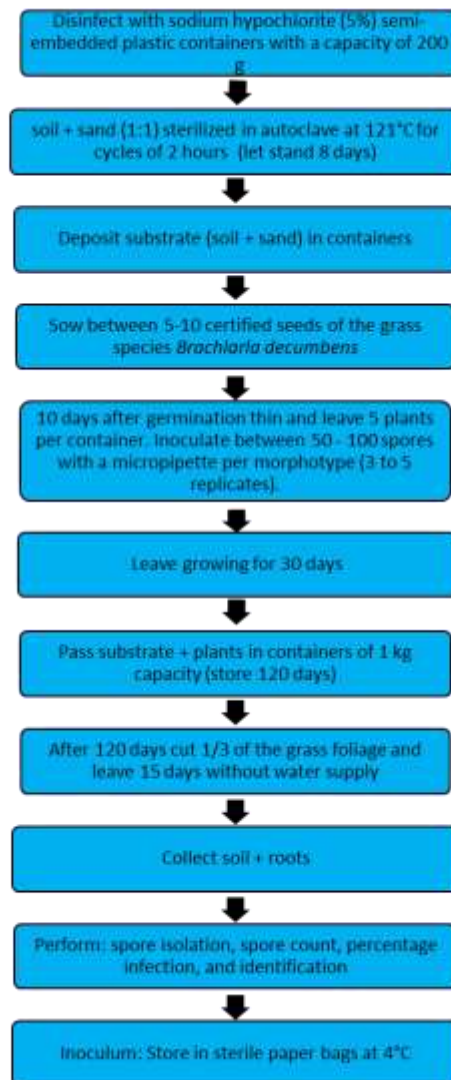
The soils of livestock farms in the department of Sucre have been deteriorating over the last 10 years, due to physiographic factors, anthropogenic actions degenerative of the environment and the use of inadequate technologies, have led to the degradation of physical, chemical and biological properties of the soil, which limits the supply and quality of pasture and forage mainly in the dry season (Pérez et al. 2016).

Microbial activity in the rhizosphere is partly responsible for the functioning of terrestrial ecosystems and the fertility of agricultural soils. Among the beneficial microorganisms of importance in the rhizosphere are arbuscular mycorrhizal fungi (AMF), which contribute to plant development and nutrition, as well as to increasing crop tolerance against biotic and abiotic stress conditions. The uses of these biological resources, as well as soil physico-chemical and climatic indicators, contribute to optimizing soil quality and health, supplying nutrient inputs and increasing yields (Pérez et al., 2016).

Taking into account the benefits of this natural multifunctional symbiosis and the fact that at present there are no studies on soil microbiology on the north coast of Colombia on this species of grass associated with these microorganisms, under this soil condition, it is proposed to isolate the different genera of native arbuscular mycorrhizal fungi associated with the Angletón grass species and to determine the parameters of the number of spores and the percentage of colonization of the fungi, The aim is to isolate the different genera of native arbuscular mycorrhizal fungi associated with the Angletón grass species and to determine the parameters of spore quantity and percentage of root colonization in cattle farms belonging to the Gulf of Morrosquillo sub-region in the department of Sucre.

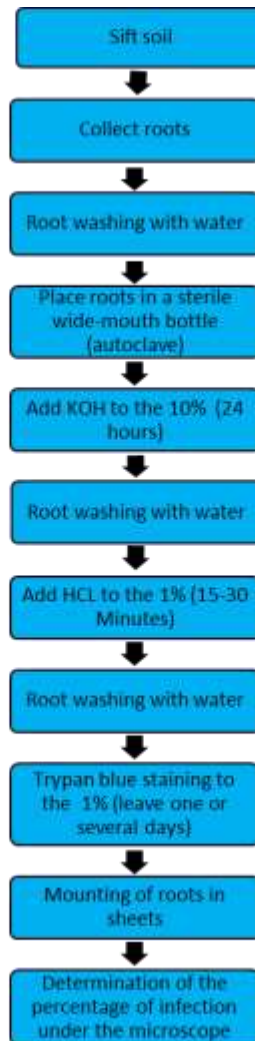
## **2. MATERIALS AND METHODS**

**2.1 Spore isolation.** The scheme for morphospecies identification was carried out by the following process described in figure 1.



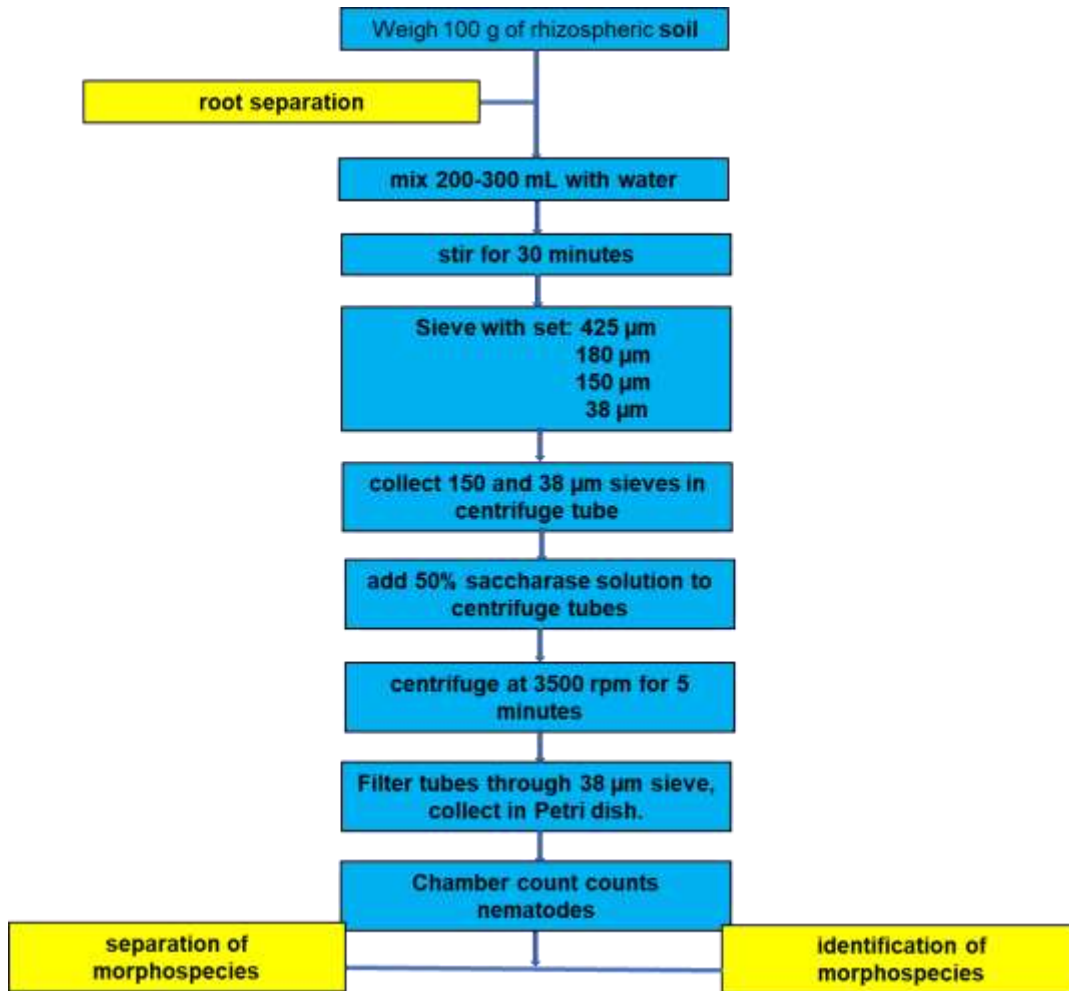
**Figure 1.** Scheme for the identification of morphospecies from spores of arbuscular mycorrhizal fungi associated with soil on livestock farms. Source: Pérez et al., (2010); Pérez et al., (2015).

**Determination of the percentage of colonization.** Figure 2 shows the process for the in vitro determination of the percentage of colonization of arbuscular mycorrhizae-forming fungi on the roots of angelica grass.



**Figure 2.** Scheme for the determination of the percentage of root colonization by arbuscular mycorrhizal fungi associated with livestock farm soils. Source: Pérez et al., (2010); Pérez et al., (2015).

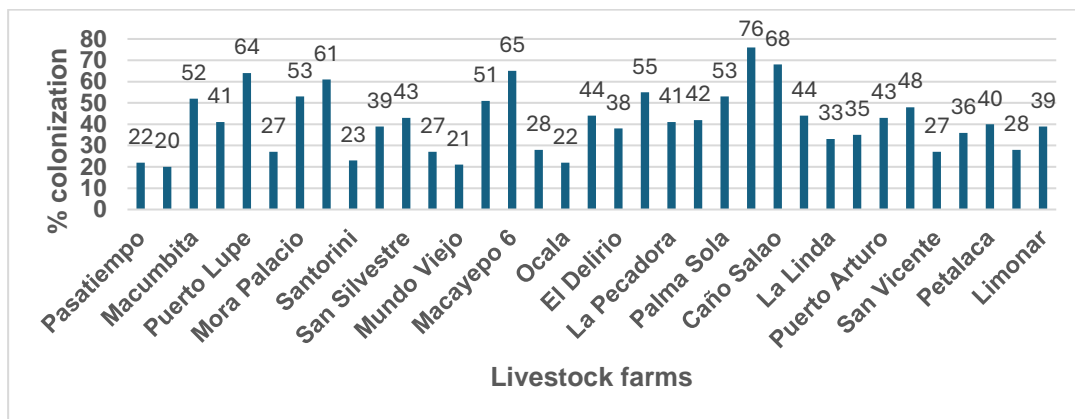
**Identification of morphospecies.** The scheme illustrated in figure 3 describes the steps for the identification of morphospecies from spores of arbuscular mycorrhizal fungi.



**Figure 3.** Scheme for the identification of morphospecies of arbuscular mycorrhizal fungi associated with livestock farm soils. Source: Pérez et al., (2010); Pérez et al., (2015).

### 3. RESULTS AND DISCUSSION

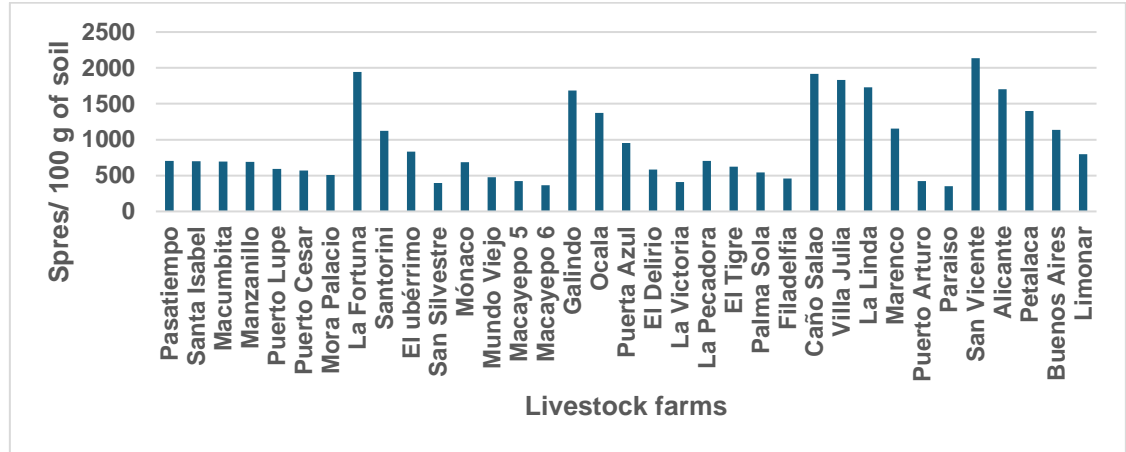
Table 4 describes the percentage of colonization in Angletón grass roots found on each livestock farm in the Gulf of Morrosquillo physiographic sub-region.



**Figure 4.** Percentage of colonization in Angletón grass roots by cattle farms analyzed in the Gulf of Morrosquillo, Department of Sucre, Colombia.

The results show that the Filadelfia cattle farm (78%) had the highest percentage of colonization, followed by Caño Salao (68%), Macayepo (65%) and Puerto Lupe (64%). The cattle farms with the lowest percentages of colonization were: Santa Isabel (22%), Mundo Viejo (21%), Pasantiempo (20%) and Ocala (20%).

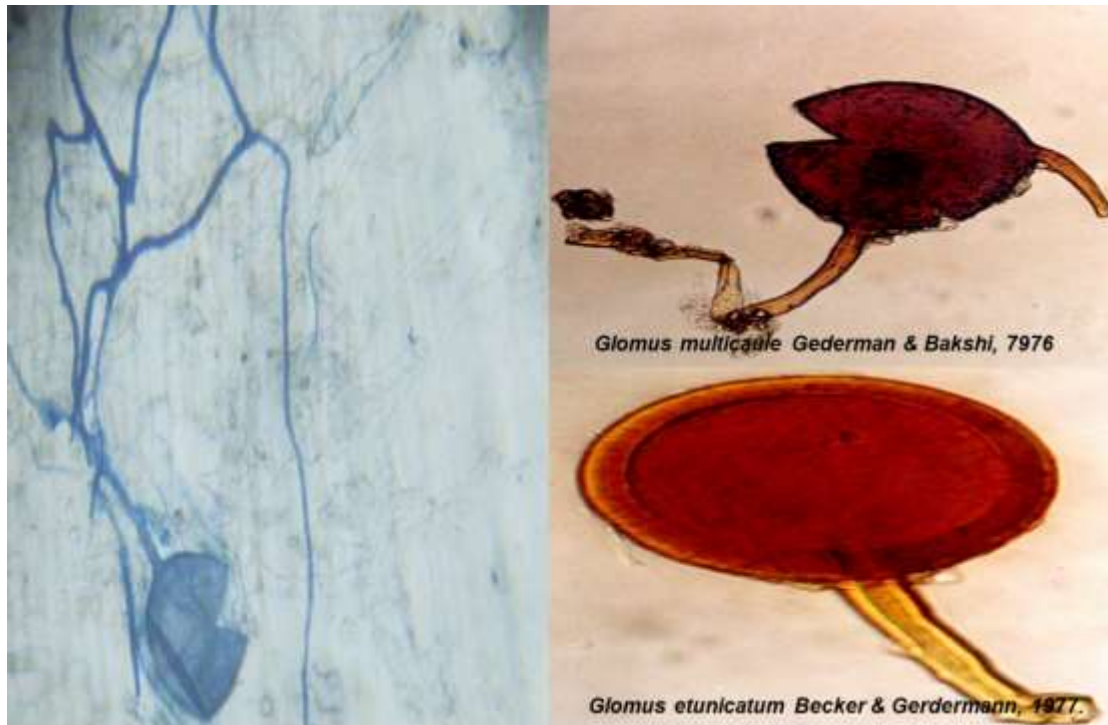
Figure 5 shows the results of the number of spores of arbuscular mycorrhizal fungi /g of soil, associated with rhizosphere soils of cattle farms located in the sub-region of the Gulf of Morrosquillo in the department of Sucre, Colombia.



**Figure 5.** Number of spores of arbuscular mycorrhizal fungi associated with the rhizosphere of Angletón grass soil by cattle farms analyzed in the Gulf of Morrosquillo, Department of Sucre, Colombia.

The highest number of spores was found in the cattle farms of San Vicente (2137/g soil), Caño Salao (1916/ g soil), al Fortuna (1944/ g soil) and Villa Julia (V/ g soil). The lowest mean spore values were found in the cattle farms of: Paraiso (353/ g soil) and Macayepo (365/g soil).

Figure 6 shows the colonization patterns and morphospecies of arbuscular mycorrhizae predominant in the soil of cattle farms located in the sub-region of the Gulf of Morrosquillo, department of Sucre.



**Figure 6.** Colonization patterns and spore morphology present in the soil of cattle farms located in the sub-region of Golfo de Morrosquillo, department of Sucre. Source: INVAM, 2023.

The soils of the livestock farms analyzed present salinity problems because they belong to the sub-region of the Gulf of Morrosquillo, but according to Mosse (1991), who states that in arid and semi-arid soils the excess of soluble salts is a special problem; salinity causes nutritional imbalance for the plants. An excess of chlorine can interfere with the uptake of nitrates and phosphates, a high concentration of sodium can affect the acquisition of calcium and magnesium. AM can alleviate some negative effects of salinity.

The morphospecies with similar characteristics to *Glomus etunicatum* was one of the three most frequently occurring morphospecies, which is in agreement with Howeler et al., (1987); Mergulhao et al., (2001, reported that *Glomus etunicatum* inoculated on *Brachiaria decumbens* under different levels of sodium chloride in Brazilian soils, the amount of spores produced by this mycorrhiza was not affected by soil salinity.

#### 4. CONCLUSION

To date, there are few reports on the presence of morphospecies and percentage of colonization of arbuscular mycorrhizal fungi (AMF) in roots of Angleton grass species in different physicochemical conditions of soils of cattle farms belonging to the Morrosquillo Gulf of Morrosquillo. However, in the present study a colonization percentage of  $22 \pm 76\%$  and a mean of  $41.4\%$  is reported. For the quantity of spores/100 grams of soil, values of  $353 \pm 2137/100$  g of soil and a mean of  $931.8$  spores/100 g of soil are reported.

On the other hand, mathematical models to predict the presence of spores as a function of physical-chemical parameters of soil in the municipality of Tolú according to Peroza and Pérez (2010) inferred that the models built to predict the number of spores as a function of salinity, shows that salinity interferes directly with sporulation in the presence of the variables pH, magnesium (Mg), sodium (Na), sulphate (SO<sub>4</sub>), percentage of exchangeable sodium (PSI) and

the percentage of sodium in parts per thousand (S/00) and inversely proportional to electrical conductivity (CEE).

On the other hand, Perez and Peroza, (2013) constructed mathematical models built to predict AMF colonization in angleton roots, they point out that the variables that are directly related are the values of the exchangeable elements potassium (K) and sodium (Na), zinc (Zn) and the percentage of hydrogen in the soils and are inversely proportional to the values of the exchangeable elements Ca and Mg.

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## DECLARATIONS

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Conflict of interest

The authors declare that they have no competing interests.

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