Ensaios nas Ciências Agrárias e Ambientais 4

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(Organizadores)

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APRESENTAÇÃO

A obra "*Ensaios nas Ciências Agrárias e Ambientais*" aborda uma série de livros de publicação da Atena Editora, em seu Volume IV, apresenta, em seus 22 capítulos, conhecimentos aplicados ao manejo de recursos hídricos com um grande apelo Ambiental.

O uso adequado dos recursos naturais disponíveis na natureza é importante para termos uma agricultura sustentável. Deste modo, a necessidade atual por produzir alimentos aliada à necessidade de preservação e reaproveitamento de recursos naturais, constitui um campo de conhecimento dos mais importantes no âmbito das pesquisas científicas atuais, gerando uma crescente demanda por profissionais atuantes nessas áreas, assim como, de atividades de extensionismo que levem estas descobertas até o conhecimento e aplicação dos produtores.

As descobertas agrícolas têm promovido o incremento da produção e a produtividade nos diversos cultivos de lavoura. Nesse sentido, o uso do recurso agua sob novas tecnologias e manejos está sendo constantemente optimizadas e, em constantes mudanças para permitir o uso racional e os avanços na produtividade das culturas. A evolução tecnológica, pode garantir a demanda crescente por alimentos em conjunto com a sustentabilidade socioambiental.

Este volume traz artigos alinhados com o manejo de recursos hídricos e manejo de recursos vegetais. Temas contemporâneos de interrelações e responsabilidade socioambientais tem especial apelo, conforme a discussão da sustentabilidade da produção agropecuária e da preservação dos recursos hídricos.

Aos autores dos diversos capítulos, pela dedicação e esforços sem limites, que viabilizaram esta obra que retrata os recentes avanços científicos e tecnológicos nas Ciências Agrárias, os agradecimentos dos Organizadores e da Atena Editora.

Por fim, esperamos que este livro possa colaborar e instigar aos professionais das Ciências Agrárias e áreas afins, trazer os conhecimentos gerados nas universidades por professores e estudantes, e pesquisadores na constante busca de novas tecnologias e manejos que contribuíam ao aumento produtivo de nossas lavouras, assim, garantir incremento quantitativos e qualitativos na produção de alimentos para as futuras gerações de forma sustentável.

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CAPÍTULO 8

INTERCEPTION OF RAINFALL BY NATIVE CAATINGA SPECIES, NORTHEAST BRAZIL

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ABSTRACT: As Brazil has biome richness and different types of vegetation cover, it is important to understand the influence of vegetation on hydrological processes. Studies indicate that 90% of the research on the interception of rainwater by vegetation is conducted in Amazon and Atlantic Forest, and this information is almost nonexistent when it comes about Caatinga. The aim of this study was to evaluate the internal precipitation and rainfall interception losses in Murici (*Byrsonima gardneriana* A. Juss), in the municipality of Olho D'Água do Casado-Alagoas. The experiment considered 21 individuals of Murici, who received interceptors to capture the internal precipitation and the "Ville de Paris" rain model was utilized to obtain the total precipitation, from January to December 2012. The readings were performed at each rain event and measured with a graduated cylinder. The rainfall events in an area with Murici occurrence indicate that the internal precipitation and the losses by interception corresponded to 16 and 83.87% of the rainfall, respectively, the distribution of rainfall index in 2012 was characterized by 17 events of low

intensity rainfall with values lower than 20mm; internal precipitation presented greater expressiveness in the rainy season in relation to dry season.
KEYWORDS: Semi-arid, Nutrient cycling; Rainfaall, Variability.

RESUMO: Como o Brasil dispõe de uma riqueza de biomas e diferentes tipos de cobertura vegetal é importante à compreensão da influência da vegetação nos processos hidrológicos. Estudos apontam que 90% das pesquisas sobre interceptação da água da chuva pela vegetação são realizadas na Amazônia e Mata Atlântica, sendo quase inexistentes essas informações quando se trata da Caatinga. Desse modo, objetivou-se avaliar a precipitação interna e as perdas por interceptação da chuva em plantas de Murici (*Byrsonima gardneriana* A. Juss), no município de Olho D'Água do Casado-Alagoas. O experimento considerou 21 indivíduos de Murici, os quais receberam interceptômetros para captação da precipitação interna e utilizou-se o pluviômetro modelo "Ville de Paris" para obtenção da precipitação total, no período de Janeiro a Dezembro 2012. As leituras foram realizadas a cada evento de chuva e mensuradas com proveta graduada. Os eventos de chuvas em área com ocorrência de Murici indicam que a precipitação interna e as perdas por interceptação, corresponderam a 16 e 83,87% da precipitação, respectivamente; a distribuição do índice pluviométrico no ano de 2012 foi caracterizado por 17 eventos de chuva de baixa intensidade com valores inferiores a 20 mm; a precipitação interna apresentou maior expressividade no período chuvoso em relação à época de estiagem.
PALAVRAS-CHAVE: Semiárido, Ciclagem de nutrientes, Precipitação pluvial, Variabilidade.

1 I INTRODUCTION

Forest cover is one of the most important barriers in the interception process of rainfall, since it allows some of the water to reach the soil surface with less impact (SHINZATO et al., 2011). Coupled to this fact, this is extremely important in water balance of ecosystems by changing the water and nutrient input mechanism on the soil surface (DINIZ et al., 2013).

For the authors, in an ecosystem the process of nutrient cycling is influenced by rainfall and the contact with the forest canopy that retains particles of a chemical-physical nature brought about by the leaching of metabolites from the tissues of leaves, trunks, of the particles deposited on the surface of the vegetation by rain, these nutrients return to the soil.

Rainfall occurs when vegetation is fractured through interception processes and effective precipitation. It is understood by interception of the rainfall that reaches the surface of vegetation, being redistributed as internal precipitation when the water enters between the openings of tree canopies (ARCOVA et al., 2003) and flow through the water trunk that is retained in canopy along with tree trunks that are then drained to the ground (OLIVEIRA JUNIOR and DIAS, 2005). The internal precipitation, added to the

flow through the trunk, results in effective precipitation (ALVES et al., 2007).

Water volume that reaches the soil and the amount of nutrients, according to Diniz et al. (2013) depend on factors such as vegetation type, morphological aspects of the forest, dominant precipitation regime in the region, vegetation cover density, tree diameter, rainfall intensity and wind speed (SILVA et al., 2009; ALVES et al., 2007).

The rainwater focus on forest cover and brings nutrients of mineral and organic constitution that return to the soil, contributing to forest nutrition, being an important process in the biogeochemical cycling (SOUZA, 2006). The understanding of this process in semi-arid region of the Brazilian Northeast is essential for contribution to the sustainability of forest ecosystems.

According to Giglio and Kobiyama (2013) the redistribution of rainwater by interception is little known in Caatinga, emphasizing the higher quantitative importance of interception in water balance, since the water stress stands out from the socioeconomic point of view, especially in the Caatinga.

In this context, it is advisable to known the quantification of rainwater interception by the crown of the plants and the nutrients present in it, especially in ecosystems with Caatinga vegetation and native plants of this biome such as Murici (*Byrsonima gardneriana* A. Juss) which presents medicinal and nutritional properties with potential for human consumption and as animal fodder.

Therefore, the aim of this study was to quantify the internal precipitation and rainfall interception losses in Murici (*Byrsonima gardneriana* A. Juss) in the municipality of Olho D'Água do Casado, Alagoas.

2 I MATERIAL AND METHODS

The study area is located in a private area in the municipality of Olho D'Água do Casado, Alagoas, located in the semi-arid Meso-region and Alagoas Microregion of São Francisco semi-arid region (ALAGOAS, 2015).

The region climate is BSh - Semi-Arid Tropical, according to the classification of Köppen (LIMA, 1977), with precipitation of 545,6 mm/year. The predominant soils in the region are lithic Neosol, constituted by stone fragments and Flossic Neosol, derived from environments with alluvial sedimentation (LEPSCH, 2002; EMBRAPA, 2006).

The area selected for the experiment was an area of natural vegetation, which was deforested for agricultural use, with native plants such as Murici (*Byrsonima gardneriana*) remaining in the locality, the study species.

The experiment was performed during the period from January to December 2012, consisting of 21 Murici matrices for the installation of rainwater harvesting structures, obtaining as inclusion criteria height of at least 2,5 m and circumference greater than 10 cm. The hydrological variables performed during the monitoring were: open or total precipitation, internal precipitation, interception losses and vegetation characteristics.

In order to obtain the total precipitation (TP), a "Ville de Paris" rain model was

installed in an open environment at a height of 1,5 m from soil surface, with a catchment area of 400 cm^2, distant 100 m from the evaluated plants.

Rainfall collections in the experimental area were performed at each rainfall event with the aid of a graduated cylinder, reading the water slide (mm).

For internal precipitation (IP), plastic intercepts (canister) with a capacity of 5 liters, a hose and a funnel with an internal diameter of 19 cm were used, with an area of 283,53 cm^2, installed at a height of 1,5 m from soil surface in the projection of the canopy, so the water accumulated in the funnel was led by the hose and stored in the plastic container.

The amount of rain incident on total precipitation (TP) and internal precipitation (IP) was calculated by the expression: h = (V/S) x 10, where: h = precipitated rainfall height (mm); V = volume of rainwater (cm^3) and S = catchment area (cm^2).

The interception (I) was calculated by the equation: I = TP - IP, where: TP = total precipitation and IP = internal precipitation.

It was not considered in this calculation the rainfall flow through the trunk, because the values obtained were very low, less than 2% (FERREIRA et al., 2005).

The rainfall values were grouped into four classes according to the methodology of Izidio et al. (20 ≤ PC <40 mm) and fourth class (PC ≥ 40 mm), the second class (10 ≤ PC <20 mm).

The experimental design was completely randomized, where 21 plants (sample units) were randomly selected and monitored in 17 rainfall events. The results were statistically analyzed by Tukey test at the 5% probability level and correlated with total precipitation data.

3 I RESULTS

Throughout 2012, variability was observed in the volume of total precipitation (Figure 1). The distribution of rainfall occurred over six months reaching a total volume of 166,9 mm, recorded in 17 events (Figure 1). Rainfall was concentrated in the period from May to August, with the highest volume in July (64,4 mm), presenting highest number of events (6), characterizing the rainy season (Figure 1).

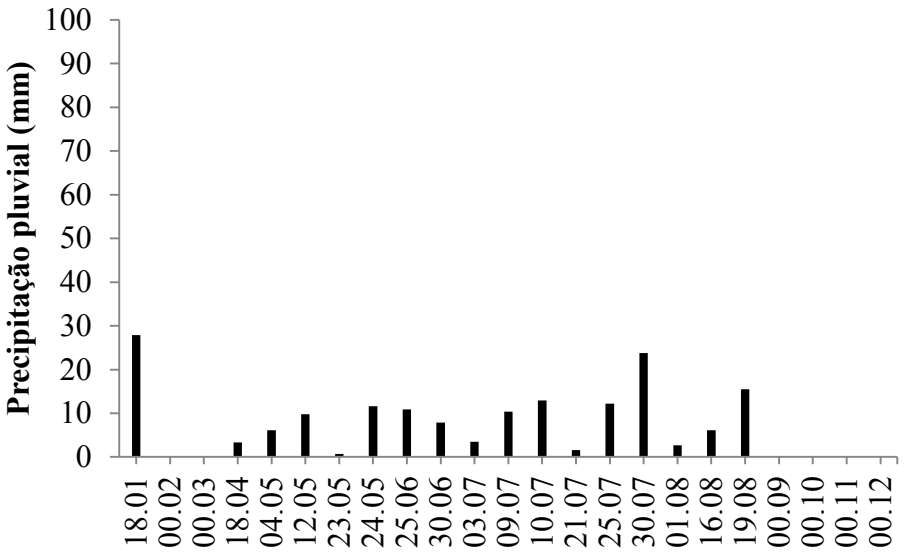

Figure 1. Rainfall (mm) observed during the period of January to December, 2012, in Olho D'Água do Casado, Alagoas.

It was observed that 9 of the 17 rainfall events had a volume lower than 10 mm, corresponding to 50% of total events, with total precipitation corresponding to 24,98%. There were seven events with volume between 10 and 20 mm, presenting 97,3 mm, totalling 58,29% of the total precipitation. Only one event was recorded in the class between 20 and less than 40 mm (Table 1).

In general, in 2012, the highest number of low-intensity rain events occurred, with values of less than 20 mm predominant (Table 1).

Precipitation classes	Number of Events	TP (mm)
PC < 10 mm	9	41,7
10 ≤ PC< 20 mm	7	97,3
20 ≤PC<40 mm	1	27,9
PC≥40 mm	0	0

TABLE 1: Precipitation classes (CP), number of events and total precipitation (TP) for classes in Olho D'Água do Casado, Alagoas

The internal precipitation (IP) reached a total volume of 26,70 mm, corresponding to 16% of total precipitation (Table 2).

Month	Events	TP		IP		I	
		(mm)	(%)	(mm)	(%)	(mm)	(%)
January	1	27,9	16,72	16,39	61,39	11,40	8,14
April	1	3,3	1,98	0,24	0,90	3,06	2,19
May	4	28,2	16,90	1,84	6,90	26,36	18,83
June	2	18,8	11,26	1,51	5,67	17,29	12,35
July	6	64,4	38,59	5,03	18,86	59,27	42,34
August	3	24,3	14,56	1,68	6,29	22,62	16,16

Table 2. Mean values of total precipitation (TP), internal precipitation (IP) and interception (I) of Murici (*Byrsonima gardneriana* A. Juss.), Olho D´Água do Casado, Alagoas, 2012

The highest percentages of internal precipitation (IP) occurred in the months of January (27,9 mm, 61,39%) and July (64,4 mm, 18,8%), due to this fact, the occurrence of rains of greater magnitude in those months that contributed to a greater wetting of the vegetation.

Precipitation total loss by interception was 83,87% (Table 2). It is important to note that of the 17 rain events, 9 of these events were less than 20 mm, resulting in greater interception, due to the initial wetting process of the leaves (Table 2).

Of the precipitate total in 2012 (166,99 mm) the losses per intercept corresponded to 133,99 mm, meaning that only 26,1 mm reached the ground.

The total volumes of internal precipitation (IP) and interception canopy (IC) presented variation (Table 3). In the analysis of variance between the months that presented the highest number of rainfall events (Table 3), no significant difference was found for internal precipitation (IP), total precipitation (TP) and interception (I). However, it was observed that in the month of greatest precipitation, greater interception was observed through the canopies of Murici.

Month	IP	TP	I
	---------- mm----------		
May	5,05 a	9,17 a	4,11 a
June	5,66 a	8,93 a	3,27 a
August	4,60 a	8,10 a	3,49 a
F Test	0,84	0,94	0,92
p>F	0,07 ns	0,03 ns	0,08 ns
C.V %	64,18	57,45	67,13
Mean	4,01	9,10	3,89

Table 3. Mean values of internal precipitation (IP), total precipitation (TP) and interception (I) of Murici (*Byrsonima gardneriana* A. Juss.), Olho D'Água do Casado, Alagoas, 2012

The accumulated values of the internal precipitation component (IP) for the rainy season (May-August) and dry (February-April) were 8,38 and 0,24 mm, respectively. In relation to the interception (I) in the rainy season was corresponded to 102,92 mm and in the dry season 3,06 mm, showing seasonal differences for these variables (Table 4). The internal precipitation during the rainy season was influenced by the increase of the total precipitation, presenting 31,43% of the precipitation in the rainy season and less than 1% in the drought period, demonstrating the reduction of precipitation.

Period	Internal precipitation (IP)		Interception (I)	
	mm	%	mm	%
Rainy	8,38	31,43	102,92	73,52
Drought	0,24	0,90	3,06	2,19

Table 4. Internal precipitation values (IP) and interception (I) by the tree canopy of Murici (*Byrsonima gardneriana* A. Juss.) in the rainy and dry seasons, Olho D'Água do Casado, Alagoas

4 I DISCUSSION

In the year of 2012, the total precipitated volume corresponded to 166,9 mm/year, being below the historical average of this region that is 545,6 mm/year (DCA, 2013), a characteristic feature of this region being the low aridity index and recurrence of droughts (MINISTÉRIO DA INTEGRAÇÃO NACIONAL, 2010).

There were 17 rain winds, with 50% presenting values less than 10 mm and only one event between 20 ≤ CP <40 mm. The results obtained were very similar to the data collected by Albuquerque and Costa (2012) in Caatinga of Coreaú city, Ceará, which registered 40 rainy events with 11 low volume events (<5 mm / day), with only 2 events records with rainfall greater than 30 mm.

Precipitation when in low volume as seen in most of the events recorded in the present study does not saturate the canopies and would cease immediately after the occurrence of the event. The internal precipitation is characterized by water that enters the openings of canopies (ARCOVA et al., 2003) and according to Moura (2013) when the events are of low volume these contribute of reduced form in the internal precipitation.

Vegetation cover has a direct influence on the redistribution of rainwater, where the tree canopies form a damping system and direct the droplets that reach the soil in a smoother and less impacting way, in order to provide greater humidity for soil and water available for vegetables (TONELLO et al., 2014).

Analyzing the internal precipitation in *Byrsonima gardneriana* species, it was also observed a variation of the values as a function of their morphology (leaf and crown size), the highest contributions of the plants that presented canopies and larger leaves; and plants arrangement in the area, with lower contribution of the internal precipitation verified in the isolated plants.

Similar behaviour was observed by Diniz et al. (2013) in a study conducted in Pinheiral-RJ with different succession stages of Rain Forest that observed lower values of internal precipitation in the smaller areas of canopies, since the smaller volume of rainwater was intercepted in canopies. In areas where the canopy was larger, a large part of precipitation was intercepted and retained in the canopies and gradually reached the ground, contributing to recharge of soil water.

For Brazil et al. (2017) although the Caatinga composition occurs predominantly of trees and shrubs with small leaves, the high rates of evaporation contribute to the interceptions as high as those recorded in regions with different climates, such as Rain Forest.

In a study about loss of interception in an area covered by Caatinga, Ceará, located in the Aiuaba Ecological Station in a preservation area (MEDEIROS et al., 2009), verified an internal precipitation value of 81% of the total precipitation, higher than that observed in the present study. Oliveira et al. (2011) highlights that this variation in internal precipitation depends of the total precipitation above the canopy.

In other ecosystems such as in the Eastern Amazon, the results were higher than the present study, as observed by Oliveira et al. (2008) that recorded internal precipitation of 76.8% of total rainfall. In Rain Forest, Diniz et al. (2013) recorded internal precipitation of 80% of the total precipitation. Sari et al. (2016) in Rain Forest in southern Brazil found internal precipitation between 75,97 and 82,40%. It is important to highlight that these different results are due to the unevenness of the vegetation structure and the climatic conditions of each region.

Moura (2013) affirms that with rain contribution, there is a greater turbulence in the leaves and branches causing the rain retained in the vegetation to be moved and fall. In addition, when canopy is saturated, the rain is practically not retained and this contributes to internal precipitation increase.

Interception compared to other studies about caatinga vegetation is considered high. Medeiros et al. (2009) at the Aiuaba Ecological Station, Ceará registered an index of 13%, and Marinho et al. (2002) Paraíba semi-arid region of 42% rainfall interception by vegetation.

In the Rain Forest, Arcova et al. (2003) found maximum interception of 18,6% of external precipitation. In a research project in the Capoeira area, Paraná, Thomaz (2005) observed interception of 36% and Lorenzon et al. (2013) in two areas with different regeneration stages, 84,39% (initial regeneration area) and 73,04% (advanced regeneration area).

In the monitoring performed by Tonello et al. (2014) in areas of Eucalyptus *cloezina*, *Pinus caribea* var. Hondurans and Semideciduous Seasonal Forest observed losses by interception of 13,8 , 15 and 22,8%, respectively.

Oliveira et al. (2008) also found variation between the values of internal precipitation (IP) and intercept by the canopy (IC), attributing this fact to the variation of total precipitation incident above the canopy. Izidio et al. (2013) studying the interception of rainfall in Caatinga area, observed that interception losses did not decrease as the rainfall height increased.

The quantification of interception in the water balance in Caatinga vegetation is rare and scarce, and new studies are necessary to cover other Caatinga physiognomies until sufficient studies of physiognomy of this biome have been made (GIGLIO and KOBIYAMA, 2013).

5 I CONCLUSIONS

- Monitoring of rainfall events in an area of Murici (Byrsonima gardneriana A. Juss.) Indicates that the internal precipitation and interception losses corresponded to 16% and 83.87% of precipitation, respectively;
- The distribution of the rainfall index in the year 2012 was characterized by 17 events of low intensity rainfall, generally with values lower than 20 mm;
- The internal precipitation presented greater expressiveness in the rainy sea-

son in relation to the dry season.

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