Survival of forest species of the caatinga in ciliary plantations in the state of Paraíba

Sobrevivência de espécies florestais da caatinga em plantios ciliares no estado da Paraíba

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ABSTRACT: Riparian forests have peculiar characteristics in relation to architecture and flowering, which are intrinsically linked to the high water content of the soil and the air they develop due to both the superficiality of the water table and periodic flooding. The aim of this research was to assess the survival or establishment of seedlings in the field through the collection of survival information in order to verify which species group(s) is most feasible for recovering of riparian forest in Caatinga areas. The riparian plantations were conducted in three rural communities from March to April, at the Riacho Trapiá, Rio Espinharas and Rio da Cruz rivers, municipality of Maturéia-PB, respectively for three years (2003, 2004 and 2005). Twenty-two native species were used, covering six pioneers, eight secondary, five clímaxes and three of undetermined ecological group. The results showed that the pioneer and secondary species had better survival performance in the areas of riparian stand plantations, this may have occurred because they had the capacity to adapt in places with adverse conditions, which demonstrates their indication for recovering of riparian forest.

KEYWORDS: northeast, revegetation, semi-arid.

RESUMO: As matas ciliares possuem características peculiares em relação à arquitetura e floração, as quais estão intrinsecamente ligadas ao alto teor de água do solo e do ar onde se desenvolvem devido tanto à superficialidade do lençol freático quanto às inundações periódicas. O objetivo desta pesquisa foi avaliar a sobrevivência ou estabelecimento de mudas no campo, por meio da coleta de informações de sobrevivência, a fim de verificar qual (is) grupo (s) de espécies são mais viáveis para recuperação de mata ciliar em áreas de Caatinga. Os plantios ciliares foram conduzidos em três comunidades rurais de março a abril, nos rios Riacho Trapiá, Rio Espinharas e Rio da Cruz, município de Maturéia-PB, respectivamente por três anos (2003, 2004 e 2005). Foram utilizadas vinte e duas espécies nativas, abrangendo seis pioneiras, oito secundárias, cinco clímax e três de grupo ecológico indeterminado. Os resultados mostraram que as espécies pioneiras e secundárias tiveram melhor desempenho de sobrevivência nas áreas de plantios de talhões ciliares, isso pode ter ocorrido por terem capacidade de adaptação em locais com condições adversas, o que demonstra sua indicação para recuperação de mata ciliar.

PALAVRAS-CHAVE: Nordeste, revegetação, Semiárido.
INTRODUCTION

The ciliary forests have peculiar characteristics in relation to architecture and flowering, which are intrinsically linked to the high water content of the soil and the air where they develop caused by both the superficiality of the groundwater and Periodic floods (Castro et al., 2013). According to Leandro and Viveiros (2003), this term of ciliary forest refers to its similarity with the eyelashes of our eyes. These forest systems are established naturally in bands on the banks of rivers and streams, in the vicinity of lakes, dams and springs, which functions as a reducer of silting, degradation of the environment, as a natural means of processing and transformation of environmental diversity (Castro et al., 2013).

It is worth noting that the riparian forest also works, as ecological corridors, linking forest fragments, since the physical retention of the roots, protects the soil against erosion, by decreasing the impact of water on the soil through the leaves and stem and by the Soil coating through the formation of the litter layer. The intrinsic relationship that these forest formations maintain with the bodies of water, makes them preponderantly important for maintaining the integrity of the local ecosystems. Thus, due to the vulnerability of the riverbanks, the establishment of a vegetation in its surroundings was fundamental for the stabilization and permanence of these sites (Oliveira et al., 2012). In order to protect the rivers, this influences directly on water quality, in the maintenance of the hydrological cycle in the river basins, avoiding the erosion process of the margins and the silting (Primo; Vaz, 2006). However, even in the face of the immense importance of these areas, it is noted that the ciliary forests over time to the detriment of the various economic interests have been highly compromised.

According to Oliveira et al., (2012) The areas located near the rivers have been suffering from the intense degradation process in their margins, provoked especially by the disorderly occupation of man in the exploitation of natural resources. Among the anthropogenic pressure factors are the occupation of land itself since the beginning, without a planning (Rizzo, 2007), as well as deforestation aiming the use of wood, burnt for the generation of energy and the implantation of swiths and pastures (Primo; Vaz, 2006).

It is also important to highlight that among the semiarid areas of the northeast, the ciliary forests of Paraíba is the most affected by environmental degradation, due to
the presence of a significant number of river basins and a high number of inhabitants, suffering. Therefore, strong pressure in the ciliary areas (Lacerda et al., 2005). These data become more worrying when considering water problems related to the Semi-arid region, such as the low water flow of rivers due to the temporal variability of precipitations and the predominance of shallow soils based on Crystalline rocks reflecting in reduced water exchange between river and adjacent soil (Cirilo, 2008). These edaphic-climatic characteristics explain the inequality of water distributions, causing this northeastern region to hold only 3% of the 13.8% of freshwater present in the domains of Brazilian rivers (Malvezzi, 2007).

Based on this assumption, the search for recovery practices that ensure the integrity of these forest formations has been emphasized. The recovery of this can be achieved by soil fertility obtained by restocing with leguminous shrubs-arboreal (Araújo Filho et al., 2007) or by planting fast-growing plant species that can accelerate the secondary succession Progressive (Franco et al., 1992), which should be conducted considering the local flora, and encompass the maximum of species previously present and with the scope of the different ecological groups, forms of dispersion, among others (Attanasio et al., 2006).

This study aimed to monitor the survival or establishment of seedlings in the field through the collection of survival information, in order to verify which group(s) of species(s) is more viable for recovery of riparian forest in areas of Caatinga.

**MATERIAL AND METHODS**

The planting areas are included in the municipality of Patos-PB, coordinates 7° 1' 46" S and 37° 20' 44" W and altitude of 242m. The dominant warm and dry climate according to Koppen (BSh) with average annual temperature of 32° C, relative humidity in annual average is 55%. The average annual rainfall is 500mm with rainfall concentrated in 3 to 4 months per year, irregularly distributed in time and space with annual insolation that reaches 2,800 hours.

The ciliary plantations were conducted in three rural communities in the months of March to April: Trench (2003 and 2004), Trench I (2004) and Campo Comprido (2005), the banks of the Trapiá Creek, Espinharas River and Rio da Cruz, respectively.
In trench the planting range ranged between 39, 0m x 10, 5m – 16, 5m, in trench I between 33m x 70m on both sides of the river and in Campo Comprido the range was 45m x 195m, on the left bank of the Rio da Cruz.

The recovery of degraded ciliary areas should be conducted considering the local flora, and cover the maximum of species previously present in the area. The species should preferably represent different ecological groups, forms of dispersion (Attanasio et al., 2006).

The appropriate choice of species and their quantities is a decisive factor in the establishment of vegetation and protection against erosive processes, thus being necessary technical knowledge that cover the climatic, Edaphic, Physiological and environmental. It is very important that these represent biodiversity, ecological balance, therefore of the choice of species: pioneers, secondary, climax.

The species employed in the ciliary plantations and their ecological groups are contained in table 1, classified according to the proposal contained in APG IV (APG IV, 2016) and the synonymy confirmed in the checklist of the association plants of the Northeast.

### Table 1. Families and species used in the ciliary plantations in the communities of Trench (Trin), Trench I (Trin) and Campo Comprido (Camp) in the municipality of Patos-PB, in the years 2003 and 2004, 2004 and 2005, respectively.

| Scientific name                          | Family                  | GE | NC  |
|------------------------------------------|-------------------------|----|-----|
| *Anadenanthera colubrina* (Vell.) Brenan | Fabaceae, Mimoideae     | (P)|     |
| *Myracrodruon urundeuva* M. Allemao     | Anacardiaceae, Angico   |    |     |
| *Schinopsis brasiliensis* Engl.          | Fabaceae, Aroeira       |    |     |
| *Triplaris gardneriana* Weed.            | Polygonaceae, Braúna    |    |     |
|                                           | Fabaceae, Cauaçu         |    |     |
| *Poincianella pyramidalis* (Tul.) L. P. Queiroz | Fabaceae, Catingueira |    |     |
| *Tabebuia aurea* (Silva Manso) Benth. & Kook. F. Ex S.Moore. | Fabaceae, Craibeira |    |     |
|                                           | Fabaceae, Chorão         |    |     |
| *Poecilanthe falcata* (Vell.) Heringer   | Fabaceae, Cumaru         |    |     |
|                                           | Fabaceae, Embratana      |    |     |
| *Amburana caerensis* (Allemão) A. C. Sm. | Malvaceae, Ingazeira    |    |     |
|                                           | Euphorbiaceae, Favela    |    |     |
| *Lonchocarpus sericeus* (Poir) DC.       |                        |    |     |
| *Cnidoscolus quercifolius* Pohl          |                        |    |     |
Hymenaea coubaril Hayne. 
Ziziphus joazeiro Mart. 
Libidibia ferrea (Mart. ex Tul) L.P. Queiroz 
Cereus jamacaru DC 
Bauhinia cheilantha (Bong.) D. Dietr. 
Erythrina velutina Jacq. 
Handroanthus impetiginosus (Mart. ex. DC) 
Mattos 
Luetzelburghia sp. 
Aspidosperma pyrifolium Mart. 
Sapindus saponaria L. 
Enterolonbium contortissiliquum (Vell.) Morong 
Parkinsonia aculeata L. 
Spondias tuberosa Arruda

GE – Ecological Group, NC – common name.

The seeds were harvested from populations in the municipalities of Malta, Patos, Santa Terezinha, immaculate, São José do Bonfim, Maturéia, Teixeira and Catingueira-PB, of at least 12 matrices, with a minimum distance of 50 m.

The seedlings were produced in the nursery of the academic unit of forestry engineering, UFCG Campus Patos-PB, in rigid tubete of volume of 250 cm³, by planting of direct sowing. The substrate consisted of the mixture, in equal proportion, of Plantmax, cattle manure and subsoil (1:1:1). The substrate fertilization consisted of 4.395 Kg of ammonia sulfate, 10.275 Kg of simple sulperphosphate and 6.850 Kg of potassium chloride, for the volume of 0.7 m³. Daily irrigation was conducted by electronically controlled spraying. The seedlings remained in the nursery with 50% of shading, before being filled to field were acclimatized until reaching height between 25 – 30 cm.

The pits were prepared with the use of a manual digger, with approximate dimensions of 10 x 30 cm in width and depth, respectively. The spacing adopted in the plantations was 1.5 x 1.5 in Trench (2003, 2004), and employed 3 x 3m in Trench I (2004) and Campo Comprido (2005) respectively, planted in quinconium, and pits of dimensions 10 x 30 cm wide and depth, open with digger Manual. The pits were
fertilized with simple superphosphate, ammonium sulfate and potassium chloride in the amount of 90g, 90g and 30g, respectively. The plantations occurred at the beginning of the rainy season. The seedlings were irrigated from August to October two times a week, with a three-day interval.

Three treatments were tested as a function of seedling disposition according to the ecological group: Treatment 1-Pioneer Association x secondary x Climax; Treatment 2-only pioneer and treatment 3-Association of Secondary X climax, in the plantations of 2003 and 2004. In 2005, five treatments were tested: Treatment 1: Pioneer x Secondary X Climax Association; Treatment 2-only pioneers; Treatment 3 – Only alternate pioneers; T4-Association of Secondary X Climax and T5-Association of a single secondary. The total number of seedlings for each ecological group in each treatment was 30; 21 and 8 pioneer, secondary and climax (T1), 30; 21 and 6 (T2) and 29; 19 and 6 (T3), 30; 26 and 8 (T4) and 29; 25 and 10 (T5), totaling 64 seedlings for each treatment. Three species did not have a specified ecological group.

The survival evaluation was performed in the month of August of each year, for replanting and in October the final percentage of survival of the species in each site, year and treatment. This was obtained through the presence and absence of them at the time of data collection.

RESULTS AND DISCUSSION

The results obtained for survival of the species in the areas and years are presented in table 2. At six months of planting the survival of the species ranged from 48.89 to 96.66% and 43.33 to 91.66% in Trench 2003 and 2004, respectively. In trench I, the variation was 10.00 to 86.11% and in Campo Comprido from 42.59 to 91.30%.

Regardless of the years and the planting sites, the species that presented survival above 80% were: Tabebuia aurea (P), Handroanthus impetiginosus, Triplaris Gardneriana (S), Enterolobium contortissiliquum (P), Parkinsonia aculeata (P), Schinopsis brasiliensis (P), Cereus Jamacaru, Myracrodruon Urundeuva (C), Cnidoscolus Quercifolius (P), Libidibia Ferrea (S), Ziziphus Joazeiro (C), Sapindus Saponaria (C) and Amburana cearensis (C). The species that presented survival below 50% were: Luetzelburghia sp. (S) and Spondias tuberosa. It is observed that most
survivors belonged to the pioneer Ecological group, followed by climax and secondary.

The species that presented survival below 50% were Luetzelburghia sp (S) and Hymenaea Coubarail (C).

The survival of the species in the trench community in the year 2003 was superior to the other areas, probably due to the complementary irrigation performed and the use of dead cover at the site of the crowdability, due to decreased evapotranspiration and greater Water availability to growing seedlings. It is noteworthy that, in the riparian forest in Cerrado domain in Assis-SP, the survival percentage of 20 tree species ranged from 67 to 100%, and was considered satisfactory, because it was higher than 50% (DURIGAN; SILVEIRA, 1999). Almeida & Sánchez (2005) Considered mortality values of up to 10% in revegetation projects, and found mortality values of 38% in plantations of mined areas in São Paulo. For Piña-Rodrigues et al. (1997) Mortality values of seedlings after planting up to 20% can be considered normal in projects of revegetation of mined areas.

Table 2. Average survival, per year and place, of the species planted in the communities of Trench (Trin), Trench I (Trin I) and Campo Comprido (CC)-PB in the years 2003, 2004 and 2005, respectively.

| Species                  | % Survival Trin/2003 e 2004 | % Survival Trin I/2004 | % Survival CC/ 2005 |
|--------------------------|----------------------------|-----------------------|---------------------|
| *Tabebuia aurea*         | 93,33                      | 79,99                 | 72,69               | 91,30               |
| *Bauhinia cheilantha*    | 63,73                      | 73,01                 | 60,97               | 66,12               |
| *Aspidosperma pyrifolium*| 77,78                      | 71,39                 | 41,67               | 77,37               |
| *Triplaris gardneriana*  | 95,83                      | 84,44                 | 41,11               | 91,11               |
| *Handroanthus impetiginosus* | 48,89                     | 50,27                 | 65,27               | 64,44               |
| *Erythrina velutina*     | 85,00                      | 43,33                 | 31,44               | 55,56               |
| *Anadenanthera colubrina*| 56,11                      | 74,01                 | 15,25               | 82,04               |
| *Enterolobium contortissilium* | 93,89                   | 51,70                 | 55,16               | 83,52               |
| *Parkeriodendron aculeata* | 96,66                    | 89,16                 | 73,81               | 71,57               |
| *Schinopsis brasiliensis*| 66,66                      | 91,66                 | 66,67               | -                   |
| *Amburana caerensis*     | 100,00                     | 91,66                 | 86,11               | 55,55               |
| *Myracrodruon urundeuva* | 97,21                      | 80,55                 | 83,33               | -                   |
| *Cnidoscolus quercifolius* | 88,88                    | 81,66                 | 66,67               | -                   |
| *Pseudobombax simplicifolium* | 77,77                   | 75,00                 | 69,69               | 57,36               |
| *Libidibia ferrea*       | 93,03                      | 54,54                 | 66,67               | 78,78               |
| *Ziziphus joazeiro*      | -                          | -                     | 50,00               | 87,04               |
| *Poincianella pyramidalis* | -                       | -                     | 35,00               | 55,56               |
| *Luetzelburghia sp.*     | -                          | -                     | 11,11               | -                   |
| *Hymenaea martiana*      | -                          | -                     | 10,00               | -                   |
The percentage of total survival was lower in the trench I community (52.65%) in 2004 (table 3). The treatment with the highest survival percentage was treatment 1 (T1) in all communities and years (table 3), consisting of pioneer, secondary and climaxes species. The survival percentages were 88.44 and 64.74% in the trench community (2003 and 2004), 53.10% in Trench I (2004) and 74.89% in the Long field (2005). Moraes et al. (2005) observed higher growth of secondary species and climax stimulated by the shading of pioneer species. For the authors it is important to note that at the beginning of development, survival rates for the species, because in addition to shading and combating invasive, pioneer species can contribute to a rapid improvement in the quality of the site, due to the return of Soil nitrogen, by deposition of leaflets (BARBOSA, 2000).

According to Ganade & Brown (2002) The number of positive and negative interactions of plants, animals and microorganisms established in one place, acts on seedlings in the way of establishment. As well as competition, parasitism and predation are some of these relationships that seem to contribute to the establishment of planted seedlings, including in Caatinga areas.

Table 3. Survival of the species in the different blocks in the communities of Trench (Trin), Trench I (Trin I) and Campo Comprido (CC)-PB in the years 2003, 2004 and 2005.

| Survival percentage | Treatments | Trin 2003 | Trin I 2004 | CC 2005 |
|---------------------|------------|-----------|-------------|--------|
|                     | T1         | 88.44     | 53.10       | 74.89  |
|                     | T2         | 69.95     | 44.99       | 74.20  |
|                     | T3         | 74.58     | 49.51       | 75.48  |
|                     | T4         | -         | -           | 59.35  |
|                     | T5         | -         | -           | 67.56  |
CONCLUSION

From the above, it is concluded that the pioneer and secondary species had better survival performance in the areas of implantation of the ciliary stands, probably because they have the ability to establish themselves in places with conditions Adverse reactions or in environments where the area already has the presence of organic matter, since the original biota was only partially altered. Thus, it is recommended its use for recovery of riparian forest in Caatinga áreas

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