A comparison of fine root density of plants in the Coastal Plateau of the Guánica Dry Forest Reserve

Introduction

Root production is an important process in the dynamic carbon and nutrient cycle of terrestrial ecosystems. Root productivity of plant community can be affected by temperature, rainfall and availability of nutrients. In dry forests, root density within the soil system depends on seasonal resources availability, age and soil properties (Pavon and Briones, 1998).

In tropical dry forests experience seasonal drought. This seasonality is more pronounced in regard to dry and wet periods than to seasonal fluctuations in temperature (Castellanos,*et al.*,. 1991). Due to the lack of information on how biology of these forests respond to the seasonality of rainfall (Murphy and Lugo, 1986),our study focuses on understanding of root production by plants in the Guánica Dry Forest as a function of water availability. The Guánica Dry Forest is located in south western Puerto Rico (Fig 1). The rainfall recorded here over the period of 70 years varied from 500 mm to 1500 mm. The soils of the Guánica Dry Forest normally exhibits a deficit of water, ten out of twelve months of the year and seasonal climatic conditions indicate runoff only during the months of September and October (Lugo, *et.al.,* 1978).

Considering the great variation in water availability we hypothesized that the fine root density (<2mm)of plants in the Guánica Dry Forest will reflect the seasonal patterns of rainfall, with an increase in root density during the rainy season.

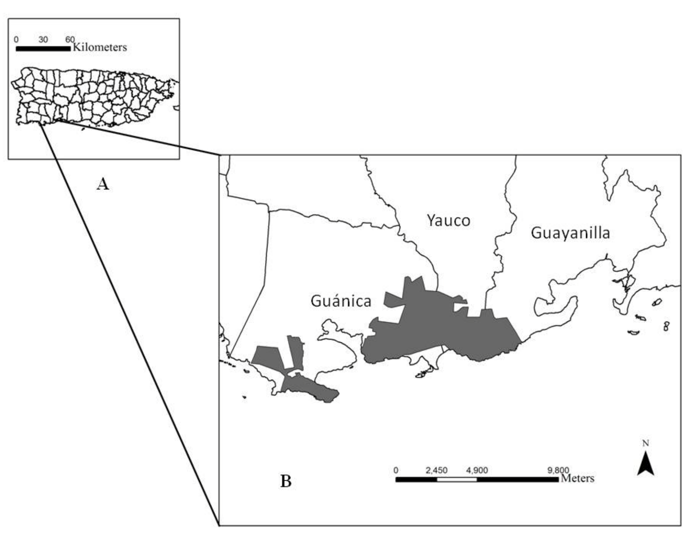

Figure 1: A Puerto Rico. B) Map of Dry Forest of Guánica.

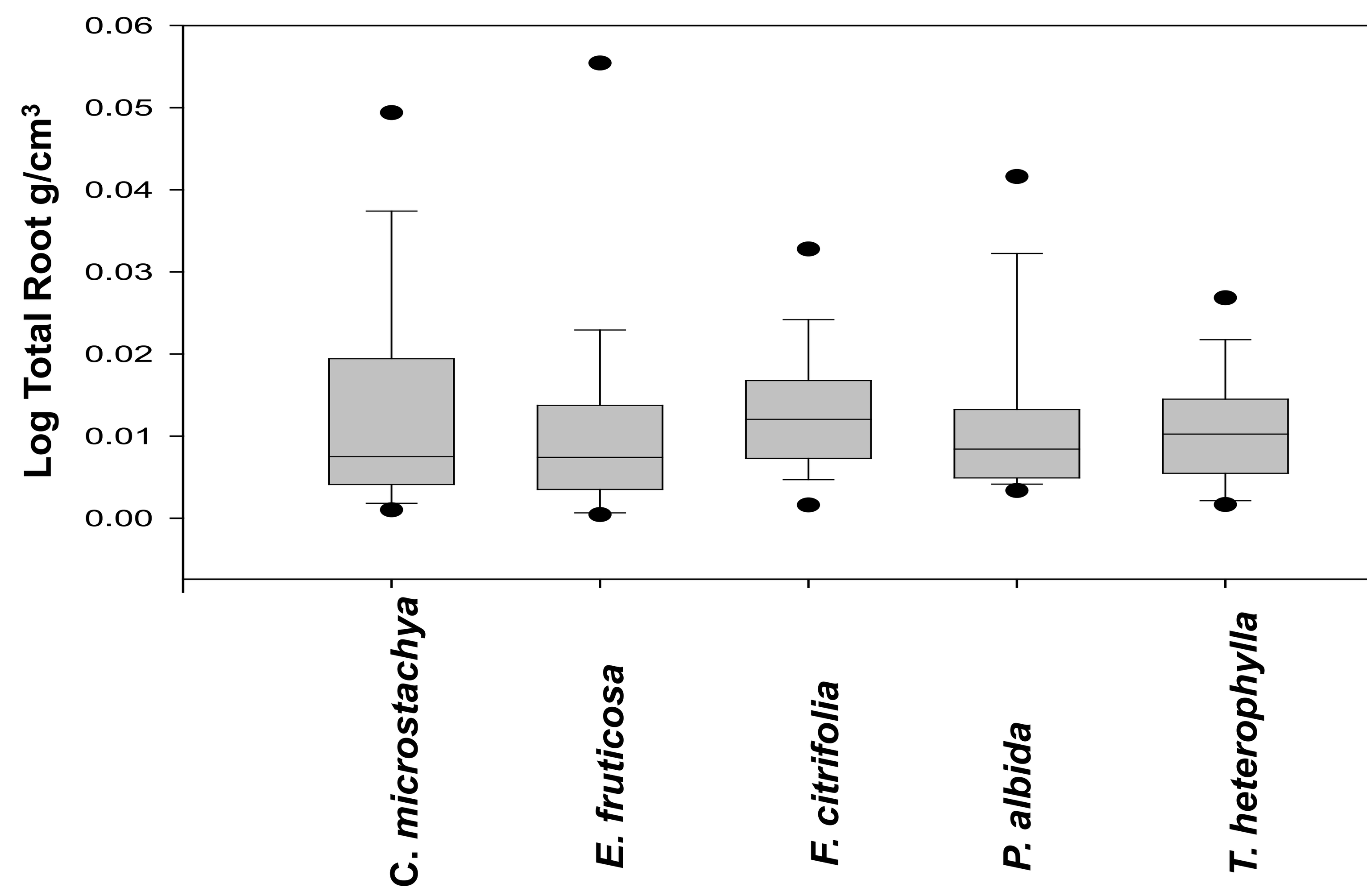

Figure 2: Total root density among five species in the Guánica Dry Forest

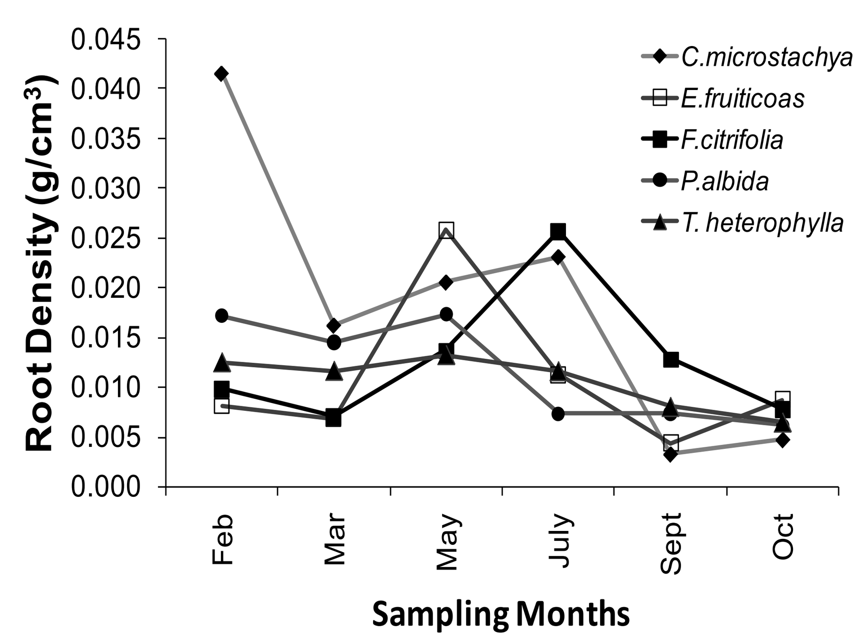

Figure 3: Temporal changes in total root density for five species collected.

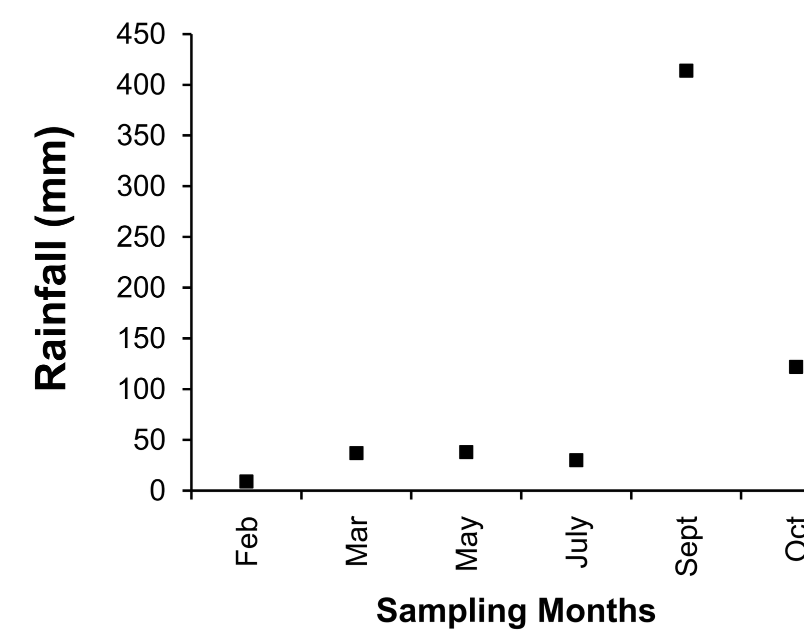

Figure 4: Rainfall measured in Guánica during sampling year.

Methodology

- In February, March, May and July,(dry season) and September and October 2008 (wet season) samples of fine roots were collected from 3 trees of 5 species (n=15). (*Coccoloba microstachya*, *Erithalis fruticosa*, *Ficus citrifolia, Pisonia Albida* and *Tabebuia heterophylla)*.
- Surface soil within a 100 cm^2 quadrat was collected down to bedrock under the canopy of the dwarf trees. The soil depth was very shallow and irregular with maximum depths of 10 cm in crevices.
- All root material was sorted and separated by sieves and hand sorting.
- The root samples were oven –dried at 60 C for 72 hours, weighed and root density [g/cm^3] was calculated.
- We log transformed total root density data and ran a two way ANOVA [SigmaStat Version 3]

100 cm^2 quadrat

Measuring Depth

Hand sorting roots

Sample Collected

Sorting using sieves

Weighing Roots

Results and Discussion

Table 1: Total Root Density (g/cm ^{3}) for each species during the sampling months

Species	Feb	Mar	May	July	Sept	Oct	Average	SDEV
C. microstachya	0.042	0.016	0.021	0.023	0.003	0.005	0.018	0.014
E. fruticosa	0.008	0.007	0.026	0.011	0.004	0.009	0.011	0.008
F. citrifolia	0.010	0.007	0.014	0.026	0.013	0.008	0.013	0.007
P. albida	0.017	0.014	0.017	0.007	0.007	0.006	0.012	0.005
T. heterophylla	0.012	0.012	0.013	0.012	0.008	0.006	0.011	0.003

Although there was variation in total root density (Table 1), we found no significant differences among species (Fig. 2.)

We found significant changes in root density for all species during the sampling period ($F= 3.914$, $df = 5$, $p \leq 0.012$). There was an increase in root density for all species in May and a decrease of root density for all species in September. Although other studies found an initial increase of root density after rainfall (Pavon and Briones, 1998), our study found a decrease in root biomass when highest rainfall was recorded (414 mm) in the Guánica Dry Forest (Fig. 3 & 4). We suspect that the timing of our sampling did not coincide with the flushing of root production but rather with the increase in decomposition of dead roots which resulted in lower root biomass for the rainy season.

Conclusions

Plants in the Guánica Dry Forest respond to changes in rainfall. Other environmental factors such as nutrient availability and timing of decomposition must be considered for future work. Our results are part of a broader study, expected to be carried out in the next 5 years. The data generated in this study is essential to understand nutrient dynamics and productivity of the ecosystem in order to predict how species respond to climate change.

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