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Comparative Study of the Structure Diameter of the Species Diospyros Crassiflora Hiern (Ebenaceae) in the Permanent Structures of the Yoko Forest Reserve and the Biaro Forest (Ubundu, DR Congo)

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Abstract

A study on the diametrical structure of the species Diospyros crassiflora was carried out in the Yoko Forest Reserve and in the Biaro Forest in two permanent devices of 400 ha each. This work pursued the objectives based on the distribution of the density by diameter class and the soil parameters in the two sites. All feet at dbh≥10 cm of the species studied were inventoried, measured across 40 strips of 10 ha each and soil samples were also taken at the two sites. 519 feet were counted, of which 325 were inventoried in the Yoko Forest Reserve. This one presents a good reconstruction of the stems of the species to have several individuals in the lower diameter classes. Soil analyzes were carried out and showed acidic soils at both sites.

Keywords: Comparative study, Diametric structure, Diospyros crassiflora, Yoko, Biaro.

1. INTRODUCTION

Forest management requires structural studies in order to know the forest species that can be exploited taking into account the logging standards set by the Congolese forestry administration.

The essence Diospyros crassiflora, called Black Ebony (pilot name) is the species used in cabinetmaking and in the manufacture of traditional statues and masks. It is one of the species most sought after by loggers and subject to illegal exploitation in recent years marking the periods before, during and post conflict in the eastern provinces of the Democratic Republic of Congo. A study was planned for this species with the objective of inventorying plants with a dbh ≥ 10 cm through the two devices at two sites and analyzing the soil at these sites.

The species considered in this study has a strict sciophilic temperament and belongs to the Ebenaceae family. It has a globular and narrow crown. Its bark is gray – blackish, rough flaking off gradually. Its notch is orange – black inside. Its fruits are subglobose berries, yellow then blackish, with 8 – 18 seeds. It is a tree with a less straight and less cylindrical bole that can reach 0.6 m in diameter. Its habitat is primary forest. His foot is fluted. Its leaves are simple, alternate, obovate 10 to 15 cm long, glabrous without stipules. Its flowers are axillary and its wood is black, very hard (Tailfer, 1989).

The permanent devices of 400ha in the Yoko Forest Reserve and in the Biaro forest are the two sites of our investigations (Picard and Gourlet – Fleury, 2008). The vegetation of the site in which the permanent system has been set up is characterized in Yoko by semi-deciduous mesophilic forests with Scorodophloeus zenkeri and in Biaro by evergreen mesophilic forests secondary to Petersianthus macrocarpus. These are replacement forests succeeding forest regrowth (Lomba, 2007) with soil presenting the characteristics recognized for the soils of the central Congolese basin (Germain and Evrard, 1954).

2. MATERIALS AND METHODS

2.1. Material

During our research in both devices, we were interested in individuals of the Diospyros crassiflora species.

2.2 Methods

2.2.1 Shedding

The works of Layonnage made it possible to delimit the device of 400ha by means of the compasses of mark SUUNTO and SYLVA SYSTEM to direct the layons; a GARMIN brand GPS (ETREX) to take the geographical coordinates of the device; pentadecameters to measure the lengths of different lines and machetes to open the lines. 40 equidistant secondary lines of 50 m were made to delimit the strips of 2000m × 50m laid out for the inventories and in which plots of 200m × 50m were made and subdivided into sectors of 50m × 50m using nylon threads (Lejoly, 1994; Stahl *et al.*, 2000; Picard, 2007).

2.2.2. Soil analyzes

Soil samples in the sandy and clayey places were taken to carry out the analyzes of the following parameters: Hydrogen potential (PH), Phosphorus and Organic matter.

2.2.3. Inventory

It consisted in listing all the individuals at dhp≥10 cm of the species studied over the area of 400 hectares of each permanent device.

The diameters or circumferences of all the plants were measured at a height of 1.30 m from ground level, above the first branch (Golley, 1983; Gesnot *et al.*, 1994; Lejoly, 1994; Taylor *et al.*, 1996; Lomba *et al.*, 2003). The counting of these individuals was carried out by sector (50m × 50m), plot (200m × 50m) and strip (2000m × 50 m), i.e. 1600 sectors; 400 plots and 40 bands.

3. RESULTS

At the end of our investigations, we counted 325 feet of Diospyros crassiflora species in the permanent device of Yoko and 194 feet in that of the Biaro forest.

The density of the species considered is 0.813 in Yoko and 0.485 in Biaro.

3.1. Diametric Structure of Pterocarpus Soyauxii

The numbers of individuals of the Diospyros crassiflora species in the two sites are as shown in the figure below.

Table 1: Breakdown of numbers and densities by diameter classes

Diameter classes	Yoko Forest Reserve	Density	Biaro Forest	Density
10 – 19.9	117	0.292	75	0.185
20 – 29.9	177	0.442	55	0.137
30 – 39.9	27	0.067	28	0.070
40 – 49.9	2	0.005	19	0.047
50 – 59.9	2	0.005	9	0.022
60 – 69.9	0	0.000	5	0.012
70 – 79.9	0	0.000	1	0.002
80 – 89.9	0	0.000	2	0.005
Total	**325**		**194**	

It follows from this table that there is a strong representation of individuals in the first class in Yoko than in Biaro. The studied species presents eight diameter classes in Biaro and five in Yoko.

The species considered has fewer individuals in the upper classes within our two sites of our work.

It also emerges from this table that class 1 (10 – 19.9) has a high density in the Biaro forest (0.185 ha^{-1}) and class 2 (20 – 29.9) in Yoko is the one with a higher density. High density (0.442 ha^{-1}).

The figure below shows the diameter distribution of the species Diospyros crassiflora in the two study sites.

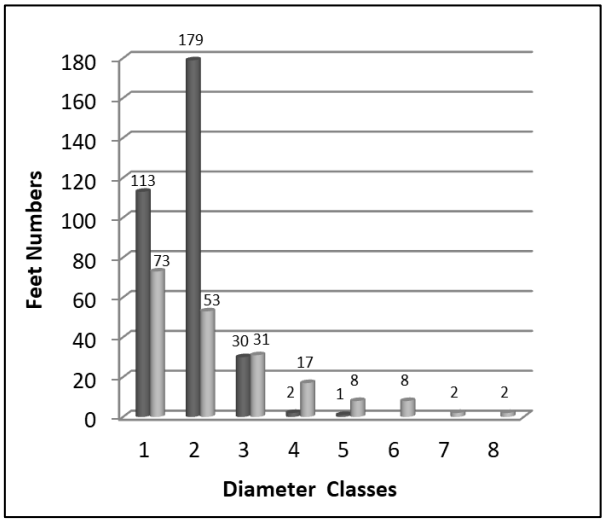

Figure 1: Diameter distribution of Diospyros crassiflora at Yoko (black bars) and at Biaro (gray bars)

In this figure, the general shape of the curve at Yoko is bell-shaped with a high peak (class two). In Biaro this general pace is exponential, inverted j with a slight slope.

This figure shows eight diameter classes overall. Three diameter classes have no individuals at Yoko, namely; classes six, seven and eight.

Yoko's permanent arrangement has few individuals in the first class and the distribution is less balanced because the number of individuals in the second class exceeds that of the first class.

As for that of Biaro, its diameter distribution is balanced because the number of individuals decreases with the increase in diameter classes. The calculated gasoline p–value coefficient is 0.27 with the Kolmogorov–Smirnov statistical value D = 0.5.

The p-value greater than 0.05 means that there is no significant difference between the two diameter distributions of the individuals in the two study sites.

3.2. Physico-Chemical Parameters of the Soils at the Two Sites

Tables 2 and 3 below present the values of the different soil parameters studied.

Table 2: Soil values at Yoko

Substrates|Soil values								
	% Clay	% Sand		pH	Conductivity Electric (µs/cm)	Phosphorus (µg/g)	Matter Organic %	Litter (cm)
Sandy soil	13.0	86.1	0.7	3.7	302.6	31.9	2.4	5.5
Clay soil	59.2	39.6	1.5	4.0	388.9	17.1	5.4	4.9

The hydrogen potential (PH) of the soils in Yoko is around 3.7 in the sandy soil and 4.0 in the clay soil; that is to say an acid soil (PH<6).

In the sandy soil, organic matter is less; i.e. 2.4% compared to clay soil; i.e. 5.4%.

Table 3: Soil values in Biaro

Substrates|Soil values								
	% Clay	% Sand		pH	Conductivity Electric (µs/cm)	Phosphorus (µg/g)	Matter Organic %	Litter (cm)
Sandy soil	10.0	84.9	0.4	4	257.5	27.4	2.1	4.9
Clay soil	63.6	35.8	1.6	4.5	322.2	17.9	5.0	3.7

The hydrogen potential of the soils in Biaro reveals an equally acidic soil including clay soil 4.5% and sandy soil 4%.

Organic matter is abundant in clay soil; i.e. 5% compared to sandy soil; i.e. 2.1%.

3.3. Diospyros Crassiflora Exposure at both Sites

The species being strict sciophilous presents many individuals in the diameter classes of reconstitution (1 and 2) in Yoko because the seedlings are covered by the canopy of the forest which favors the shade necessary for the development of young stems.

4. DISCUSSIONS OF THE RESULTS

4.1. Distribution of Individuals by Diameter Classes

The species Diospyros crassiflora presents many individuals in Yoko in the diameter classes which constitute the classes of replacement of the adult feet. This is justified by the good regeneration of seedlings in the Yoko Forest Reserve which has many individuals of small diameters favorable for the reconstitution of the forest. Lomba (2007) also confirmed this for certain ligneous species.

In Biaro, the forest has many gaps which allow enough light to penetrate and do not quickly favor the germination of gasoline diaspores. In Yoko as in Biaro and on 400 ha of our work, the essence is less represented compared to others. This could be explained by the different movements of the inter-tropical convergence front which regularly cross the area of our two study sites causing the fall of trees which would modify the ecological conditions of Diospyros crassiflora (Aussenac, 1970; Leonard *et al.*, 1996; Puig *et al.*, 1989 and Zobi, 2002).

The diameter distribution of Diospyros crassiflora is in the form of an inverted J in the Biaro forest because it is a young forest, open and in full recovery. This distribution is bell-shaped in Yoko following the presence of a mature forest, covered with an abundance of litter which favors the power of germination of the diaspores of this species.

4. 2. Comparison of the Diameter Classes of Two Sites

Diospyros crassiflora species presents eight diameter classes in the Biaro forest. This would be justified by a good adaptation of this species in Biaro in the upper diameter classes, whereas in the Yoko Forest

Reserve there are no individuals in classes six, seven and eight.

Nevertheless, the good regeneration of this species is reported to Yoko for having presented many individuals with small diameters.

4.3. Comparison of Physico-Chemical Parameters of Soils

In Yoko and Biaro the soils are acidic with a slight nuance in terms of organic matter in favor of Yoko. The acidity of these soils is explained by their permanent leaching in the tropical zones. Sahungu *et al.*, (1996) found acidic hydrogen potential for the soils of Doi Inthanon National Park. In Cameroon, Newberry *et al.*, in (1986) and Peh *et al.*, in (2011) determined the quality of acid soils successively in the EDEBA Forest Reserve and the Dja Fauna Reserve. Amani (2011) also observed soil acidity in our two sites.

5. CONCLUSIONS

At the end of this work which reveals the ecology and the diametrical structure of the species Diospyros crassiflora in the Biaro forest and in the Yoko Forest Reserve, 519 feet including 325 in Yoko were counted.

The essence of our study counts many individuals of lower classes in Yoko and upper classes in Biaro. This duality would be due to the strict sciophilic temperament of this essence.

The reconstitution of this species would be favorable in Yoko given the optimum ecological conditions of young stems and in Biaro these conditions are upset by the presence of many gaps which bring a lot of light into the undergrowth.

The soils in the two sites of our study are acidic.

We suggest carrying out studies relating to the anatomy of it's wood to know its growth in height and diameter monthly or annually.

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