Principes, 27(1), 1983, pp. 38–42

Developmental Morphology of Desmoncus isthmius, a Climbing Colonial, Cocosoid Palm

FRANCIS E. PUTZ

Department of Botany, University of Florida, Gainesville, Florida 32611

Palms lack a vascular (lateral) cambium and thus lack the capacity for secondary thickening. Palm stems which increase in girth below the crown (above the ground) do so through cell expansion and the formation of schizogenous lacunae (sustained primary growth; Waterhouse and Quinn 1978). Most palms pass through a rosette or "establishment growth" period (Tomlinson and Zimmermann 1966) during which the stem base thickens without internodal elongation forming an inverted cone-shaped (obconical) stem base. In stilt-rooted palms, stem diameter growth and internodal expansion proceed simultaneously thus the obconical stem base is much elongated. *Desmoncus isthmius* Bailey is an exception to these general developmental patterns because stems making up the clone, i.e. ramets or branches, are successively larger in the fashion of bamboos (McClure 1966), *Ripogonium scandens* (Smilacaceae; Tomlinson and Esler 1973), and perhaps some climbing lepidocaryoid palms (Dransfield 1978).

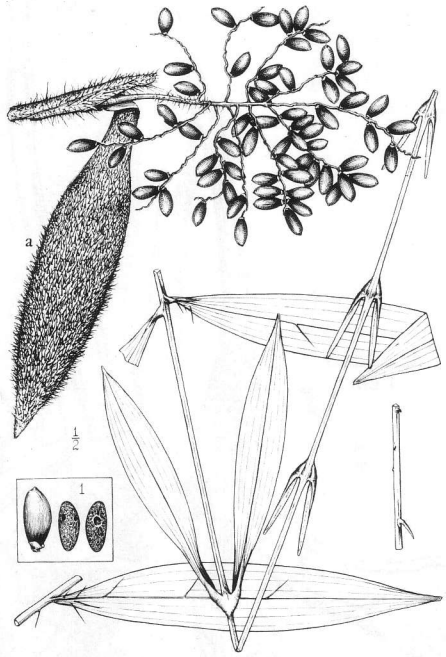
During the seedling stage, palms suffer low light conditions and hazard the depredations of terrestrial terminal-bud-eating animals, such as peccaries. In the forest, small increases in height can lead to substantial increases in available light. Some palms reach these improved light conditions while the bud and incipient trunk are still at or below ground level by producing large leaves which grow upward into the light; leaves from a rosette of *Scheelea zonensis* Bailey, for example, can be 8 m long and weigh 10 kg (fresh weight). These huge leaves grow upward as a sword, open, bend over, and in the process create their own openings (gaps) in the understory; such leaves increase the effective height of the as-yet stemless palm. This growth habit allows palms to thrive in areas where tangles of herbaceous vines, lianas, and fallen trees interfere with the regeneration of plants not endowed with gapmaking capabilities. Internodal expansion during primary thickening leads to relatively rapid height-growth in stilt-root palm seedlings. In addition to rapidly attaining height and light by growing vertically, the stems of some stilt-rooted palms supported by prop roots sometimes grow laterally towards light (Bodley and Benson 1980); this is another developmental modification that serves to ameliorate the conditions encountered during the establishment growth period. *Desmoncus isthmius* has a greater degree of flexibility in its ability to grow laterally than stilt-rooted palms and it is not at all hampered by establishment growth.

Desmoncus Mart. (Greek: *desmos* (band) *Ogkos* (hook)) is an entirely New World genus of approximately 40 species (Burret 1934). C. F. P. von Martius

described the genus in 1824 in his "Palmarum Familia" (p. 20). *D. isthmius* (Fig. 1) is a slender monoecious climber locally known in Panama as "matamba." Because of its fiercely spiny leaf sheaths, petioles, rachises, and leaflets, and the long barbed whip at the end of the each leaf (cirrus), this species suffers a notorious but well deserved reputation among travellers in secondary (disturbed) forests where it abounds. I studied the morphology of *D. isthmius* on Barro Colorado and surrounding islands in the Panama Canal.

The fruits of *Desmoncus isthmius* are bright red, 1.8–2.2 cm long, single-seeded drupes which are often eaten by large frugivorous birds. The seed is enclosed by a woody endocarp. Germination occurs after approximately 6–8 weeks and follows the *Archontophoenix* (adjacent ligular) pattern described by Gatin (1906) and reviewed by Tomlinson (1960). After two plumular leaves develop, the first true leaf has a 5 cm long petiole and two 9 cm long and 3 cm wide leaflets. The second and third leaves have 14 and 25 cm long petioles but still have only two leaflets. The third and all subsequent leaves are spiny. The fourth leaf has two pairs of leaflets and it takes approximately one year for a well watered seedling under partial (50%) shade to produce four leaves. The tenth leaf is usually the first to develop a rudimentary cirrus.

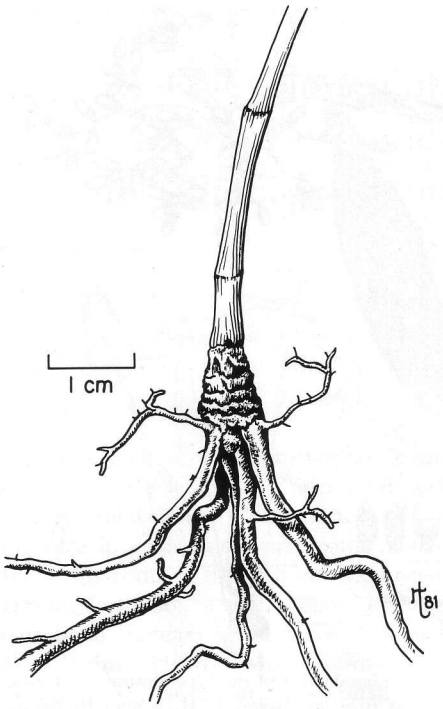
The developmental morphology of *Desmoncus isthmius* is remarkable because its seedlings do not pass through an extended rosette stage. The internode between the second and third true leaves extends 2–3 cm; internodes on the first stem become increasingly longer until the stem is 2–3 m long above which point fully extended internodes are approximately 20–30 cm long. The first stem is only 0.3–0.4 cm in diameter at a point midway between nodes approximately 10 cm from the base. The first stem in an incipient clone seldom reaches more than 4 or 5 m before it dies (Fig. 3) but when



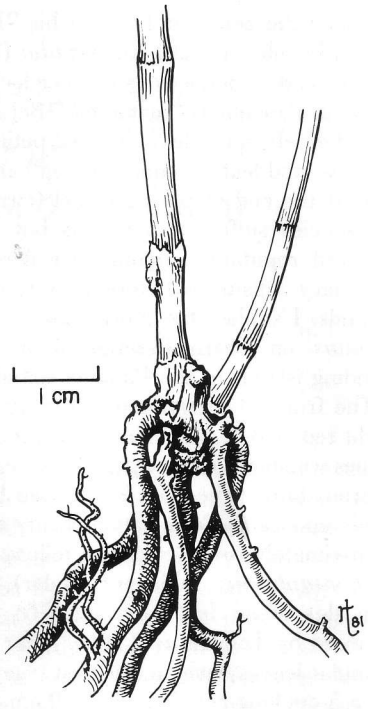
1. A reproduction of the type illustration of *Desmoncus isthmius* (Bailey, L. H., Gentes Herbarum VI:212), leaf and infructescence.

only 35–40 cm long a bud on its first or second node begins to swell; this will represent the first branch, i.e., the second stem in the clone. When the second stem starts to elongate, its base is laterally displaced from the first stem by only 1.0–1.5 cm.

Stems emanating from expanding clones are successively larger in diameter until the tenth or fifteenth stem is produced. After a clone reaches this size, subsequent stem diameters (10 cm from the base) range from 1.3 to 1.5 cm. Along with being larger in diameter, the first internodes on successively produced stems are successively longer (Fig. 6). There is a marked relationship between the stem diameter and the maximum observed stem length (Fig. 5); stems less than 2 cm in diameter often reach more than 40 m in length. Large stems generally increase in diameter from base to approximately the tenth internode by a factor of two.



2. A single plant.

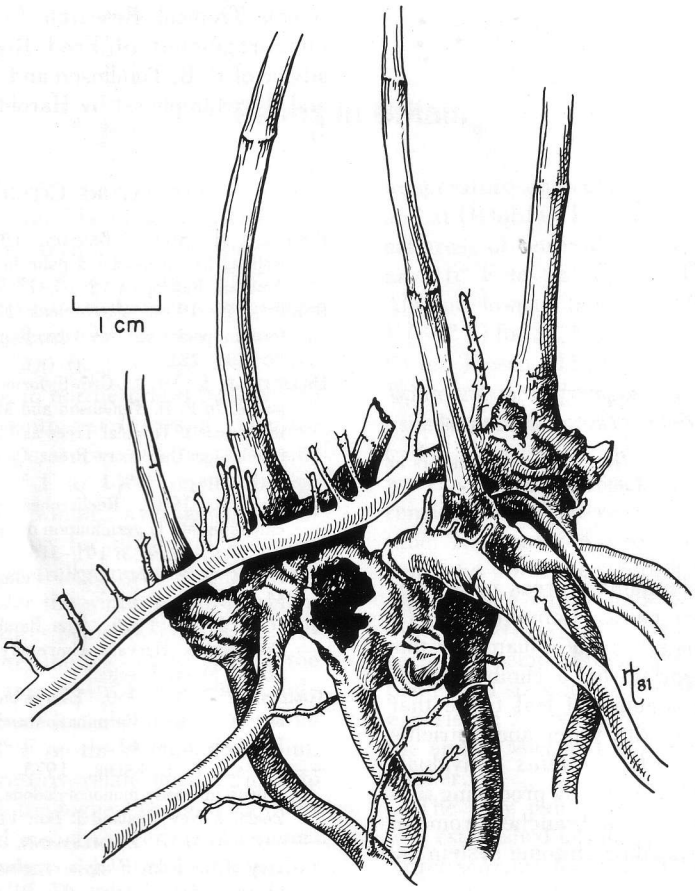


3. An early stage in clone development.

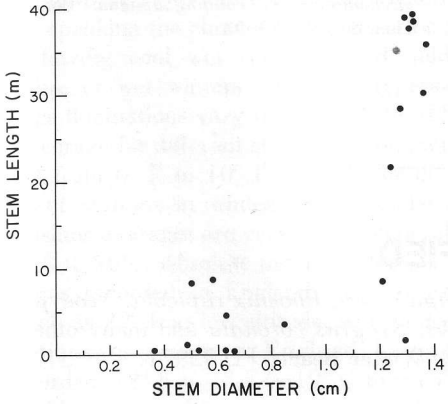
As is the case in all rhizomatous palms, erect stems in *Desmoncus isthmius* clones are basal branches of other stems (Figs. 2, 3). Each branch grows horizontally 1–2 cm before commencing vertical growth. The subterranean portions of stems in a clone comprise the short segments of a sympodial rhizome system. The solid rhizomes grow to be 5 cm thick and become covered with roots (Fig. 4). One large clone had 32 live aerial stems and rhizomes covering 0.3 m² of ground area.

Lacking the capacity to thicken, the radicle (primary root) is soon incapable of supplying the growing shoot with water and nutrients and lateral (adventitious) roots are produced from the stem base. Although the first adventitious roots are smaller than the radicle, subsequent roots are increasingly larger in diameter (Fig. 7); the largest clones have both the largest diameter stems and the largest diameter roots. Large adventitious roots have a solid woody core covered by a spongy cortex. Emerging from the solid core and growing through the cortex are small (1 mm diameter) branch roots. Many of these small roots grow directly upwards to a height of 4–5 cm, in the fashion of pneumatophores (breathing roots). Aeration of roots and rhizomes may indeed be one of their functions but *Desmoncus isthmius* is common on well drained soils. These small, negatively geotropic roots in turn produce numerous rootlets; this suggests that they are important in absorbing nutrients leached from the abundant leaf litter trapped at the base of the caespitose clusters of stems.

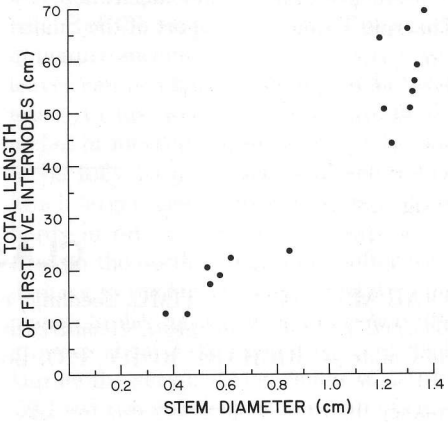
Desmoncus isthmius stems are not delayed in height growth by a long period of establishment growth and consequently



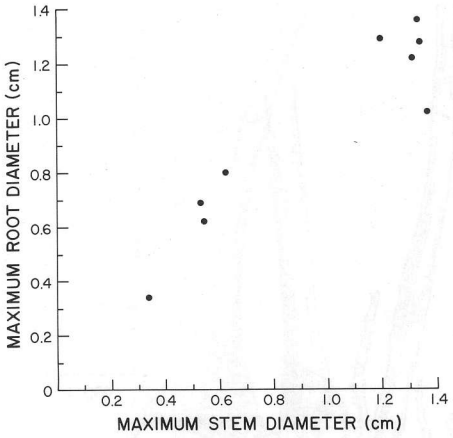
4. A clone at a later stage.



5. Stem length and diameter of stems in nine clones. Diameter measured at a point midway between nodes approximately 10 cm from the ggound.



6. Total length of the first five internodes plotted against stem diameter.



7. Maximum recorded root and stem diameters in clones of different size.

reach better illuminated areas more rapidly than other palms. Consequently, *D. isthmius* stems are small in diameter; this may be appropriate for a climbing plant but limits the amount of leaf tissue that can be supplied with water and nutrients from the roots. *D. isthmius* individuals increase their leaf areas by producing successively larger basal branches from an indefinitely expanding rhizome system.

Acknowledgments

I am grateful for the illustrations by Roxanne Trapp, the support of the Smithsonian Tropical Research Institute, the encouragement of Fred Rickson, the advice of P. B. Tomlinson and N. W. Uhl, and the example set by Harold E. Moore, Jr.

Literature Cited

BODLEY, J. H. AND F. C. BENSON. 1980. Stilt-root walking by an iriarteoid palm in the Peruvian Amazon. Biotropica 12: 67–71.

BURRET, M. 1934. *Desmoncus*. Fedde's Repertorum Specierum Novarum Regni Vegetabilis 36: 197–221.

DRANSFIELD, J. 1978. Growth forms of rain forest palms. *In* P. B. Tomlinson and M. H. Zimmermann (eds.). Tropical Trees as Living Systems. Cambridge University Press, Cambridge, Massachusetts.

GATIN, G. L. 1906. Recherches anatomiques et chimiques sur la germination des palmiers. Ann. Sci. Nat., ser. 9, 3: 191–315.

MARTIUS, C. F. P. VON. 1824. Palmarum Familia. Munich.

MCCLURE, F. A. 1966. The Bamboos, a Fresh Perspective. Harvard University Press, Cambridge, Massachusetts.

TOMLINSON, P. B. 1960. Essays on the morphology of palms. I. Germination and the seedling. Principes 4: 56–61.

——— AND A. E. ESLER. 1973. Establishment growth in woody monocotyledons native to New Zealand. New Zealand J. Bot. 11: 627–644.

——— AND M. H. ZIMMERMANN. 1966. Anatomy of the palm *Rhapis excelsa*. III. Juvenile phase. J. Arnold Arbor. 47: 301–312.

WATERHOUSE, J. T. AND C. J. QUINN. 1979. Growth patterns in the stem of the palm *Archontophoenix cunninghamiana*. Bot. J. Linn. Soc. 77: 73–93.