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Three New Intraspecific Taxa of *Manihot* (Euphorbiaceae) from the
Brazilian Neotropics

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ABSTRACT. *Manihot caerulescens* subsp. *laevis*, *M. carthaginensis* subsp. *hahnii*, and *M. dichotoma* var. *undulata*, all three assigned herein to section *Glaziovianae*, are described and illustrated. *Manihot carthaginensis* subsp. *hahnii* appears endemic to northern and northwestern portions of Minas Gerais. *Manihot dichotoma* var. *undulata* and *M. caerulescens* subsp. *laevis* are endemic to Brazil's northeastern semiarid phytogeographic region known as caatinga. A new combination is provided for *M. glaziovii*, which is submerged as a subspecies in the expanded circumscription of *M. carthaginensis*.

Key words: Brazil, Euphorbiaceae, *Manihot*, Neotropics.

Recent taxonomic studies of the genus *Manihot* in Brazil have disclosed a number of new species and taxa (Allem, 1989a, 1989b, 1999). In the last monograph (Rogers & Appan, 1973) 98 species were recognized, all confined to the New World. The economic importance of the genus resides in the root crop cassava (*Manihot esculenta* Crantz subsp. *esculenta*), a major staple for rural and indigenous populations in much of the Neotropics and Paleotropics. Rogers and Appan (1973) assigned ca. 80 species to Brazil. Recent reassessment of the Brazilian species yielded a more reasonable estimate of 45 species (Allem, 2001). However, at least two more new species will join the Brazilian taxa in the near future. *Manihot* is a difficult genus on account of the extensive infraspecific vegetative and floral variation; this explains the high levels of inflation recorded for the genus (e.g., Rogers & Appan (1973) recognized 98 spe-

cies out of 170 published prior to 1973). Croizat (1943) was of the opinion that the sections created by Pax (1910) were unworkable from a practical standpoint. Likewise, many of the sections recognized by Rogers and Appan (1973) were considered too artificial to serve any practical purpose by Allem (2001). Sixteen groups of related taxa were proposed, with 45 species; group VI in particular, the *Manihot esculenta* group, has already been extensively studied using genetic markers, and the molecular results have coincided with the phenetic classification (a comprehensive review of this bibliography appears in Allem, 2001). Some authors (e.g., Second et al., 1997) have noted the large discrepancies existing between Rogers and Appan's (1973) treatment and Allem's more cohesive delimitations of species.

During preparation of a treatment on section *Glaziovianae* Pax emend. Rogers & Appan, a group largely confined to caatinga vegetation in northeastern Brazil, it was necessary to describe three new taxa to document infraspecific variation: *Manihot caerulescens* subsp. *laevis*, *M. carthaginensis* subsp. *hahnii*, and *M. dichotoma* var. *undulata*. In addition, because the names *M. carthaginensis* and *M. glaziovii* represent the same variable and widespread taxon within *Manihot*, a new combination and status are provided for the latter.

A key to all species and infraspecific taxa of the revised section *Glaziovianae* will appear in a forthcoming article by the author.

MATERIALS AND METHODS

In this treatment the ranks "subspecies" and "variety" correspond to allopatry and sympatry, re-

spectively, in *Manihot*. Thus, because *M. carthaginensis* was described from Colombia and *M. glaziovii* from Brazil, this author chose the category subspecies for them. The reasoning for *M. caerulescens* followed a similar pattern. Rogers and Appan (1973) recognized three subspecies for this species, with abundant synonyms. This author proposes only two taxa, subspecies *caerulescens* and subspecies *laevis*: subspecies *laevis* is known only from southwestern Bahia, while subspecies *caerulescens* thrives in much of neotropical Brazil and Paraguay. *Manihot dichotoma* var. *dichotoma* and variety *undulata* overlap to a large degree in Bahia and were thus conferred varietal status.

Description of fruit dimensions follows Rogers and Appan's (1973) treatment. Because precise lengths and widths are often difficult to delimit because of the shape of the fruit, the authors aptly chose to use the expressions "from base to apex" [and] "wide."

Manihot sect. **Glaziovianae** Pax emend. Rogers & Appan, Fl. Neotr. 13: 175. 1973. TYPE: *Manihot carthaginensis* (Jacquin) Mueller Argoviensis, in DC., Prod. xv. II. 1073. 1866.

Manihot sect. *Carthaginenses* Rogers & Appan, Fl. Neotr. 13: 112. 1973. Syn. nov.

Tall shrubs to small trees; lamina coriaceous or chartaceous, deeply lobed, lobes variously shaped but not linear. Inflorescence a raceme, less commonly a panicle. Floral bracts and bracteoles setaceous to foliaceous, margins dentate, fimbriate, or entire.

1a. Manihot caerulescens Pohl emend. Rogers & Appan, Fl. Neotr. 13: 242. 1973. Basionym: *Manihot caerulescens* Pohl, Pl. Bras. Ic. et Descr. 1: 56. 1827. TYPE: "Brasil, Bahia, Malhada ad Sincorá," *Martius s.n.*, ca. 1818 (syntypes, G, L, M).

Manihot heptaphylla Ule, Notizbl. Bot. Gart. Berlin 5(41): 2. 1908. Syn. nov. TYPE: "Brasil, Bahia, serra de São Inácio próximo ao rio São Francisco," Feb. 1907, *Ule 7206* (syntypes, G—2 sheets, K photo, L not seen, MG not seen, UC not seen, US not seen).

1b. Manihot caerulescens Pohl subsp. *laevis* Allem, subsp. nov. TYPE: Brazil. Bahia: Município de Xique-Xique, 30 km SW of city along dirt road to Santo Inácio, ca. 11°05'S, 42°45'W, 580 m, glabrous treelet, 6 m tall, with flowers and fruits, 11 Dec. 1987, *A. Allem & W. Werneck 3740* (holotype, CEN; isotypes, G, K, MBM, MO). Figure 1.

A *M. caerulescens* Pohl fructibus superficie omnino laevi differt.

Treelet 4–10 m tall, glabrous in vegetative and floral parts, highly branched. Stems with copious white latex exudate. Leaves alternate; stipules conspicuous, margins lacinate to serrate; petioles 4–15(–25) cm long, cylindrical, greenish, eventually tinted with red; petiole basally attached to lamina; upper lamina deep green, shiny, pale green beneath, the lamina simple, (3)5(7)-deeply cleft, chartaceous; median lobe elliptic to elliptic-oblongate, 3–12(–15) × 2–3(–5) cm, often pandurate, lamina edges entire or slightly undulate, apex acuminate or cuspidate; outermost lobes smaller than median lobes. Monoecious inflorescence, terminal, glabrous, lax raceme, 3–8(–12) cm long; mature male floral bracts large and showy, yellowish, rather persistent, broadly ovate to lanceolate, margins entire or slightly toothed at the apex, 5–12(–20) × 3–8(–14) mm; bracteoles half this size. Mature male buds lanceolate, at times somewhat constricted at mid level, attenuated at apex. Male flower: pedicel 4–8(–10) mm long; flower 9–15 mm long, cleft in apical third into 5 lobes, tepal greenish and glabrous externally; stamens 10, in 2 whorls of 5 each; glandular disc fleshy and conspicuous. Female flower: restricted to the lowermost part of the bisexual inflorescence and at times in clusters of 2 to 5 solitary flowers in the upper dichotomies; pedicel somewhat thickened, 10–20 mm long; perianth 10–15 mm long, cleft to the base into 5 lobes, tepals broadly triangular, glabrous externally; ovary cylindrical to lanceolate, glaucous, smooth, glabrous, stigma fimbriate, glandular disc conspicuous. Mature fruit very large compared to the average capsular fruit of the genus, 20–25(–30) mm from base to apex, approximately the same width (vs. the average of 10–13 mm long from base to apex, 8–10 mm wide), baccate and indehiscent, rounded, smooth, glabrous, green in fresh material. Mature seed plump, ca. 12–14 × 8–12 mm, crotonoid, cylindrical, mottled, caruncle minute.

Distribution. *Manihot caerulescens* subsp. *laevis* is endemic to a few southwestern municipalities of Bahia.

Phenology. This subspecies flowers in late October and sets mature fruits from April through June.

The subspecific name refers to the unique wingless character of the fruit surface.

Manihot caerulescens is the only species of *Manihot* known to range across three of the largest Brazilian biomes: cerrados of the Brazilian Amazon, cerrado in central Brazil, and caatinga. The species

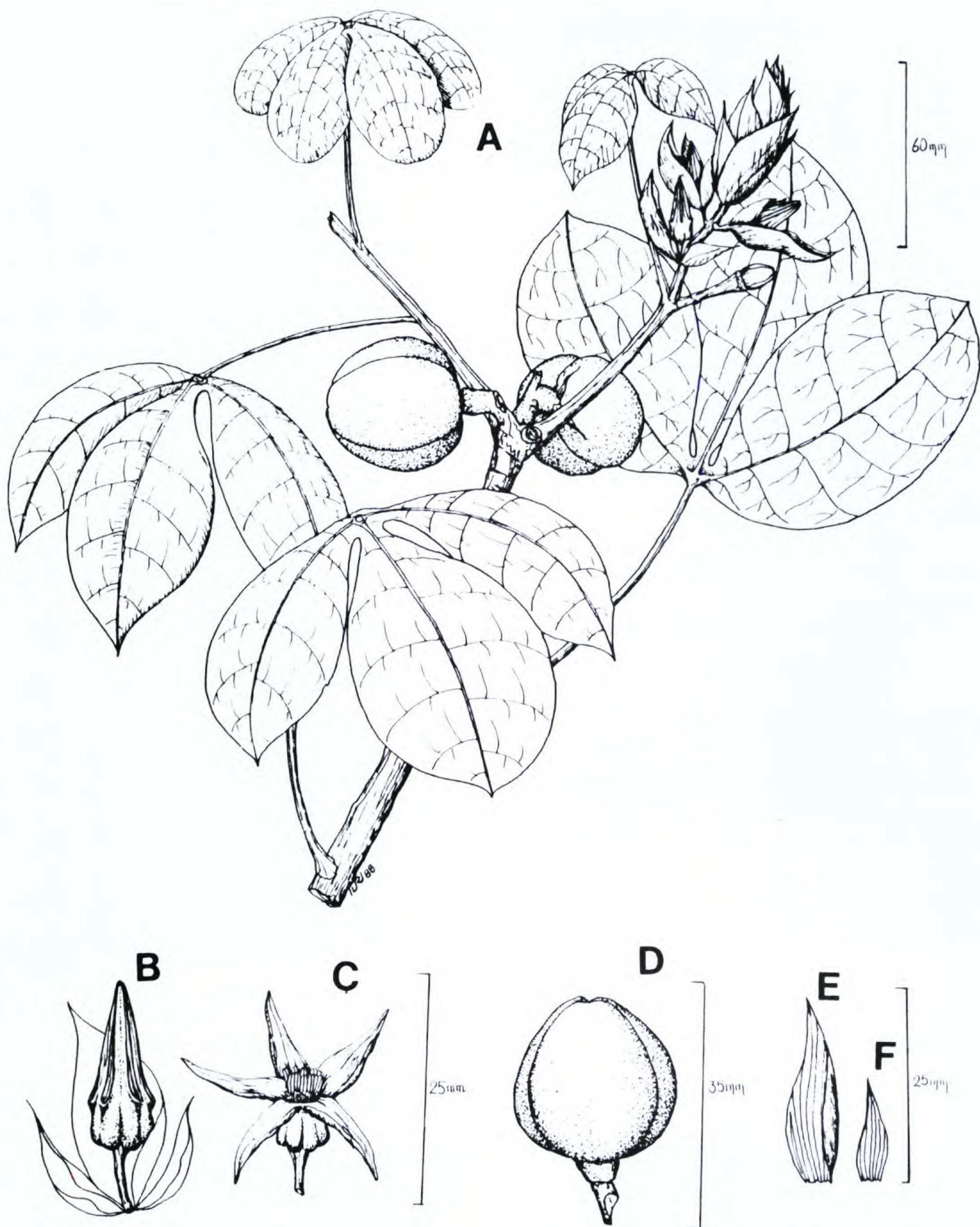


Figure 1. *Manihot caerulescens* subsp. *laevis* Allem (drawn from holotype, *Allem & Werneck 3740*). —A. Flowering branch with foliaceous floral bracts and smooth fruits. —B. Mature male bud subtended by the floral bract and two bracteoles. —C. Male flower (same scale bar for B). —D. Indehiscent, smooth, glabrous fruit. —E. Mature male floral bract. —F. Mature male floral bracteole.

has also been recorded for Paraguay. Despite such a broad distribution, the species morphology is relatively uniform except for the shape and ornamentation of the fruit. The species was exploited as a minor source of latex during the rubber-tapping

economic boom at the beginning of the 20th century by tens of thousands of families from Brazil's northeastern region (Zehntner, 1914). It was locally known to rubber-tappers as "maniçoba-do-piauí." Rogers and Appan (1973: 238) created a special

section (*Caerulescentes*) to accommodate only this species, but this is not warranted herein. In addition to *M. caerulescens*, Rogers and Appan (1973: 242) recognized two further subspecies, *M. caerulescens* subsp. *paraensis* (Mueller Argoviensis) Rogers & Appan and subspecies *macrantha* (Pax & Hoffmann) Rogers & Appan. These two taxa need additional studies to support their recognition.

The placement of *M. heptaphylla* under the synonymy of subspecies *caerulescens* was empirically decided in 1979 (Allem, 1979a) after seeing the accurate drawing of the fruit of the type specimen redrawn from the original by Pax (1910: fig. 15b). The fruit shown is one of the variants displayed by subspecies *caerulescens*; in this case, the type has slim ornamental wings but still a conic shape. More recently, examination of the phototype of the syntype of *M. heptaphylla* (Ule 7206, K) shows a plant bearing a compact raceme with foliaceous floral bracts, but no fruits are present and fruits are critical to separate the two varieties. The syntype Ule 7206 at G was examined by Rogers and Appan (1973) and appears as their figure 122; this plant is different from the Kew syntype in that this particular branch bears two young conically shaped fruits, a trait associated with subspecies *caerulescens*. *Manihot caerulescens* subsp. *laevis* is vegetatively indistinguishable from subspecies *caerulescens*; in addition, it shows the same type of inflorescence with large and showy foliaceous floral bracts. As a distinctive character, however, the new variety shows conspicuous, unusually large, completely smooth and rounded fruits. Subspecies *laevis* is endemic to a few southwestern municipalities in Bahia and prefers dry semi-xeric habitats, thriving particularly well on rocky outcrops and alongside boulders.

Manihot caerulescens belongs to section *Glaziovianae* on the basis of its geography and ecology. The baccate fruit of *M. caerulescens* establishes a transitional link between this species and the group of Amazonian species (e.g., *M. baccata* Allem, *M. quinquepartita* Huber ex Rogers & Appan) also characterized by baccate fruits (Allem, 1999). The fruit of subspecies *caerulescens* is characterized in the main by its conspicuously triangular-conic shape with slightly to strongly developed wings (the latter condition prevails). *Manihot caerulescens* is unique within section *Glaziovianae* because of its baccate indehiscent fruits. All other species of the section have capsular fruits.

The distributional range of section *Glaziovianae* was in northeastern Brazil according to Rogers and Appan (1973). However, these authors do not recognize section *Caerulescentes* Rogers & Appan

(stated above). By transferring its species into section *Glaziovianae*, the geographic range of this section is expanded considerably. *Manihot caerulescens* ranges southward to the cerrados of the state of São Paulo and north well into the cerrados of the state of Pará in Amazonia (Allem, 1994). This demonstrates the difficulty in defining sections that rely heavily on geographical distribution to delimit them, as they may be inaccurate.

Paratype. BRAZIL. **Bahia**: Ibotirama, Hotel Velho Chico, cultivated in backyard by the San Francisco river, ca. 12°08'S, 43°12'W, 17 Nov. 1984, A. Allem, G. L. Webster & W. L. Werneck 3015 (CEN).

KEY TO THE TWO BRAZILIAN SUBSPECIES OF *MANIHOT CAERULESCENS*

- 1a. Fruit conical, moderately to strongly winged . . .
 *M. caerulescens* subsp. *caerulescens*
 1b. Fruit rounded, completely wingless
 *M. caerulescens* subsp. *laevis*

2a. *Manihot carthaginensis* (Jacquin) Mueller Argoviensis, in DC., Prod. xv. II. 1073. 1866. Basionym: *Jatropha carthaginensis* Jacquin, Select. Stirp. Amer. Hist. 256 t. 162 f.1. 1763. TYPE: Colombia. Bolívar: Cartagena, *Jacquin s.n.* (holotype, P not seen; isotypes, F photo not seen, W). For synonymy, see Allem (1979b).

2b. *Manihot carthaginensis* subsp. *glaziovii* (Mueller Argoviensis) Allem, comb. et stat. nov. Basionym: *Manihot glaziovii* Mueller Argoviensis, in Martius, Fl. Bras. 11(2): 446. 1874. TYPE: Brazil. Rio de Janeiro: "environs of Rio de Janeiro," cultivated, *Glaziou 1022* (syntypes, F photo not seen, G).

Manihot johannis Pax, in Engler, Pflanzenreich IV. 147 (Heft 44): 78. 1910. Syn. nov. TYPE: Brazil. Bahia: "in sylvis catiingae inter Malhada et Sincora," *Martius s.n.* (type, M not seen; G phototype, M phototype).

Manihot epruinosa Pax & Hoffmann, in Engler, Pflanzenreich IV. 147 (Heft 85): 196. 1924. Syn. nov. TYPE: Brazil. Paraíba: Acary, Mar. 1920, *Luetzelburg 12417* (syntypes, F not seen, M).

Manihot pseudoglaziovii Pax & Hoffmann, in Engler, Pflanzenreich IV. 147 (Heft 85): 196. 1924. Syn. nov. TYPE: Brazil. Rio Grande do Norte: Serra Parelhas, Mar. 1920, *Luetzelburg 12888* (syntype, M).

On the basis of field experience, this author had concluded in January 1995 that *M. carthaginensis* and *M. glaziovii* are conspecific. After documenting over 15 populations of the former species along the Brazilian-Bolivian border from 1976 through 1979 and again in 1995, as well as over 40 populations of the latter in much of northeastern Brazil from

1985 on, it seemed untenable to construct workable dichotomous taxonomic keys to separate the two species. Preliminary geographical information systems (GIS) studies conducted at CIAT in 1995 indicated that *M. carthaginensis* was expected to occur in northeastern Brazil (Peter Jones, pers. comm., Nov. 1995). In addition, recent molecular studies with AFLP/RAPD markers (Second, 2000; Second & Iglesias, 2000) found a high degree of genetic relatedness between both species. In practice, this meant that the section *Carthaginenses* of Rogers and Appan (1973) was in all likelihood artificial.

The two subspecies were mainly based on geographical criteria: *M. carthaginensis* subsp. *carthaginensis* is restricted to parts of Argentina, Paraguay, Bolivia, Colombia, and Venezuela, its populations often with pandurate leaves, while *M. carthaginensis* subsp. *glaziovii* is mostly restricted to northeastern Brazil, but is also found in northeastern parts of Minas Gerais, in transitional areas with caatinga vegetation, close to the Bahian border. Its populations generally have elliptic or elliptic-lanceolate leaves, seldom pandurate. The type and place of collection of *M. pseudoglaziovii* leave no doubt that it is conspecific with *M. glaziovii*. Likewise, the type and place of collection of *M. epruinosa* suggest that it is also conspecific with *M. glaziovii*. The fact that Rogers and Appan (1973) described *M. epruinosa* as "tall shrubs to low trees, to 10 m tall" is good evidence of man's influence on the taxonomy of the genus. The shrubby habit, that most commonly found, is due to anthropogenic fires and the pruning back of plants carried out by road workers; undisturbed individuals are treelets reaching 8–11 m tall. *Manihot johannis* was placed by Rogers and Appan (1973) in their group of "species dubia." The type specimen of *M. johannis* (*Martius s.n.*, M phototype) is reduced to little more than a scrap, but the remains of a young inflorescence seem to suggest rather sessile male buds and filiform floral bracts, characters loosely associated with an *M. glaziovii* species complex. The 5 branches of the type specimen carry no leaves and on the basis of such scanty material, in addition to the geography of the species, *M. johannis* is cautiously assigned as a further synonym of *M. carthaginensis* subsp. *glaziovii*.

2c. *Manihot carthaginensis* subsp. *hahnii* Allem, subsp. nov. TYPE: Brazil. Minas Gerais: município de Januária, exactly 2.9 km after disembarking from the ferryboat along BR-135 Hwy. on the way to the city center, ca. 15°29'S, 44°23'W, 470 m, glabrous treelet 6 m tall, disturbed remnant of dry semi-caducifolious forest, 16 Feb. 1995, A. Allem & V. Silva 4572 (holotype, CEN; isotypes, G, K, M, MBM, MO, NY, UB, US). Figure 2.

A *M. carthaginensis* (Jacquin) Mueller Argoviensis fructibus conspicue alatis differt.

Treelet 4–7 m tall, glabrous in vegetative and floral parts, highly branched. Stems rather blackened, twigs with copious white latex exudate. Leaves alternate; stipules conspicuous, margins lacinate; petioles 5–15(–20) cm long, cylindrical, greenish, petiole basally attached; upper surface of lamina deep green, pale green beneath, the lamina simple, (3)5(7)-deeply cleft, chartaceous; median lobe elliptic to elliptic-oblongate, occasionally pandurate, 4–12(–15) × 1–4(–6) cm, lamina edges entire or slightly undulate, apex acuminate or eventually cuspidate; outermost lobes smaller than median lobes. Monoecious terminal inflorescence, glabrous, lax raceme, 4–12(–20) cm long, occasionally panicles. Mature male floral bracts minute, inconspicuous, very early deciduous, narrowly lanceolate, 3–5(–7) mm long, 0.5–1(–1.5) mm wide, margins slightly toothed or ciliate; bracteoles half this size. Male flower: shape rather campanulate; buds compressed inward in apical third; pedicel 5–10(–12) mm long, perianth 9–13 mm long, cleft in apical third into 5 lobes, tepal greenish and glabrous externally; stamens 10, in 2 whorls of 5 each; glandular disc conspicuous, fleshy. Female flower: restricted to the lowermost part of the inflorescence, occasionally in clusters of 2 to 5 solitary flowers in the upper dichotomies; pedicel somewhat thickened, 10–20 mm long; perianth 10–12 mm long, cleft into 5 lobes, tepals broadly triangular, glabrous externally; ovary rounded, slightly to strongly winged, glabrous, stigma fimbriate, glandular disc conspicuous. Mature fruit rounded to roundish-ovate, 16–20(–22) mm from base to apex, 15–17(–20) mm wide, strongly winged (Fig. 2E), a few slightly winged, glabrous, dehiscent, green in fresh material. Mature seed plump, broadly ovate, ca. 8–10 × 6–8 mm, mottled, ecarunculate.

Distribution. *Manihot carthaginensis* subsp. *hahnii* has so far been found only in scattered forest sites in northeastern Minas Gerais.

Phenology. Like most other species in Brazil, this subspecies flowers in late October and sets fruits from January through early April.

Vernacular name. Mandioca-brava (Ratter et al. 2633).

It is very appropriate that this subspecies be named after Sang Ki Hahn, who, over a 22-year career span with the International Institute of Tropical Agriculture (IITA) at Ibadan in Nigeria, successfully transferred virus-resistant genes of *M. glaziovii* into commercial African cassava cultivars.

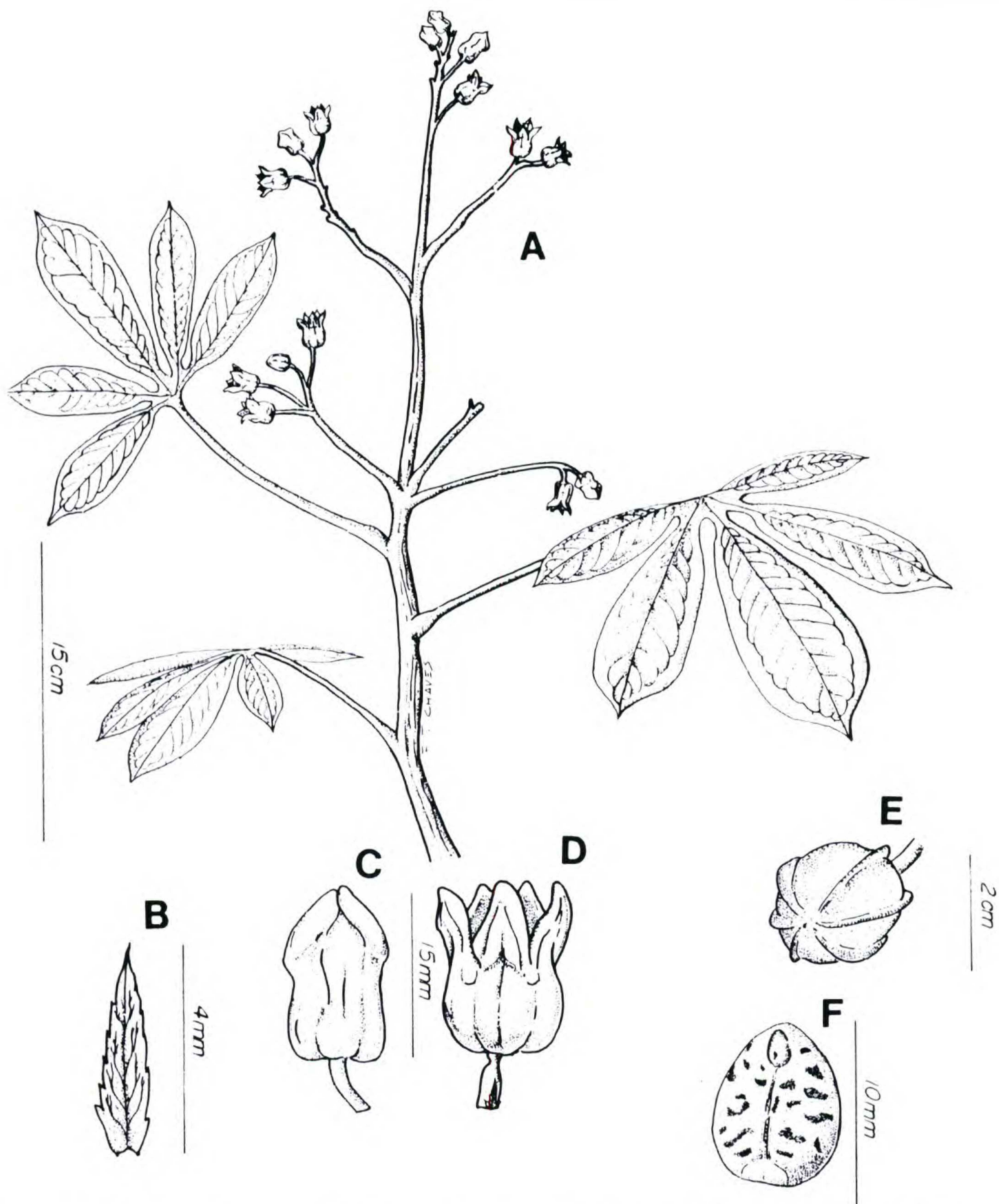


Figure 2. *Manihot carthaginensis* subsp. *hahnii* Allem (drawn from holotype, *Allem & Silva 4572*). —A. Flowering branch. —B. Mature male floral bract. —C. Mature male bud. —D. Male flower (same scale bar for C). —E. Nearly mature fruit. —F. Nearly mature seed, ventral view.

Manihot carthaginensis subsp. *hahnii* constitutes a narrow endemic in the dry semi-caducifolious forests of northwestern Minas Gerais. Its recognition as a distinct taxon is supported on geographic distinction and principally on morphology (fruit wings). Fresh mature fruits of this subspecies are slightly larger (up to 22 mm long) than those of

subspecies *glaziovii* (only to 20 mm long); the seeds of both are similar in size and shape.

Paratypes. BRAZIL. **Minas Gerais:** Januária, ca. 5 km SW of Januária along BR-135 Hwy. on road to Lontra, A. *Allem & W. Werneck 3687* (CEN); ca. 31 km NE of Januária along road to Itacarambi, A. *Allem & W. Werneck 3690* (CEN), 3694 (CEN); exactly 8.3 km from old bridge

over the San Francisco river along BR-135 toward city center, *A. Allem & V. Silva* 4571, 4573, 4574, 4575 (all CEN); 32.3 km NE of city along BR-135 toward Itacarambi, *A. Allem & V. Silva* 4580, 4581, 4583 (all CEN); 10 km W of Januária, treelet 5 m tall on limestone cliffs, *J. A. Ratter, S. G. da Fonseca & R. A. de Castro* 2633 (UB); Cardeal Mota, 10 km S of Serra do Cipó, shrub 4 m tall on limestone (marble) outcrop in shaded valley, *W. R. Anderson, M. Stieber & J. H. Kirkbride, Jr.* 36269 (UB); Mirabela, 5 km ahead of last access to Mirabela along BR-135 toward Januária, *A. Allem & V. Silva* 4584, 4585, 4586, 4587, 4588 (all CEN).

KEY TO THE SOUTH AMERICAN SUBSPECIES OF *MANIHOT* *CARTHAGINENSIS*

- 1a. Fruits regularly winged
. *M. carthaginensis* subsp. *hahnii*
- 1b. Fruits wingless.
 - 2a. Leaf lobes often pandurate, less often elliptic to elliptic-oblongate; South America (except Brazil)
. *M. carthaginensis* subsp. *carthaginensis*
 - 2b. Leaf lobes elliptic to elliptic-oblongate, seldom pandurate; tropical Brazil
. *M. carthaginensis* subsp. *glaziovii*

3a. *Manihot dichotoma* Ule, Notizbl. Bot. Gart. Berlin 5(41): 2. 1907. TYPE: Brazil. Bahia: bei Caldeirão, Oct. 1906, *Ule* 7045 (syntypes, G, K photo, L, MG not seen).

Manihot catinae Ule, Bot. Jahrb. Syst. 62: 221. 1908. Syn. nov. TYPE: Brazil. Bahia: bei Remanso, Dec. 1906, *Ule* 7142 (syntypes, F not seen, G, K photo, L not seen).

Drawings of a floral branch and a floral bract of *M. dichotoma* var. *dichotoma*, as well as of a fruit and a seed, appear in Pax (1910, figs. 11A, B, 15F–H). This illustrated fruit is elongate and shows slightly undulate wings, these wings only slightly prominent, characters associated with this variety. Variety *dichotoma* has been more often collected than variety *undulata* and thus seems more common. Material of variety *dichotoma* collected by this author in Bahia shows a glabrous fruit, narrowly lanceolate, attenuate at apex, and slightly winged (wings undulate), while the seed is relatively cylindrical, rather depressed ventrally, and very thin in profile. The variety *dichotoma* occurs in Bahia near its southeastern border and adjacent Minas Gerais. The Kew phototype of synonymous *M. catinae* (*Ule* 7142) suggests a plant with foliaceous floral bracts, but experience suggests they might be crumpled leaves, as these tend to cluster around the tips of apical branches. Fortunately, the syntype at G clarifies that the species has filiform floral bracts and attenuate, slightly winged fruits, characters associated with *M. dichotoma* var. *dichotoma*. This same syntype was examined by Rogers and Appan

(1973: 187), and they reported “capsules subglobose, slightly elongated, surface smooth.” The type locality of *M. catinae*, the Bahian municipality of Remanso, was inundated some years ago for the construction of the hydroelectric dam “Barragem de Sobradinho,” on the southwestern border of Bahia with Pernambuco.

3b. *Manihot dichotoma* var. *undulata* Allem, var. nov. TYPE: Brazil. Bahia: Município de Manoel Vitorino, 107 km N of Vitória da Conquista along BR-116 Hwy. to Jequié, ca. 14°10'S, 40°15'W, 380 m, glabrous treelet, 5 m tall, with flowers and fruits, 11 Nov. 1984, *A. Allem & W. Werneck* 2934 (holotype, CEN; isotype, DAV). Figure 3.

A *M. dichotoma* Ule fructibus conspicue alatis et seminibus majoribus differt.

Treelet 4–9 m tall, glabrous in vegetative and floral parts, highly branched. Stems with copious white latex exudate. Leaves alternate; stipules conspicuous, margins lacinate; petioles 5–15(–20) cm long, cylindrical, greenish; petiole basally attached; upper lamina deep green, pale green beneath, the lamina simple, (3)5(7)-deeply cleft, chartaceous; median lobe elliptic to elliptic-oblongate, 3–10(–12) × 1–3(–5) cm, often pandurate, lamina edges entire or slightly undulate, apex acuminate or eventually cuspidate; outermost lobes smaller than median lobes. Monoecious inflorescence, terminal, glabrous, lax raceme, 3–8(–10) cm long; mature male floral bracts small, rather inconspicuous, very early deciduous, narrowly lanceolate, margins slightly toothed to ciliate, 3–5(–10) × 0.5–1(–1.5) mm; bracteoles half this size, ovate to lanceolate. Mature male buds somewhat conic-lanceolate, attenuate at tip. Male flower: pedicel 4–8(–10) mm, perianth 9–15 mm long, cleft in apical third into 5 lobes, tepal greenish and glabrous externally; stamens 10, in 2 whorls of 5 each; glandular disc fleshy and conspicuous. Female flower: restricted to the lowermost part of the bisexual inflorescence and at times in clusters of 2 to 5 solitary flowers in the branches of the upper dichotomies; pedicel somewhat thickened, 10–20 mm long; perianth 10–15 mm long, cleft to the base into 5 lobes, tepals broadly triangular, glabrous externally; ovary cylindrical and wholly glabrous, strongly winged; wings undulate; stigma fimbriate; glandular disc conspicuous. Mature fruit larger than the average fruit of the genus, glabrous, cylindrical, its top somewhat blunt, strongly winged, wings prominently undulate, dehiscent, green in fresh material, 18–20(–24) mm from base to apex, 14–16(–18) mm wide. Ma-

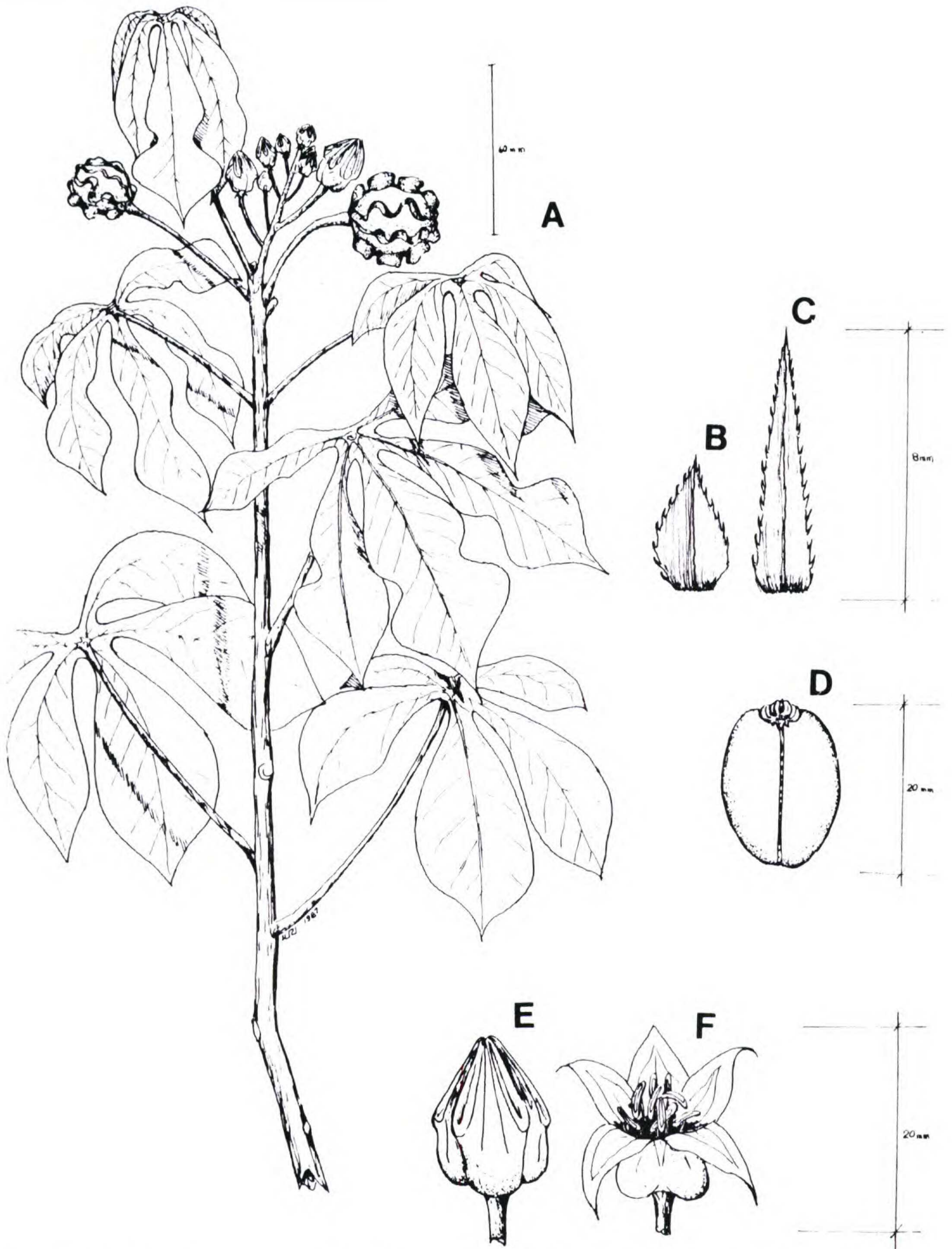


Figure 3. *Manihot dichotoma* var. *undulata* Allem (drawn from holotype, *Allem & Werneck 2934*). —A. Flowering branch with conspicuous undulate-winged fruits. —B. Mature male floral bracteole. —C. Mature male floral bract. —D. Young seed, ventral view. —E. Mature male bud. —F. Male flower.

ture seed rather compressed, broadly cylindrical, ca. 14–20 × 8–12 mm, gray to grayish, carunculate; caruncle showy.

Distribution. Wild *Manihot dichotoma* var. *undulata* has been found only among xerophilous vegetation in Bahia; it is also locally cultivated as a living fence.

Phenology. This variety sets flowers in late October and sets fruits from January through early April.

Paratypes. BRAZIL. **Bahia:** Irecê, 9 km SW of Irecê along BA-052 Hwy. to Central, A. Allem & W. Werneck 3735 (CEN); Manoel Vitorino, ca. 100 m ahead of the crossroads between BR-116 Hwy. and dirt road to Catíngal, A. Allem & V. Silva 4520 (CEN); Boa Nova, 28, 7 km SW of Manoel Vitorino along BR-116 Hwy. to Poçoões, A. Allem & V. Silva 4525 (CEN).

The varietal name refers to the unique ornamentation of the fruit's surface.

KEY TO THE BRAZILIAN VARIETIES OF *MANIHOT DICHOTOMA*

- 1a. Fruit narrowly lanceolate, elongated, wings narrowly undulate or at times almost absent; seed ca. 5 mm wide *M. dichotoma* var. *dichotoma*
1b. Fruit cylindrical, broadened, wings broadly undulate and showy; seed ca. 12 mm wide
. *M. dichotoma* var. *undulata*

Manihot dichotoma var. *undulata* is characterized by cylindrical, glabrous, strongly undulate and conspicuously larger fruits. These wings are so wide (to 4 mm) and invaginate outward to such an extent that they may obscure much of the fruit's surface. Its seeds are similar to those of variety *dichotoma*, but they are much larger.

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