

## DISTRIBUTION OF *ANADENANTHERA MACROCARPA* (BENTH.) BRENNAN SEEDLINGS IN AN AREA OF THE CAATINGA OF NORTHEASTERN BRAZIL <sup>(1)</sup>

DILOSA CARVALHO DE ALENCAR BARBOSA

Departamento de Botânica, Centro de Ciências Biológicas, Universidade Federal de Pernambuco - 50670-901 - Recife, PE, Brasil.

**ABSTRACT** - (Distribution of *Anadenanthera macrocarpa* (Benth.) Brennan seedlings in an area of the caatinga of north-eastern Brazil). The distribution of *Anadenanthera macrocarpa* (Benth.) Brennan seedlings under the adult tree and at some distance from it was analyzed quantitatively. The analyzes were performed at four different times, i.e., January 1979, July 1979, January 1980, and May 1980, corresponding to the beginning (January) and to the peak (July and May) of the rainy season, in a semi-arid region of the Brazilian Northeast (Sertânia, State of Pernambuco). To determine the number of seedlings, 10 adults trees were selected and 1 m<sup>2</sup> sections were marked at a distance of 1 m, 5 m and 10 m from the trunk to the North, South, East and West, for a total of 12 m<sup>2</sup> per tree and an overall total of 120 m<sup>2</sup>. A large number of seedlings was detected at all three distances investigated and their number was maximum during the months of highest rainfall, i.e. July 1979 (2,000 plants) and May 1980 (2,500 plants). No differences in number of seedlings under the adult trees were detected among cardinal points.

**RESUMO** - (Distribuição de plântulas de *Anadenanthera macrocarpa* numa área de caatinga do nordeste do Brasil). Analisou-se quantitativamente, a distribuição de plantas jovens de *Anadenanthera macrocarpa* (Benth.) Brennan sob e fora da planta adulta. As análises foram realizadas em 4 períodos: janeiro/1979; janeiro/1980 e julho/1979; maio/1980 respectivamente início e plena estação chuvosa, em uma localidade (Sertânia-PE) da região semi-árida do Nordeste brasileiro. Para determinar o número de plantas jovens foram selecionadas 10 plantas adultas e sob cada uma foram lançados quadrados (1 m<sup>2</sup>) a 1 m, 5 m e 10 m distantes do tronco, nas direções Norte, Sul, Leste e Oeste, perfazendo 12 m<sup>2</sup> por árvore e 120 m<sup>2</sup> no total. Detectou-se grande número de plantas jovens nas três distâncias analisadas, evidenciando-se maior quantidade nos meses de maior precipitação, julho/1979 (2.000 plantas) e maio/1980 (2.500 plantas). Não foram registradas diferenças quanto ao número de plantas jovens sob as adultas, com relação às direções.

**Key words:** *Anadenanthera*, Leguminosae, seedlings, caatinga.

### INTRODUCTION

*Anadenanthera macrocarpa* (Benth.) Brennan (Leguminosae-Mimosoideae) is a tree growing to a height up to 10 m, with a basal perimeter up to 2 m. The bark is reddish-brown and thick (2-5 cm) and exudes a reddish gum when injured. Aculei are present from the young to the adult stage, and the branches are smooth. The tree blooms in January and its fruits ripen in September (Brennan 1955), although Rizzini (1978) reported that the species blooms in November-December and produces fruits in July-September.

The tree is widely distributed in the caatingas and other dry wooded areas of Brazil from the State of Maranhão to the State of São Paulo (Andrade-Lima 1960, 1970, 1977, Benthham 1870-1876, Hueck 1972, Luetzelburger 1922-23, Rizzini 1978, Vasconcelos-Sobrinho 1971), and can also be found in the dry wooded areas of Paraguay and Bolívia and in the Chaco of Argentina (Bigarella *et al.* 1975, Hueck 1972, Parodi 1959).

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According to Luetzelburger (1922-23) and Tavares (1964), this species may be indicated for reforestation in Brazil, especially in the semi-arid Northeast, since it is resistant and adapts well to these conditions. Forest inventories conducted in the States of Pernambuco and Ceará, which belong to this same region, have considered *A. macrocarpa* to be one of the most valuable sources in timber and firewood available in the caatingas (Tavares *et al.* 1970, 1974a,b).

While conducting an ecophysiological survey in a semi-arid area of this type (Sertânia, State of Pernambuco), the author observed the occurrence of a representative natural population of *A. macrocarpa* and noted a large number of seedlings under the parent trees during the rainy season. On this basis, the present study was undertaken with the objective of analyzing quantitatively the distribution of seedlings of this species under the parent tree at the beginning and at the end of the major rainy season in Sertânia.

### STUDY AREA AND METHODS

The study was carried out the Cachoeira Farm of the Department of Agriculture of the State of Pernambuco (semi-arid region of Northeastern Brazil) in the municipality of Sertânia (8°5' latitude S and 37°16' longitude W.G.) is at an altitude of 650 m (Division of Cartography, Superintendent Office for the Development of the Northeast, SUDENE). The Farm with an area of 630 hectares. The study was conducted on an area of 3 hectares.

The climate of the region is of the semi-arid hot type (BSw'h' in the classification of Koeppen) and corresponds to type II of Walter (1971), i.e., tropical climate with rainy summers. The climatic diagram was constructed with data supplied by the 3rd Meteorology District of the National Institute of Meteorology (MA), Recife, and obtained at the closest station in the vicinity (Monteiro, State of Paraíba), located 23 km from the site (07°53' latitude S and 37°04' longitude W.G.) at an altitude of 599.11 m (Figure 1).

According to Jacomine *et al.* (1973), the soil is a combination of Brown non-Calcic soils intermediate between Vertisol and Eutrophic Litholic Soils. The vegetation is of the "dense shrub-like caatinga" type according to the classification of Egler (1951), with *Anadenanthera macrocarpa* (angico) predominating among tree species as determined by a preliminary survey of the area under study.

Ten adult trees of *A. macrocarpa* were selected in the study area for a quantitative study of seedlings occurring under each tree. During the rainy season, seedlings quantification was carried out during four different periods: January 1979, July 1979, January 1980 and May 1980. The ten trees selected were separated by a mean distance of 25 m and ranged in height from 2.20 to 8 m, with a basal circumference of 0.52 to 2.97 m at 10 cm from ground level.

The trunk of each *A. macrocarpa* tree was taken as the central point for the demarcation of four sets of three 1 x 1 m squares. The first two squares were located 1 m and 5 m within the projection of the crown of the parent tree, and the last (10 m) was located outside the crown. The four sets were marked facing North, South, East and West, respectively (Figure 2). To estimate the number of seedlings per adult tree, counts were per tree, performed in an area of 12 m<sup>2</sup> a total of 120 m<sup>2</sup> for all trees analyzed.

I first measured the vertical height of each seedling up to 20 cm in height. Each plant was marked with an aluminium tag attached with a nylon thread. The number of newly germinated seeds was also recorded, using as criterion the emergence of cotyledons.

During the periods analyzed (July 1979, January 1980 and May 1980), soil humidity was measured using a metal ring of known volume for sampling. Since the soil of the area under study

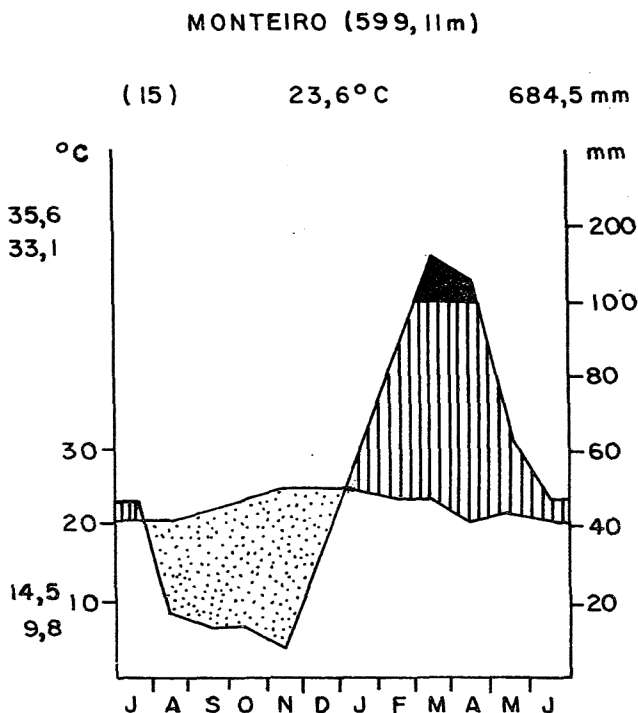


Fig. 1 - Climatic diagram for Monteiro (State of Paraíba, Brazil), latitude 07°53'S, longitude 37°04'W, constructed according to Walter and Lieth (1967).

Fig. 1 - Diagrama climático para Monteiro (Estado da Paraíba, Brasil), latitude 07°53'S, longitude 37°04'W, construído de acordo com Walter & Lieth (1967).

is shallow, a characteristic of caatinga zones, samples were obtained on the surface (0-5 cm) and at a depth of 30-45 cm by the method of Buckman and Brady (1974). The collection sites were selected at random at a distance of approximately 5 m from the trunk of the trees, with 3 replications per site.

A daily rainfall graph was constructed throughout the experiment on the basis of data provided by a pluviometer set up in the area belonging to the Cachoeira Farm.

## RESULTS

The number of seedlings and newly germinated seeds (cotyledon emergence) per m<sup>2</sup> was determined separately in January 1979, July 1979, January 1980 and May 1980 in areas at different distances from the trunk of 10 selected trees facing North, South, East and West.

Figure 3 shows the number of seedlings per m<sup>2</sup> in the plots located at a distance of 1 and 5 m from the tree trunk (under the crown) and at a distance of 10 m (outside the crown) for each month analyzed. Small differences were observed in number of juveniles measuring an average of 15 cm in height at the various distances from the tree. Similarly, no remarkable differences in seedling density were detected among the various directions (Figure 4). As to the various study periods, the number of individuals per m<sup>2</sup> was sharply higher in July 1979 and May 1980, at the peak of the rainy season, than in January 1979 and January 1980, at the beginning of the rainy season. At the beginning of January 1980 (January 6), in addition to already existing seedlings measuring on average 10 cm in height (26.35% of all seedlings

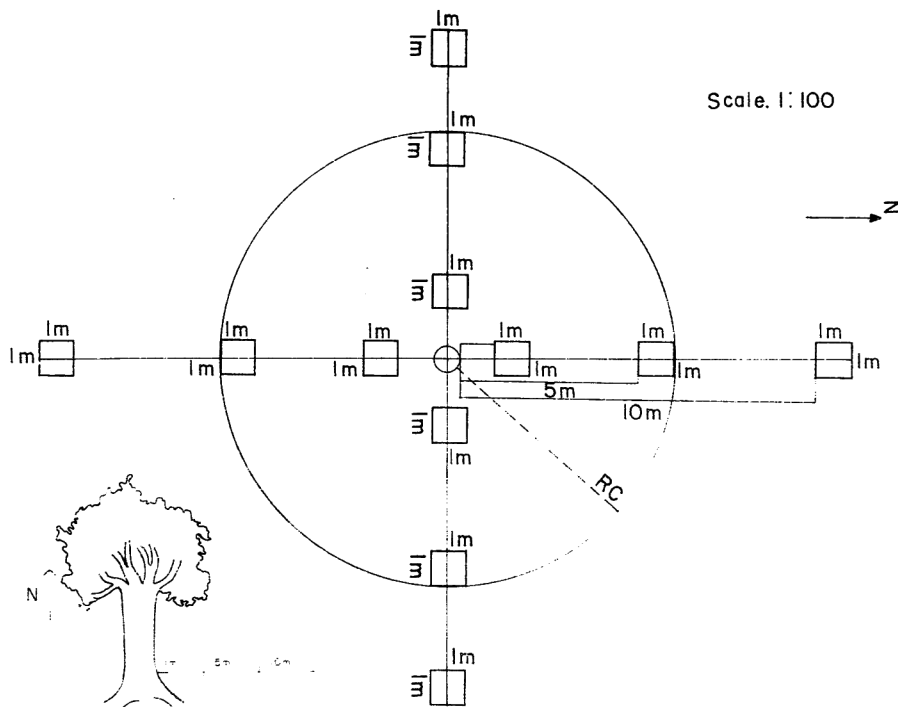


Fig. 2 - Schematic presentation of each *Anadenanthera macrocarpa* (Benth.) Brenan tree for the survey of seedlings. The central circle corresponds to the tree trunk and the squares represent the seedling sites under and away from the crown (RC) facing North, South, East and West.

Fig. 2 - Representação esquemática de uma árvore de *Anadenanthera macrocarpa* (Benth.) Brenan para o levantamento de plântulas. O círculo central corresponde ao tronco da árvore e os quadrados representam os sítios de plântulas sob e fora da copa (RC) nas direções Norte, Sul, Leste e Oeste.

counted), newly germinated seeds were also detected (73.74% of all seedlings counted) after a rainfall of 20 mm recorded on January 3 and 4 (Figure 5).

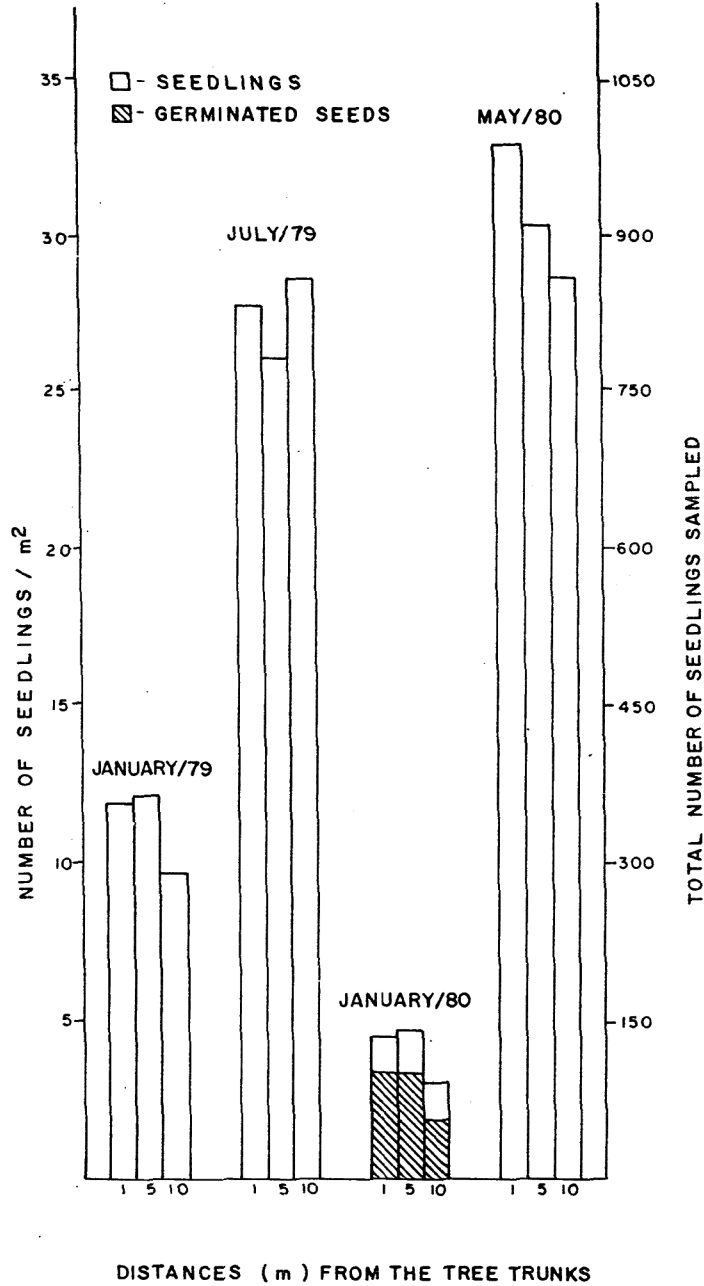
The total number of seedlings under and away from the trees analyzed was estimated at about 950 and 130 in January 1979 and January 1980, respectively. During the months of greatest rainfall, the number of seedlings was 2,000 (July 1979) and 2,500 (May 1980).

Figure 5 shows daily rainfall data for 1978, 1979 and 1980, when the field observations of the present study were made. In contrast to 1979, 1978 was not considered dry, with considerably high rainfall during the rainy season corresponding to an annual total of 777 mm, which was higher than the 684,5 mean for the region (Figure 1). On a single day in March 1978, rainfall was 106 mm, corresponding to almost the entire amount of rainfall for the month. From January to October 1980, rainfall was approximately 461.9 mm, and an interruption of the rainy season was observed from the beginning of March to the beginning of June.

Table 1 presents soil humidity data as a function of volume obtained near the trees selected for the study of seedling distribution and growth in July 1979, January 1980 and May 1980. Soil hu-

Fig. 3 - Total number of seedlings sampled and number of seedlings/m<sup>2</sup> at a distance of 1,5 and 10 m from the trunk of each tree, in January and July 1979, and in January and May 1980. Sertânia, PE.

Fig. 3 - Número total de plântulas amostradas e número de plântulas/m<sup>2</sup> a uma distância de 1,5 e 10 m do tronco de cada árvore, em Janeiro e Julho de 1979, e em Janeiro e Maio de 1980. Sertânia, PE.



midity was quite low at the end of the rainy season (July 1979 and May 1980) when the rainfall of the preceding months is taken into account (Figure 5).

Table 1. Soil water content near the selected trees. Sertânia, PE.

	SURFACE 0-5 cm	DEPTH 35-40 cm
	(%V)	(%V)
July/79	2.5	3.2
January/80	8.7	7.4
May/80	3.5	4.7

#### DISCUSSION AND CONCLUSIONS

Among the studies reported in the literature on the distribution pattern of seedlings in relation to adult trees in tropical forests, particularly interesting is the study by Janzen (1970) who stated that the dispersal pattern of these trees in a population depend on the interaction of two functions, i.e., the density of dispersed seeds and the probability of their survival with respect to the distance from the parent tree. The author presented a qualitative model which proposes greater distribution of seedlings at a certain distance from the adult tree and high mortality rates close to it, mainly due to predators, parasites and pathogenic fungi that may act more intensely on the seeds and/or seedlings present there.

The results obtained for the species studied here both at the beginning (January 1979, 1980) and during the peak of the rainy season (July 1979, May 1980) in this region were the opposite of the model reported by Janzen, i.e., there was a larger number of seedlings under the parent tree (1 and 5 m) and outside the crown (10 m). It should also be pointed out that the amount of seedlings was much larger during the periods of greatest rainfall, i.e., 2,000 for July 1979 and 2,500 for May 1980 (Figure 3).

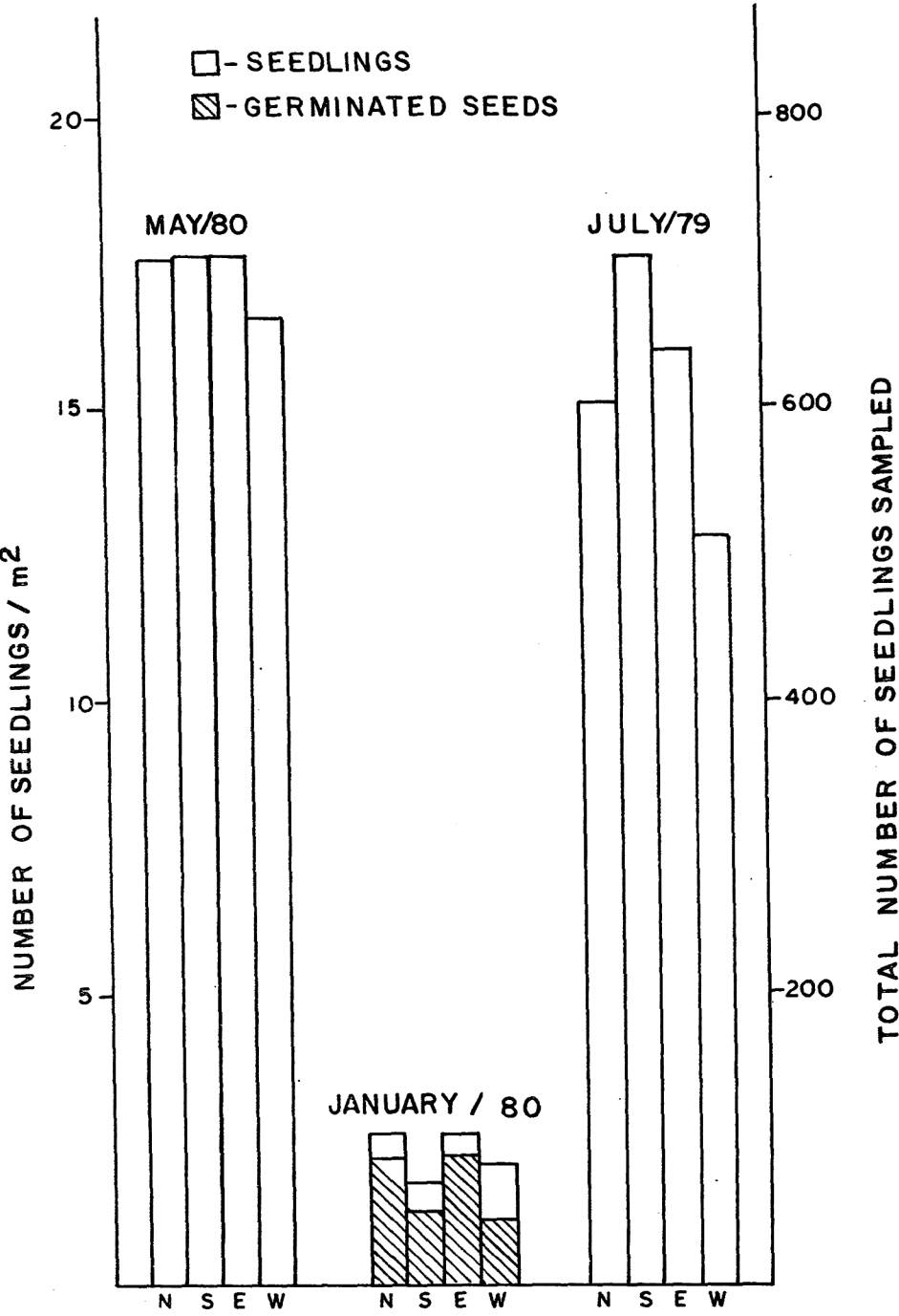
The survival of these seedlings under the crown of the parent tree may perhaps be explained by the large number of intact seeds detected there. Even during the rainy season, the water content of the soil adjacent to the selected trees was low (Table 1) because of the shallowness of the soil in this region, where rock may be reached at a depth of 50 cm at many sites.

The occurrence of seedlings under and outside the crown did not differ in intensity among the various directions (North, South, East and West) (Figure 4).

Continuing this line of research on the tree species *Bumelia sartorum* Mart. (Sapotaceae) occurring in another semi-arid area to the Brazilian Northeast, Barbosa (1978) observed a pattern identical to that of *Anadenanthera macrocarpa*. Seedling density under the parent tree was approximately 100 per m<sup>2</sup> during the rainy season, with a reduction corresponding to a true biological loss.

Fig. 4 - Total number of seedlings sampled and number of seedlings/m<sup>2</sup> in the directions facing North, South, East and West from the base of each tree, in July 1979 and in January and May 1980. Sertânia, PE.

Fig. 4 - Número total de plântulas amostradas e número de plântulas/m<sup>2</sup> nas direções Norte, Sul, Leste e Oeste, a partir da base de cada árvore, em Julho de 1979 e Janeiro e Maio de 1980. Sertânia, PE.



In contrast, Friedman and Orsham (1975), in a study of *Artemisia herba-alba* seedling distribution, emergence and survival in the Israeli desert, noted a low seedling emergence rate under the adult tree and attributed this phenomenon to the effect of substances released by the roots and stems of the parent plant, i.e., the well-known allelopathy phenomenon (Whittaker 1970). This hypothesis, however, does not apply to *A. macrocarpa*, since the greatest percentage of emergence of this species was observed under the adult tree.

Ferreira *et al.* (1987) discussed the validity of Janzen's model in a study of seedling distribution in relation to the adult trees of a population of *Anadenanthera falcata* (Benth) Spig. in a "cerrado" area in Mogi-Guaçu, State of São Paulo, and suggested that seedling survival does not depend on density or on distance from adult trees.

Marinho-Filho *et al.* (1989), in a study of distribution patterns of *Xylopodia aromatica* seedlings in another "cerrado" area in the State of São Paulo, obtained results compatible with Janzen's model, i.e., greater population recruitment at a certain distance from the parent tree. These results also agree with those reported by Moreira (1987) about seedling development and survival under the crown of adult *Emmotum nitens* (Benth.) Miers trees in a "cerrado" area in the Federal District, suggesting that the parent trees themselves probably offer microhabitats that are favorable to seedlings and young individuals. The author concludes that the space distribution pattern of the population is associated with differential seedling mortality during development, either because of biotic factors (predation and competition) or abiotic factors (desiccation). Moreira also explains that the initial mortality is high and greater for seedlings located in the regions most distant from the crown, whereas during the more advanced stages of development mortality increases in the regions under the influence of the crown. In agreement with this model, Augspurger (1983, 1984), in studies on tropical tree species of Panamanian semideciduous forests, also noted a very reduced number of juveniles under the adult tree.

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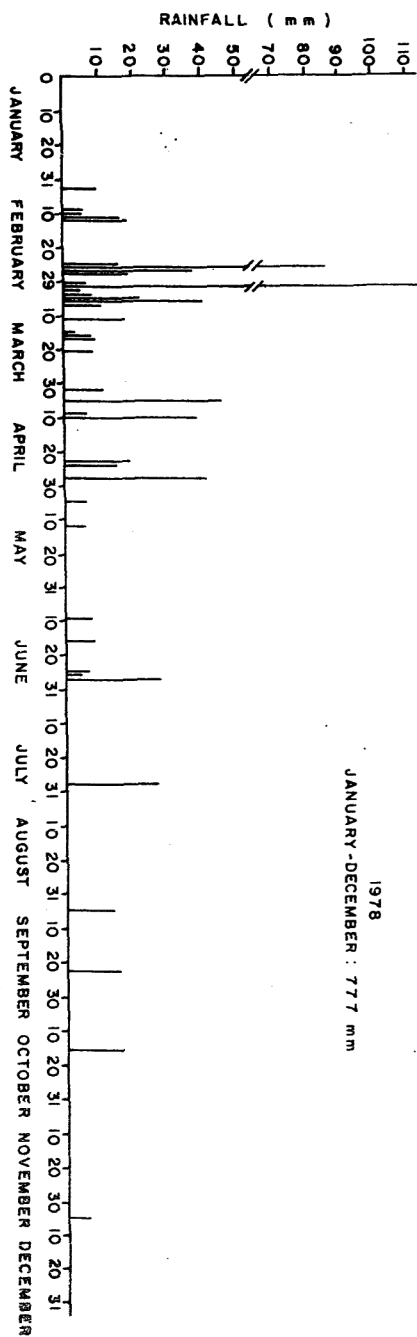
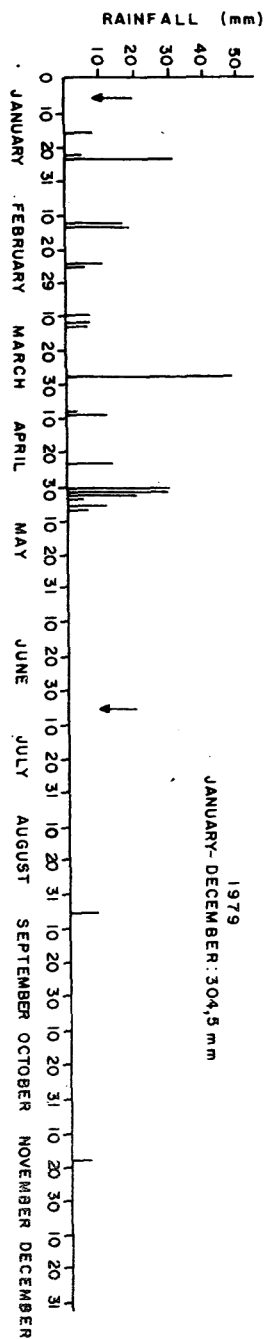
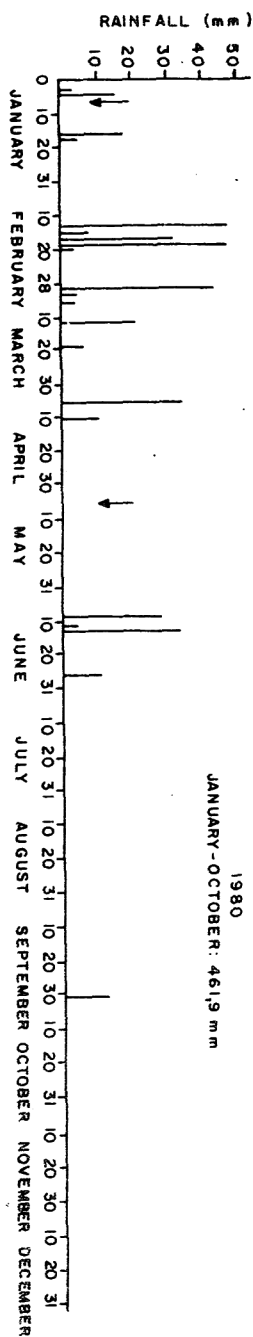
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Fig. 5 - Daily rainfall for the period from January 1978 to December 1980.

Fig. 5 - Precipitação diária no período de Janeiro de 1978 a Dezembro de 1980.





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