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Simpósio

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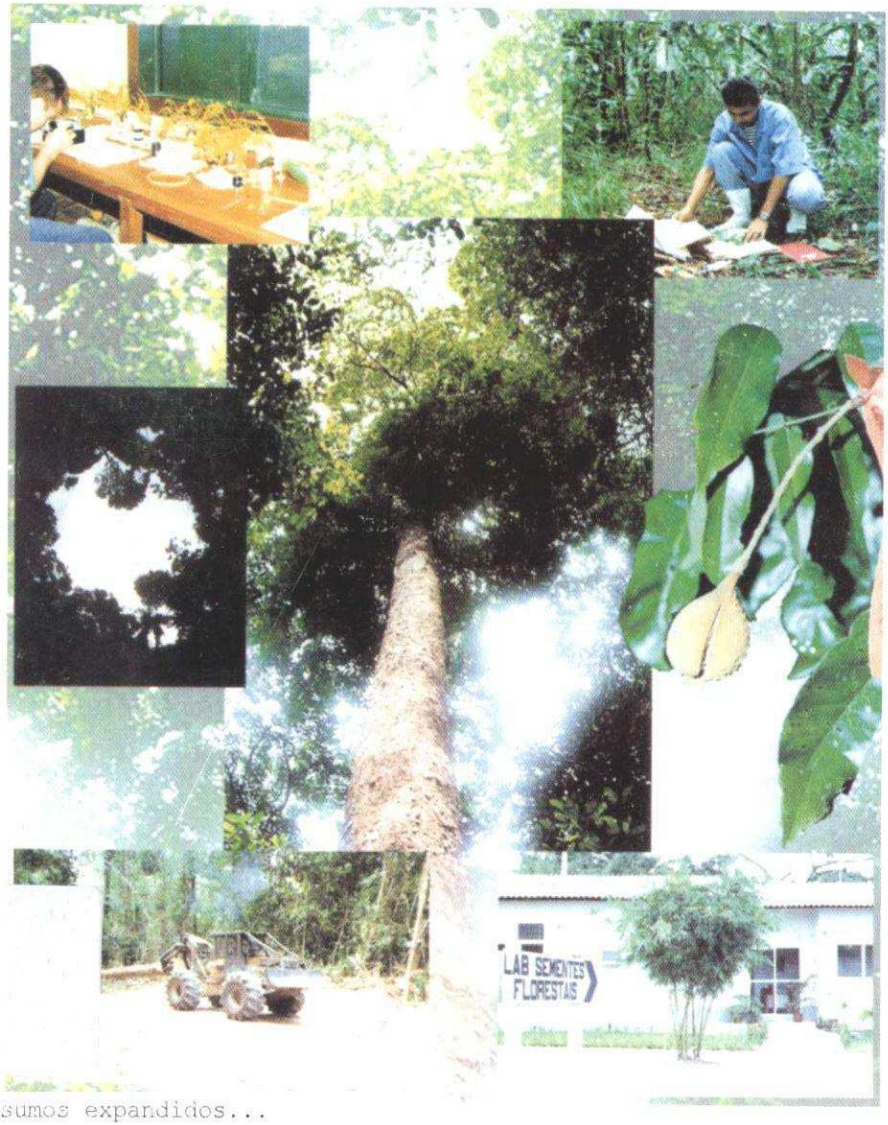

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SIMPÓSIO

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REPRODUCTIVE ECOLOGY OF *Schizolobium Amazonicum* HUBER EX DUCKE AND *Sclerolobium Paniculatum* VOGEL (Leg:Caesalpinioidea) AND ITS IMPORTANCE IN FORESTRY MANAGEMENT PROJECTS[1]

Giorgio Cristino Venturieri[2]

The Amazon Region contains the greatest timber reserve found in the world's tropical forests. The rapid diminishing of these resources is a concern, occurring mainly due to the expansion of the agricultural frontier and the uncontrolled timber extraction, practised today in this region.

The lack of basic biological information on the great diversity of timber species, impedes the secure recommendation of measures to guarantee the ecological viability of so-called "sustainable management projects," presently considered to be the only means capable of insuring the continuous use of tropical forest resources (Johnson et al., 1993).

This paper presents, observations of *Sz.ama.* and *Sl.pan.*, two species that are important not only for the economic value of their wood, but also for their role as pioneer, rapid-growth species in the regeneration of degraded areas and in the naturally created forest clearings.

The field studies were undertaken from May of 1993 to May of 1996 in Belterra (2°38'S 54°57'W), municipality of Santarém, and Belém (1°53'S 48°46'W), Pará state. The first locality is on a plateau with an altitude of 175 m. The climate in this region is AMi, according to the Köppen scale, with a mean temperature of 25°C, average relative humidity of 86%, and annual precipitation of 2,111 mm, and an average total of 2,150 hours of sunlight (Carvalho, 1978). In the Belem Region, the climate is AFi, with no great differences from that of Belterra, with a slightly high mean annual level of precipitation, and an altitude close to sea level.

Access to the flowers was made with the help of climbing equipment and the construction of scaffolds. For the morphological characterization of the flowers and inflorescence, blossoms containing buds and flowers were collected. These were then dissected, photographed and drawn with the aid of a magnifying glass. To measure the percentage of sugars (samples collected between 9:00 and 11:00 h in flowers previously protected) and availability of

[1] Supported by the agreement between Embrapa Amazônia Oriental/DFID.

[2] Agronomist M.Sc., Research of Embrapa Amazônia Oriental, Caixa Postal 48, CEP 66.017-970, Belém, PA.

nectar throughout the day, a portable spectro-photometer and 2µl capillary tubes were used. Tests with H_2O_2 (5%) were carried out to verify the viability of the stigma at different times. The pollen-ovule ratio, was established according to the methodology proposed by Cruden (1977), with the adaptation of a haemocytometer to count the grains of pollen. To obtain averages 500 samples from different flowers of different trees were used for each species.

For the investigation of the reproductive system, three different individuals were used, with the undertaking of the following controlled pollinations: (a) induced self-pollination without emasculation, (b) spontaneous self-pollination and (c) control plant, to verify natural pollination (adapted from Dafini, 1993; Zapata and Arroyo, 1978). To verify natural rates of fruiting, inflorescences and later branches containing mature fruit in different stages of development were taken from the five individuals used for this study. In each panicle the total number of buds emitted, the number of flowers that bloomed during the day and finally, at the end of the season, the number of fruits produced were counted.

Schizolobium amazonicum (*Sz.ama.*): Is a tree-size species, quite similar to *S. parahyba* of the Brazilian Atlantic Forest, distinguishing itself only by the presence of an articulated pedicel, smaller flowers and fruits, and more oblong petals which are firmer and glabrous. It grows rapidly, quickly reaching the forest canopy. If compared with other species of the primary forest, its life span is short (20-40 years), limited by the low resistance of its wood and frequent attacks by termites.

Flowering, which occurs in May or June, is massive, quick and synchronized with that of other individuals of the same region. Its flowers are borne in inflorescences that are paniculate, ascendant and acropetal. The flowers are average sized, measuring, 2.5 to 3.0cm, and of a yellow color. The flower is hermaphroditic, xygomorphic with a chaliced receptacle where the perianth segments are inserted, dialypetal, valvate and dialysepal, and pentamerous. The corolla is imbricated, with the petal edges slightly fringed and spatulated along the upper edge. There are 10 free-standing stamens, united at their base, that are heterodynamous, with one being isolated and the other adaxially disposed on the standard petal. The anther has two lobe, dorsifixed with a longitudinal dehiscence. The ovary is unicarpel and unilocule, and its external wall is covered with dark brown hairs, the stigma is filamented with only one lobes. The pollen-ovule ratio was 4,990, a characteristic which, according to Cruden (1977), indicates the presence of xenogamy.

Anthesis begins at about 5:45h (local time), and dehiscence begins

about one hour later in a progressive manner, such that, at first, only six anthers open, always with four remaining, with the last two opening later, at about 10:00 and 11:30 h, respectively. With this strategy the flower of the *Sz.ama.* prolongs the offering of its resources and consequently increases its chances of being pollinated.

Tests with H_2O_2 indicate protogyny, with the stigma remaining viable until the end of the day, when the flower closes. Flowers do not show any type of exsudate and the zone of receptivity is located half-way along the apex. The flowers are without fragrance, large and visible. When in flower the crown becomes completely yellow, as total or partial leaf-fall may occur. The average percentage of sugars for the nectar was 30.83(±0.26), n=20. The volume of nectar taken from the flowers was never greater than 1.5µl. In the controlled pollination tests, paricá showed itself to be self-incompatible, with complete abortion of all the self-pollinated flowers.

For the individuals studied in Belterra the number of fruits obtained from each natural pollination in each panicule was 1.38±0.02 (n=50), resulting in a success rate of 3.2% in relation to the number of flowers emitted. It was observed that paricá does not support more than four fruits on the same panicule. When three or four fruits are successful, the other buds abort, which causes the rest of the panicule to dry up.

The flower of paricá is visually very attractive, offering nectar and pollen in large quantities, attracting various species of insects, however the effective pollinators of this specie are notably the medium and large-sized bees, such as Anthophoridae (*Xylocopa* spp. and *Centris* spp., males and females) and some Apidae (*Melipona* spp. and *Apis mellifera*). Smaller bees (4-6 mm) of the Trigonini tribe, together with Lepidoptera (families Hesperiidae, Danaidae and Nemeobiidae) were found collecting nectar (and pollen, in the case of the bees) throughout the whole day. These insects, howevwer, contribute in only a small way to pollination, as their behavior and size are not compatible with the flower structure.

Sclerolobium paniculatum (*Sl.pan.*): The flower is light yellow, with fragrance, borne on panicule inflorescences, pentamerous, hermaphroditic, pedunculate, with a size of 7 mm in length and 5 mm in width (when open), slightly xygomorphic, with a hypogenous perianth, and the receptacle forming a small chalice base. The perianth segments are tepal-like, with developed and free-standing sepals. Staminodes are mixed among the stamems. Filament petals alternate around the chalice. Stamens with filaments longer than the perianth segments, with different lengths and long

hairs in tufts in the lower third. The anther is two-lobe, dorsifixed, with longitudinal dehiscent. Ovary is hypogynous, with hairs, unilocular and unicarpel. The pollen-ovule ratio was 6,000, a characteristic that, according to Cruden (1977), indicates xenogamy.

The *Sl.pan.* tree in open areas begins to flower at about two to three years of age in the period with less rainfall, beginning in September, and extending until February. Flowering is prolonged. For example, a single tree may have various inflorescence in different stages of development, causing the constant formation of flowers over an extended two to three month period for the same tree.

On days with a lot of sunlight, anthesis begins at about 7:00 h, with the flower becoming fully in bloom by about 9:00 h. On cloudy or rainy days however, anthesis may be delayed or even postponed until the next day. The dehiscence of the anthers occurs about two hours after anthesis. In this period the flower continues to offer nectar, but in small quantities.

At 16:00 h the flower begins to close, becoming totally closed by about 20:00 h. When closed, the sepals and petals are longitudinally positioned, leaving the apex of the pistil and the stamens exposed. This condition is maintained for five to seven days, when the flower falls from the branch due to rain or wind action (if it hasn't been fecundated) or the sepals, petals and stamens are lost, leaving only the gynoecium with the ovary already slightly developed.

Sl.pan. flowers are intensely visited by diverse species of insects, mainly bees and flies (Diptera) that fly to the flowers in search of the abundant pollen and nectar. Bees visit the flowers to collect both pollen and nectar. The species most commonly found were *Apis mellifera, Trigona pallens, Melipona melanoventer, Scaptotrigona nigrohirta* (Apidae) and *Augocloropsis* sp. (Anthophoridae). Diptera, especially Syrphidae, were very frequent, and were observed landing on the flowers and remaining to lick the anthers containing pollen for more than 5 seconds. These insects may be considered occasional pollinators, but not as efficient as the bees, which are more adapted for the collecting of pollen and nectar, visiting a much greater number of flowers in the same time period. The attraction mechanism for the pollinators of this plant is primarily fragrance (see Kevan & Backer, 1983), that in this species is easily perceived by humans at a distance of 100 m. The number of fruits obtained by natural pollination in each paniculate was 4.9±2.5 (n=50), resulting in a 5.11% success rate in relation to the number of flowers found on each paniculate. For the controlled pollination tests, *Sl.pan.* was shown to be auto-incompatible, with the premature falling of 87% of the

self-pollinated flowers. The other 13% did not develop.

Both *Sz.ama.* and *Sl.pan.* are melittophylic species with hermaphroditic flowers that require cross pollination, a characteristic frequently found among trees that occupy the upper canopy of Neotropical forests (Bawa, 1974; Bawa, 1979; Bawa et al., 1985; Zapata & Arroyo, 1985).

According to Bawa (1979), Frankie et al. (1983) and Janzen (1971), the mass, synchronized flowering of *Sz.ama.*, favors the action of the pollinators and consequently cross-pollination. Large bees with greater flight paths, such as *Xylocopa* spp. and *Centris* spp., are fundamental in this process (Bawa, 1990; Frankie et al., 1976; Frankie et al., 1983; Jansen, 1977; Koptur et al., 1988). While flying above the treetops these bees, easily locate the trees completely covered with yellow flowers. Other bees of medium size, such as other smaller Anthophoridae (*Augocloropsis* spp), *Apis mellifera, Melipona compressipes, M. melanoventer* and *M. seminigra*, are also important.

Small and medium-sized bees, in spite of their shorter flight paths, are indispensable for the reproduction of *Sl.pan.*, since this species occurs naturally in clusters, colonizing clearings and large disturbed areas, facilitating in this way the needed gene exchange among individuals of this species.

Flowering of both species in the seasonal dry periods, matches the findings obtained in tropical forests of Central America, where Frankie (1975), Frankie et al. (1974), Jansen (1967), and Newston et al. (1994) demonstrated the existence of co-adaption between plants and pollinators to take advantage of the resources available in this period.

Characteristics, such as theire annual flowering, rapid growth, high rates of natural frutification, abundance of pollinators, wind dispersion of seeds and others described in the results, indicate that *Sz.ama.* and *Sl.pan.* are reproductively very efficient, easily regenerated and quite aggressive in conquering open spaces in the forest. This means they may be intensively logged in forest management projects where, however, the minimum density of at least one reproductive adult tree for each 2 hectares, must be maintained.

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