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Raphia hookeri: A Survey of Some Aspects of the Growth of a Useful Swamp Lepidocaryoid Palm in Benin (West Africa)

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The genus *Raphia*, considered as "the most distinguished African contribution to palms" (Corner 1966) is known in Europe and North America for its fiber (raphia, raffia) obtained from young leaves. In fact, many other products of the tree are used by man in the *Raphia* palm distribution area (Moist Tropical Africa, Madagascar, parts of South America—Moore 1973). This genus includes 28 species, none of which is present in Asia, although Asia has the largest range of genera and species of

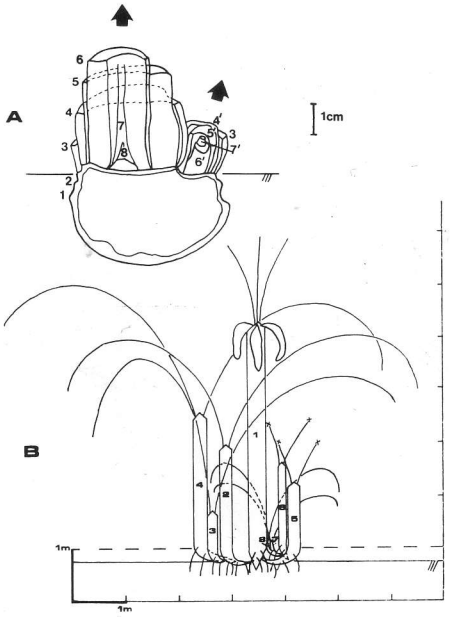
1. A *Raphia* swamp, *Raphia hookeri* is the dominant species after destruction of the swamp forest at Sélé-Podji (21 km east from Cotonou). Ground flora consists of *Cyclosorus striatus* (Schum.) Ching (Thelypteridaceae) and *Cyrtosperma senegalense* (Schott) Engl. (Araceae).

2. Herbaceous swamp with isolated clumps of *Raphia hookeri* at Cococodji (10 km west from Cotonou). Dominant herbaceous species: *Typha australis* Schum. & Thonn. (Typhaceae).

the lepidocaryoid line (Moore 1973). Apart from central Africa, most certainly the biggest center of *Raphia* speciation (Otedoh 1977a), only seven species are found in all West Africa (Russell 1965, Tuley and Russell 1966, Russell 1968). In Benin, lying along the Gulf of Guinea, four species have been recorded; in the southern area of the country *Raphia hookeri* Mann & Wendland and *Raphia vinifera* P. de Beauvois constitute an important element of the swamp forest flora localized in the talwegs of the sedimentary soil type, "terre de barre", and also in the plateaus and in depressions of Quaternary barrier beaches (de Souza et al. 1983). In the center and the northern part of the country grow the other two species: *Raphia sudanica* A. Chevalier, and according to the same author *Raphia humilis* A. Chevalier, two species which are confined to the seasonal swampy depressions of savannahs. *Raphia* species are not equally used by the population: in the South of Benin *Raphia hookeri* is the most popular species. The people use the rachis of leaves as poles and to build houses, and also use the leaves for roofing and making fiber (raphia and piassava). The sap is transformed into palm wine and further distillation gives the spirit called *Sodabi*. The exploitation of *Raphia hookeri* consists of a simple gathering of the products; in some places however (mainly swampy areas) it is done in an arboricultural zone.

The aim of this paper is to present botanical and ecological data, collected during a study of this important species. The data given here will be accompanied with an inventory of human uses of *Raphia* in Benin and other countries within its distribution area (Profizi 1983,

3. Transition from Herbaceous swamp to *Raphia* swamp at Cococodji. Herbaceous layer with *Thalia welwitschii* Ridl. (Marantaceae) and *Cyclosorus striatus*.



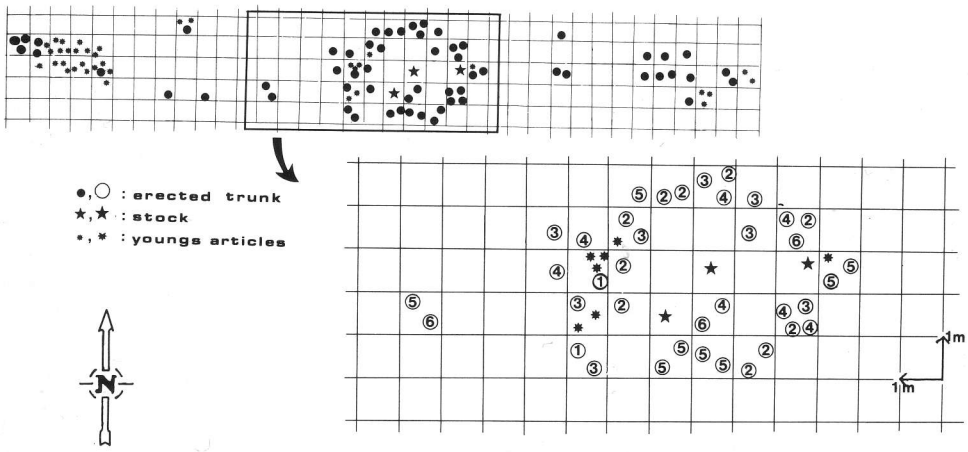
4. Genets of *Raphia hookeri*. A. Seedling developing a sucker 26 months after transplantation. The numbers represent the order of development of the primary axis leaves (1, 2, 3 . . . 8) and those of the sucker (4′, 5′, 6′, 7′). B. A clump in a swamp. The leaves are represented by a single rachis. The numbers represent the order of trunk development.

human uses in Profizi 1984). From an economic point of view, the use of swampy areas, nowadays neglected by modern agriculture, can be extended favorably as far as *Raphia* products are concerned, and this study aims at a better knowledge of *R. hookeri*.

Seedling and Juvenile Phase

Germination is adjacent-ligular and can occur very quickly; it requires 20 to 40 days according to Otedoh (1977b) and personal observations in the field, jointly with S. de Souza's experiment (pers. comm.). Accordingly the seeds are not always completely extricated from the pericarp when germination starts. In the natural environment germination seems low and only a few seedlings survive and reach the adult stage. Specialized producers collect seeds and after thoroughly controlled germination, transplant the seedlings into a clearing near the swamps. The pinnate leaves of the seedling bear spines on the rachis and nerves and are similar to those of the adult but much smaller. Aerial roots soon develop; their number grows and they become important near the bases of the trees. These special roots, containing alternate pneumatozones (de Souza 1984) have the same structure as that of the South American palm, *Mauritia flexuosa* L.f, studied by de Granville (1974) and perhaps *Raphia farinifera* (Gaertn.) Hylander in Cameroon (Cardon 1978).

Young *Raphia* plants consist of an aerial clump of leaves; the juvenile phase consists of subterranean growth in stem diameter (2 to 3 years). The diameter of the adult erect trunk varies and depends



5. Circular structure in a swamp: several *Raphia hookeri* stems grow around original stocks. The numbers represent the height of the trunks (1 below 1 m, 2: 1–2 m, 3: 2–3 m, 4: 3–4 m, 5: 4–5 m).

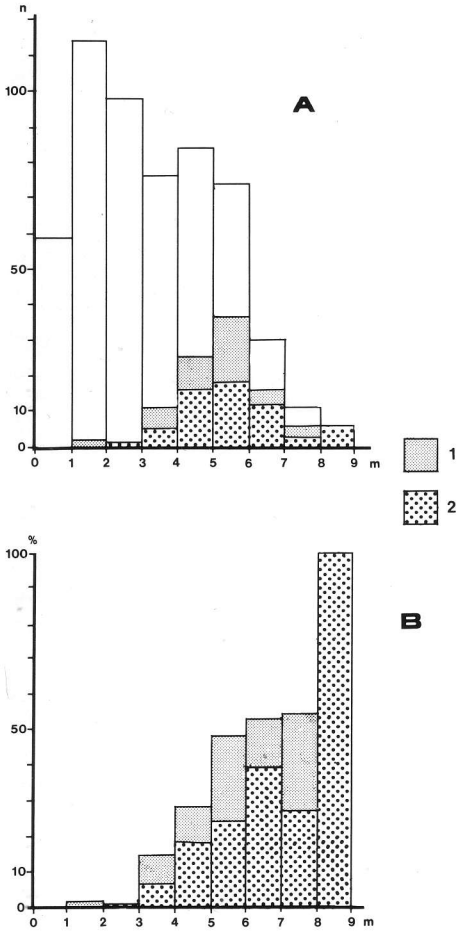
on ecological conditions; *Raphia hookeri* growing in swamps that are regularly flooded have a very short stem (1 or 2 m) and a small diameter (less than 0.1 m). In other cases trunks are rather taller (8 or 9 m) and wider (0.17 to 0.3 m) (See Figs. 1–3). The unexpanded sword-leaves are collected for making *Raphia* fiber; this fiber consists of the epidermis and an underlying sclerenchymatous zone.

The species has an architecture conforming to the model of Tomlinson (Hallé et al. 1978) and it forms a clump (genet according to Harper 1977) of several ramets in different stages of growth. While still a seedling, it produces several basitone suckers in the swamp. A seedling germinated on May 17th 1981 will develop a sucker 26 months later (February 1983). A vertical section of this genet shows that the ramification appears quite early as the stem diameter begins to increase (Fig. 4A).

Even when the ramification starts later, it does not appear after an erect trunk is produced. The result of this is apparent when several ramets develop their trunks as in Fig. 4B. Colonization of the swamp develops centrifugally from the single seedling axis, resulting in a colony as observed in a swamp (Fig. 5). This colony probably results from a single seedling, represented by one of the several stocks found in the center. This form would be an extension of a less extended clump that has been observed elsewhere. This method of growth also involves the death of each trunk of the genet after flowering (the palm is hapaxanthic), but the whole genet is of course polycarpic.

Adult Phase

Phyllotaxy is spiral with four orthostichies; four to eight new leaves are produced in one year. The leaves from the adult trunk are generally 9.5 to 11 m long (with leaf stalk 2 m). According to farmers, the trunk becomes completely erect 5 or 6 years after planting (7 to 9 years after germination). Measurements of 551 trunks gathered during the ecological study (Fig. 6) and divided into 9 categories indicate that the number of trees by categories decreases as the height increases (Fig. 6A). This phenomenon is related to the progressive increase in the proportion of trunks flowering or exploited for tapping



6. Measurements of 551 trunks observed in the ecological study. A. number of trunks; B. proportion of trunks exploited by tapping for palm wine (1) or in flower (2).

palm-wine. The extraction of palm-wine is made just before the appearance of the inflorescences (Fig. 6B). One first notes the high mortality of juvenile stages and there is a flow back of the structure of the number of clumps with several young stems surrounding some erect stems. The proportion of flowering trees and others that have been tapped (potentially flowering) indicates that trunks do not have an equal height under different ecological conditions. For example those that grow in lagoon borders have a short height (3–4 m); in cultivation they can reach 8 to 9 m tall.

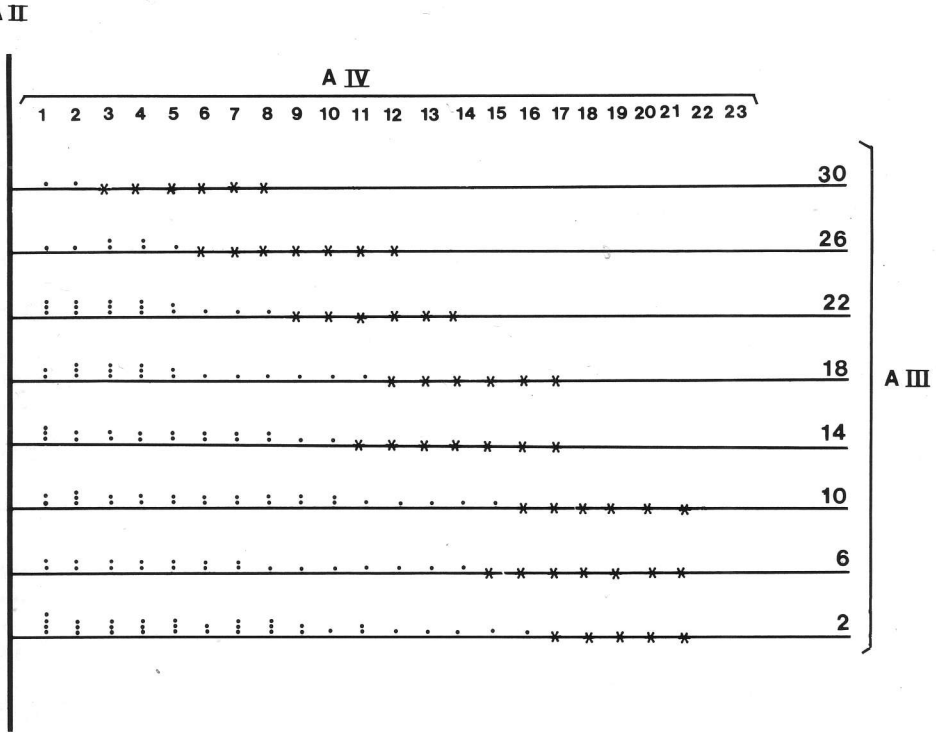
The imminent production of inflorescences is indicated by the presence of short leaves held sub-vertically. Each of these leaves subtends an inflorescence. At this time, palm wine is collected by tapping the meristem of the trunk. If not tapped, the trunk develops inflorescences (two in 6.45%; three, 67.74%; four, 20.27%; five, 1.61% of flowering trunks analyzed).

The second order of branching of the inflorescence bears male and female flowers. The first measure 8.5 to 9 mm, and contain 16 or more (15 to 24, Russell 1968) functional stamens. The second measure 15 to 20 mm and scarcely open at anthesis, but the stigmas project beyond the corolla. Three ovules are present but usually only one of them is fertilized. Female flowers are more numerous towards the base of the inflorescence and they are always situated in the proximal region of the rachillae, the male being confined to the distal area. Fig. 7 represents one orthostichy of the flowering axis, A IV (ramification of A III, borne by A II, the inflorescence axis), with the number of female flowers (number of points); all male flowers are indicated by a cross.

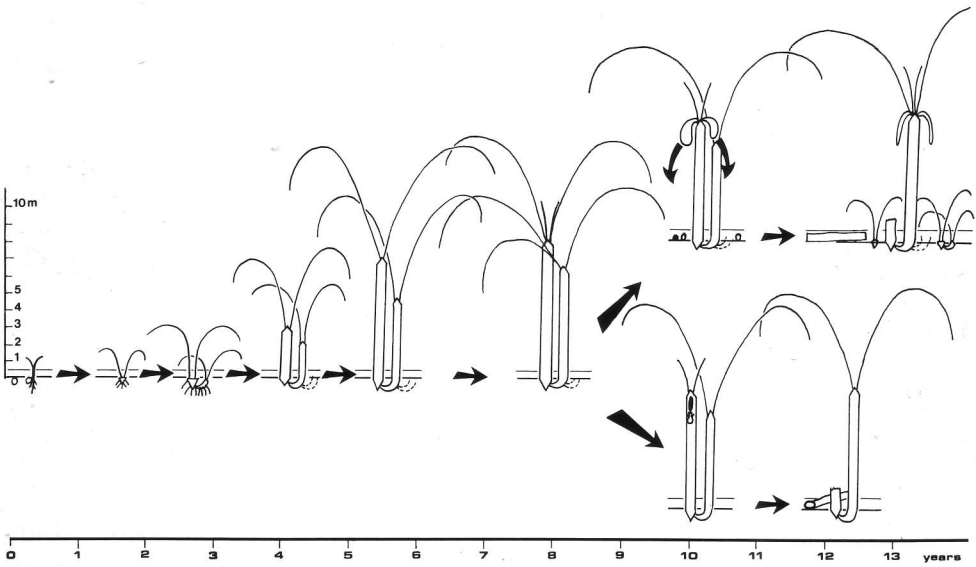
The fruits are covered in 12 vertical rows of scales and take long to mature. Dispersal by animals or by simple falling and rolling begins one year after flowering and ends with the collapse of the inflorescence two years later. Under the scales, the mesocarp is rich in edible oil and is eaten by striped ground squirrels (*Xerus erythropus*), bats, and birds. The ruminate endosperm is also very rich in oil.

A senescent phase occurs 3 or 4 years after the falling of the fruit. The trunk then dies completely and falls into the swamp, soon to be covered by lianas.

Sketches in Fig. 8 give a resumé of the life of a plant of *Raphia hookeri*; although the first axis eventually dies, other axes of the clump continue to grow in the swamp.



7. Proportion of staminate and pistillate flowers along one orthostichy of the rachilla.



8. The life cycle of *Raphia hookeri*, showing its fate when tapped (lower part of diagram) or allowed to flower (upper part of diagram).

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