

# Characterization of four pioneering species from a tropical forest in the Pindorama Biological Reserve, São Paulo State, Brazil based on soil and Phytosociological attributes

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## Abstract

This work had the objective to characterize populations of pioneering tree species of the Biological Reserve of Pindorama, SP, Brazil, based on the physical and chemical attributes of the soil. For this, 65 parcels of 400 m<sup>2</sup> had been demarcated in two toposequences located in remainders of a Seasonal Semi-deciduous Forest. In each parcel the degree of infestation of weed species was evaluated. Inside of each parcel was drafted a subunit of 10 x 10 m (100 m<sup>2</sup>), where the physical and chemical attributes of the soil had been evaluated, the altitude, the basal area, the height, the number of individuals of the trees species with diameter at breast height (DAP) equal or superior than 5 cm. The species diversity was calculated with the Index of Shannon (H') and with the Index of Equability of Pielou (J) of the trees species community of each top sequence. It was also calculated the Similarity Index of Jaccard (ISJ) between the two remainders. The characterization was made by sampling parcels considering pioneering species that presented six or more individuals in at least one of the remainders evaluated: *Aloysia virgata* Ruiz & Pav. A. L. Juss., *Acacia polyphylla* DC, *Croton floribundus* Spreng and *Casearia Sylvestris* Sw. The hierarchic grouping analysis by the Ward method made possible a division of the physical and chemical attributes of the ground in five groups of parcels. For each group the average values of each characteristic had been determined, as well as recalculated the index of diversity of species and equability of the tree species that allowed a characterization of the pioneering species for groups. The evaluated species were responsive to different soils and phytosociological attributes. *Croton floribundus* occurred in sandy soil parcels and with lower fertility, *Acacia polyphylla* and *Aloysia virgata* occurred in soils of higher altitudes. The soils with higher clay percentage and of natural good fertility had greater infestation of weeds such as lianas, bamboo and other grassy and lower diversity of tree species. The infestation of the parcels by weeds affected the basal area and height of the evaluated species. In these parcels it was observed that the pioneering species had reduced basal area and height.

## Key Words

Top-sequence, phytosociology, soil and vegetation relation, forest fragments

## Introduction

The Biological Reserve of Pindorama, SP, located in an agricultural experimental unit called Polo Regional Centro Norte, in the city of Pindorama, SP, Brazil, has an area of 120 ha, distributed in four forest remainders of biome Atlantic Forest, classified as Seasonal Semi deciduous Forest. The majority of the remainders in São Paulo state have small size, due to fragmentation with edge effects (Kronka *et al.*, 2006). The structure of these fragments are related with the occurrence of the trees of the different described sucessional groups for Budowski (1965) where pioneer species in bush in a primary sucessional period represent a low density of the tree component, therefore these species tend to occupy areas modified by anthropic actions, areas in the neighborhoods of the edges and bare places in the interior of the remainder (Budowski, 1965). In accordance with Tabanez *et al.* (1997) the edge effect intervenes with the occurrence of pioneering, secondary and climax species in a band that can extend up to 100 meters. In these bands, the occurrence of invading species is favored by the presence of light and ground attributes (Tabarelli and Mantovani, 1999). The opening of bare places can contribute for the diversity of the fragments; therefore some species depend on these occurrences for regeneration, such as the pioneering species (Tabarelli and Mantovani, 1999). The wealth of pioneering species varies with biome, the place and the presence of invading plants. Tabarelli and Mantovani (1999) had determined that the density and diversity of pioneering species had presented negative relations with the height of the adjacent canopy and infestation of bamboo. These factors function as barriers to the arrival of direct light to the surface, the plant cover was related to diverse factors including climate, relief, altitude, physical, chemical characteristics of the soil. The present

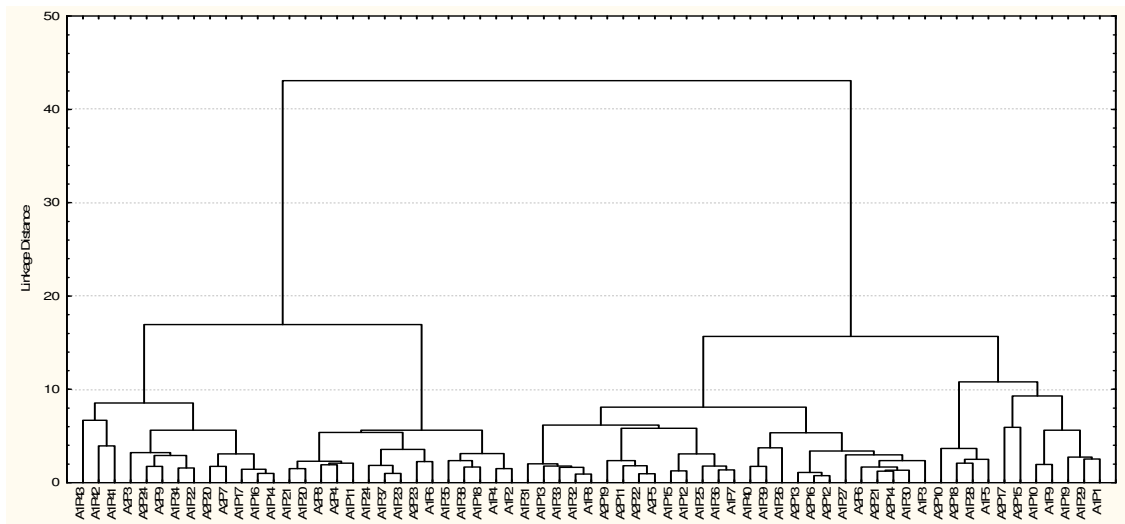
work had as an objective the characterization of populations of pioneering tree species of the Biological Reserve of Pindorama, SP, on the basis of the physical and chemical attributes of the soil and the phytosociological attributes.

## Methods

The parcels were distributed throughout two toposequences 1 and 2, on the basis of Tabanez *et al.* (1997). Each toposequence demarcated into 20 sequential parcels of 20 m x 20 m (400 m<sup>2</sup>). In toposequence 1, 43 parcels and, in toposequence 2, 22 parcels were demarcated. In each parcel of 400 m<sup>2</sup> a quadrant of 10 m x 10 m was selected for characterization of arboreous individuals with a diameter at chest height (DAP)  $\geq$  5 cm, for the phytosociological survey. The phytosociological survey and the collection of material for ground analysis was for the drafted quadrant of each parcel (10 m x 10 m) and for the evaluation of the degree of infestation for invading plants the total parcel was 400 m<sup>2</sup>. For soil evaluation, physical and chemical analysis a composite sample of 20 sub samples to a depth of 0-20 cm was used. After air drying, the following analyses were conducted: physical analysis, pH, organic substance, phosphorous, potassium, calcium and magnesium; potential acidity, basis saturation. In the drafted quadrant of 100 m<sup>2</sup>, trees with DHC (diameter at chest height 130 cm from the ground)  $\geq$  5 cm. These individuals were identified with metal plates consisting of the identification number of the parcel and the individual. For each individual the diameter and material collected for botanical identification were written down. The following phytosociological variables: density, dominancy, frequency of the species, value of importance, the basal area of all the individuals of the species and for the analysis of diversity was calculated as the Index of diversity of Shannon (H') and the Index of equability of Pielou (J). To verify the similarity between the areas the Index of Similarity of Jaccard (ISJ) was used. The characterization of the pioneering species was made from pioneering species that presented as six or more individuals in at least one of the studied areas that is: *Aloysia virgata* Ruiz & Pav. A. L. Juss., *Acacia polyphylla* DC, *Croton floribundus* Spreng and *Casearia Sylvestris* Sw. Multivariate analysis of hierarchic grouping was used with the physical and chemical attributes of the ground indicated the division in five groups of parcels were possible. Evaluation of the degree of infestation for invading plants in each parcel of 400 m<sup>2</sup> was evaluated. 10 classes of infestation were created that varied from null (zero) to completely infested (ten) (Valeri *et al.*, 2003). Multivariate, exploratory statistical techniques were used to verify similarities between parcels based on physical and chemical attributes of the soil. Analysis of grouping using a hierarchic method used Euclidean distances as a measure of similarity and the method of Ward, as the algorithm linking between groups. After the adoption of five groups of edaphic similarity had been calculated the altitude averages, physical attributes and chemical soil attributes and degree of infestation by invading plants for each group of parcels was determined according to Hair *et al.* (1995). The processing of the grouping analyses was by Statistica software, version 7.0 (Statsoft, 2004) after standardization.

## Results

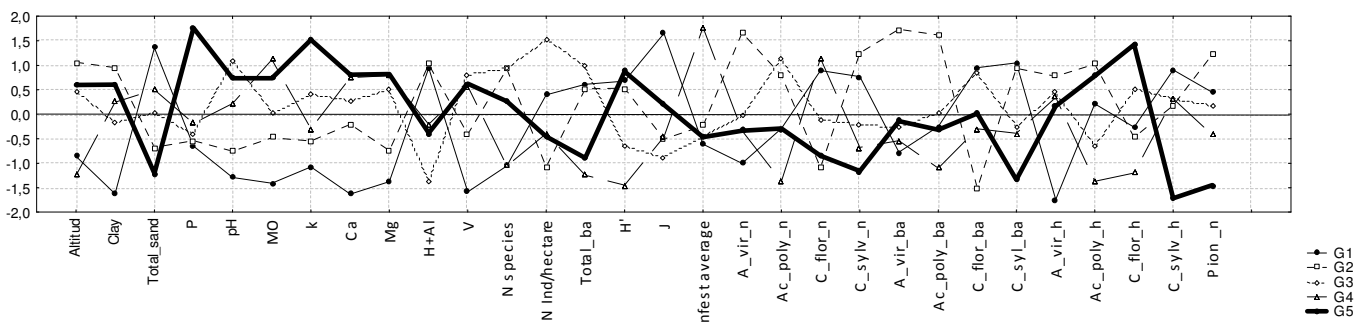
The structure of groups is shown in Figure 1. Division was into 5 groups based on granulometry and attributes of soil fertility was adopted, maximizing the similarity between parcels inside the group and maximizing the dissimilarity between the groups. From the division into five groups the average values of altitude and the physical and chemical attributes of soil for each group were determined (Table 1). Averages were calculated for number of species, number of individuals per hectare, basal area per hectare of all the individuals, value of importance, Index of Shannon (H') and Index of Equabilidade de Pielou arboreous (J) of the community, as well as the degree of infestation by invading plants. The characteristics of occurrence and growth of the pioneering species for groups of parcels of edaphic similarity are presented in Table 2. The characterization of the pioneering species on the basis of the variations of the altitude, of the physical and chemical attributes of soil, and degree of infestation of invading plants for each group of parcels of edaphic similarity are illustrated in Figure 2. The occurrence of the trees and its relation with soil attributes can be seen in the Figure 2



**Figure 1. Dendrogram with the structure of the analyzed groups data based on soil attributes of two top sequences of tropical forest in the biological reserve, pindorama, sp, Brazil.**

**Table 1. Average of physical and chemical attributes of the soil for groups of parcels (g1 to g5).**

Groups	Clay	Sand	P	pH	MO	K <sup>+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	H + Al	V
	..... g kg <sup>-1</sup> .....	..... mg dm <sup>-3</sup> .....	..... mg dm <sup>-3</sup> .....	Ca Cl <sub>2</sub>	g dm <sup>-3</sup>	..... mmol <sub>c</sub> dm <sup>-3</sup> .....	..... mmol <sub>c</sub> dm <sup>-3</sup> .....	..... mmol <sub>c</sub> dm <sup>-3</sup> .....	..... % .....	
G1	124,07	815,53	4,84	5,60	20,07	1,75	37,15	10,53	17,23	73,67
G2	157,06	752,60	5,06	5,78	24,13	2,06	56,73	12,06	17,40	80,20
G3	142,57	774,21	5,35	6,40	26,35	2,59	63,21	15,07	12,07	86,82
G4	148,00	789,08	5,75	6,11	31,08	2,20	69,75	15,75	14,66	85,62
G5	152,63	736,36	9,54	6,29	29,45	3,23	70,54	15,81	14,27	85,92



**Figure 2. Average for the five groups of altitude, soil attributes, phytosociology attributes and characteristics of the pioneering species. Where A\_vir = *Aloysia virgata*, A\_poly = *Acacia polyphylla*, C\_flor = *Croton floribundus*, C\_sylv = *Casearia sylvestris*, n = numbers of individuals, ba = basal area and h = height**

**Table 2. Number of individuals, basal area and height of the pioneering species.**

Groups	<i>Aloysia virgata</i>	Pioneering <i>Acacia polyphylla</i>	Species <i>Croton floribundus</i>	<i>Casearia sylvestris</i>
	Number of individual			
G1	0	5	9	4
G2	8	8	1	5
G3	3	9	5	2
G4	2	2	10	1
G5	2	5	2	0
Basal area (cm <sup>2</sup> ha <sup>-1</sup> )				
G1	0,00000	0,12940	0,15539	0,02977
G2	0,09390	0,38122	0,01031	0,02840
G3	0,01832	0,17005	0,14928	0,01334
G4	0,00882	0,01438	0,08197	0,01179
G5	0,02359	0,12090	0,10028	0,00000
Height (m)				
G1	0,00	13,60	9,56	7,75
G2	7,25	17,00	9,00	5,60
G3	6,33	10,00	11,60	6,00
G4	6,00	7,00	7,10	6,00
G5	5,50	16,00	14,00	0,00

### Conclusion

The distribution and growth of pioneering species varies in accordance with variations of the physical attributes and fertility of soil, relief, and covering of the area with weeds.

The characterization of the population of pioneering trees species and the vegetal covering must be made by unit of area or group of parcels with similar characteristics that represent sampling elements, as species, edaphic characteristic, among others changeable variables.

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