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VEGETATIVE AND FLORAL MORPHOLOGICAL STUDIES OF SOME SPECIES OF *HIBISCUS* LINN. IN NIGERIA

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Abstract
A morphological study of ten species of *Hibiscus* found in Nigeria was conducted in search of useful and stable characters which may enhance the knowledge of the taxonomic status of the genus. Both qualitative and quantitative characters were recorded. Characters of taxonomic value not recorded in the Flora of West Tropical Africa include, habit, leaf bases, stipule shape, petal shape, fruit shapes and apices. A new key to the *Hibiscus* species is included.

Keywords: Morphological, stable characters, taxonomic status.

1. Introduction

The genus *Hibiscus Linn.* is the largest genus in the family Malvaceae with about 300 species widely distributed world-wide (Walsh, 1975; Heywood, 1978). Hutchinson and Dalziel (1958) reported 33 species of *Hibiscus* for West Tropical Africa of which 23 species may be found in Nigeria.

Hibiscus is composed of tropical herbs, shrubs or trees (Metcalfe and Chalk, 1950; Lebler 1973; Walsh, 1975). They are found growing in an admixture of humus and sandy soils. The species of *Hibiscus* are very important economically. The outstanding economic importance of this genus is the fibres which they yield, hence some are cultivated for their fibres (Schippers, 2000). An acid jelly extracted from the edible calyx of *H. sabdariffa* is often used as a preventive of scurvy.

The taxonomic value of morphological characters has been stressed by several workers, including Hutchinson and Dalziel (1958); Kundu and Biswas (1973) and Terrel and Winters (1974). Isawumi (1985) used morphological characters such as corolla colour, pedicel disposition in anthesis and calyx teeth to separate *Capsicum annuum, C. frutescens* and *C. chinense*.

Hutchinson and Dalziel (1958) in the Flora of West Tropical Africa reported 23 species of *Hibiscus* in Nigeria using few morphological characters. Isawumi (1992) reported the structure, distribution, classification and taxonomic importance of trichomes in the West African species of *Hibiscus*. The ornamental species, *H. rosa-sinensis* is morphologically familiar, but knowledge is sparse about the other *Hibiscus* species in Nigeria, this work is therefore aimed at filling this knowledge gap. The floral and vegetative morphological characters of ten species in this genus are studied with a view to finding additional morphological characters not used by Hutchinson and Dalziel (1958) which may broaden the scope of the knowledge of this genus.

2. Materials and Methods

For the purpose of this work, ten species of *Hibiscus* found in Nigeria were studied. They are:

H. lunarifolius Willd.
H. rostellatus Guill. & Perr.
H. scotellii Bak. F.
H. sterculiifolius (Guill. & Perr.) Steud.
H. tiliaceus Linn.
H. physaloides Guill. & Perr.
H. acetosella Welw.
H. sabdariffa Linn.
H. vitifolius var. *vitifolius* Linn.
H. surattensis Linn.

Each of the foregoing ten species was collected fresh at different locations (Table 1). Herbarium accessions of the ten species were also studied morphologically and compared with the fresh accessions (Table 1). The habits and habitats of the different species were noted. Qualitative morphological characters studied include the shape, base, apex, margin, veins and petioles of the leaf, stipule shape, fruit type and shape and fruit apex. Other characters studied are colours of the petals, petal bases, pedicel, sepal, style,

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Table 1: Sources of the species of *Hibiscus* used for the study (ac., accession; FHI, Forestry Herbarium Ibadan; LUH, Lagos University Herbarium).

Species	Sources
H. vitifolius var. *vitifolius*	
ac. 1	Urban Day Grammar School, Ring-Road, Ibadan, Oyo State.
ac. 2	Behind Faculty of Agriculture, Ile-Ife, Osun State.
ac. 5	Federal University of Technology (FUTA), Akure Campus, Akure, Ondo State.
Gbile FHI 79012	Ibre Village, Bendel State
Latilo, FHI 66295;	Ekiti, Ondo State
Latilo, FHI 61324,	Ilorin, Kwara State.
H. surattensis	
ac. 1	Near commercial farm, Obafemi Awolowo University, Ile-Ife, Osun State.
ac. 2	Ibadan – Ife road, Oyo State.
ac. 3	Near police station, Eleweran, Abeokuta, Ogun State
Ariwaodo FHI 49299	Ugep, Obubra District, Cross-River State
Ekwuno, FHI 93117	Gembu, Mambilla, Gongola
Olorunfemi, FHI 86879	Ikere, Ondo State.
H. sabdariffa	
ac. 1	Farmland, Ibadan – Ife road, Osun State.
ac. 2	Near FORMECU Gate, Idi-Isin, Ibadan, Oyo State.
ac. 3	Near petrol station, Ojota, Lagos.
Soladoye/Ekwuno, FHI 84454	Zaria-Kaduna Road, Zaria, Kaduna State
Olorunfemi/Oguntayo/Ihe, FHI 88551	Ajeigbe's Camp, Ilorin, Kwara State
H. lunarifolius	
ac. 1	Idanre Hills, Ondo, Idanre, Ondo State.
ac. 2	The Apostolic Grammar School, Modakeke, Osun State.
ac. 3	In front of Asero Stadium, Abeokuta, Ogun State.
Daramola, FHI 23835	Olokemeji, Abeokuta, Ogun State
Lowe, FHI 101469	Old Idanre, Ondo State
Olorunfemi, FHI 86935	Ikare-Aisegba Road, Ikare, Ondo State
H. tiliaceus	
ac. 1	Forestry Research Institute of Nigeria (FRIN) compound, Idi-Isin, Ibadan, Oyo State.
Daramola, LUH 395	University of Lagos campus, Lagos.

Table 1 continued:

Species	Sources
Gbile, FHI 64020	East of Majidun River Mangrove Forest, Ikorodu, Lagos.
Okafor, FHI 58591	Apapa Seashore, Lagos
H. sterculiifolius	
ac. 1	Hill 2, Obafemi Awolowo University, Ile-Ife, Osun State.
ac. 2	Ile-Ife Road, Ilesa, Osun State
ac. 3	Near Hope Grammar School, Bolorunduro, Ilesa, Osun State
Emwiogbon, FHI 63138	Ogbete Area, Enugu, Anambra State.
H. acetosella	
ac. 1	Near AP Petrol Station, Mayfair, Ile-Ife, Osun State.
ac. 2	Ansar-Ud-Deen Primary School Compound, Ososami, Ibadan, Oyo State.
ac. 3	Near Hope Grammar School, Bolorunduro, Ilesa, Osun State.
Latilo/Daramola/Onijamawo, FHI 73414	Ikom, Cross River State.
H. rostellatus	
ac. 1	Near Moremi High School, Obafemi Awolowo University, Ile-Ife, Osun State.
ac. 2	Near Ayedaade Grammar School, Ikire, Osun State
ac. 3	Ede road, Ile-Ife, Osun State.
Ekwuno, FHI 82483	Agbede forest Research, Etsako, Bendel State.
Gbile, FHI 80136	Naraguta Game Reserve, Jos, Plateau State
Okafor, FHI 59280	Kuma, Pankshin, Plateau State.
H. physaloides	
ac. 1	Hill 2, Obafemi Awolowo University, Ile-Ife, Osun State.
ac. 2	Hill 1, Obafemi Awolowo University, Ile-Ife, Osun State
Daramola, FHI 18404	Ijebu, Ogun State
Gbile, FHI 71789	Calabar, Cross-River State.
Odewo, FHI 88106	Ilaro, Ogun State
H. scotellii	
ac. 1	Hill 2 Obafemi Awolowo University, Ile-Ife, Osun State.
ac. 2	On rocky ground in Old Buka, Obafemi Awolowo University, Ile-Ife, Osun State.
Keay, FHI 22587	Ondo, Ondo State.

AN ARTIFICIAL KEY TO THE SPECIES OF *HIBISCUS* STUDIED.

1 a. Epicalyx free at base.
- 2a. Surface of stem glabrous:
  - 3a. Leaf ovate, base rounded; petal red, petal base, deep red; filament red; anther dark red; stigma dark red; fruit apex aristate; fruit diameter 1.6-1.8 cm ..... *H. acetosella*
  - 3b. Leaf lanceolate, base cuneate; petal lemon yellow, base yellow; filament white; anther yellow; stigma white; fruit apex acuminate; fruit diameter 1.9-2.3 cm ..... *H. sabdariffa*
- 2b. Surface of stem pubescent;
  - 4a. Petal colour golden yellow;
    - 5a. Leaf apex acuminate; epicalyx without foliaceous appendage; petal base purple-brown; fruit ovoid with aristate apex ..... *H. lunarifolius*
    - 5b. Leaf apex acute; epicalyx with foliaceous appendage; petal base deep red; fruit elongate conical with acuminate apex ..... *H. rostellatus*
  - 4b. Petal lemon yellow;
    - 6a. Leaf apex acuminate; filament whitish-yellow; stigma white-yellow ..... *H. physaloides*
    - 6b. Leaf apex acute; filament red; stigma dark red;
      - 7a. Stipule shape foliaceous-orbicular; fruit-apex aristate; stem procumbent ... *H. surattensis*
      - 7b. Stipule shape acicular; fruit apex acuminate; stem erect
        - 8a. Fruit conical; leaves deeply lobed ..... *H. scotellii*
        - 8b. Fruit round; leaves not deeply lobed ..... *H. vitifolius* var. *vitifolius*

1b. Epicalyx conate at base
- 9a. Leaf apex acuminate, margin entire; stipule foliaceous-spathulate; petal reddish-orange, spathulate; fruit apex acute ..... *H. tiliaceus*
- 9b. Leaf apex acute, margin serrate; stipule linear; petal golden yellow, obovate, fruit apex acuminate ..... *H.sterculiifolius*

filament, anther, and stigma, shapes of the petals, sepals and epicalyx.

Morphological characters measured quantitatively are, length and breadth of leaves, length and breadth of stipules, length and diameter of the fruits, length and breadth of the seeds, petal length, style length, stamen length, length and breadth of epicalyx. Counts were taken of number of petals, sepals and epicalyx. Measurements were taken with a metric ruler and a measuring tape. The photographs of a representative of each species used for the study were also taken. An artificial key to the species was prepared.

3. Results

(see Tables 2, 3, and 4)

Table 2: Morphological description of *H. vitifolius* var. *vitifolius*, *H. surattensis*, *H. sabdariffa* and *H. lunarifolius*

	H. vitifolius var. *vitifolius* (Figure 1A)	*H. surattensis* (Figure 1B)	*H. sabdariffa* (Figure 1C)	*H. lunarifolius* (Figure 1D)
Habitat	A weed commonly found on roadsides, farmlands and abandoned wastelands.	A weed commonly found on roadsides, occasionally on farmlands	Cultivated plants on farmlands, occasionally found on roadsides	A weed usually found along roadside and in bushes
Habit	An annual shrub, usually erect, up to 1.3 m high	An annual herb, procumbent and trailing on the ground or straggling on other nearby plants; around 1.1 m high	An annual herb; erect; up to 1.7 m in height	An annual shrub; erect; about 1.4 cm in height
Stem	Green; covered with grey hair	Green-red; thorny; pubescent	Green; glabrous	Green; covered with thick dense hair
Stipule	Acicular, 0.2-0.3 cm long and 0.1 cm wide	Paired; shape foliaceous-orbicular; 1.5-1.7 cm long and 1.3-1.5 cm wide.	Paired; linear; 1.1-1.4 cm long 0.1-0.3 cm wide	Paired; shape acicular; 0.4-0.7 cm long and 0.1-0.2 cm wide
Petiole	Round; 7-12.1 cm long	Outline round; 4.3-7.9 cm long	Round-oval; 7.1-10.0 cm long	Round-oval; 13.9-22.3 cm long
Leaf	Simple; stipulate; alternate; ovate or lobed with serrate margin; base cordate; apex acute; 6.1-9.8 cm long and 6-11 cm wide.	Simple; alternate; lobed or ovate; stipulate; base cordate; apex acute; margin serrate; 3.9-6.7 cm long and 3.7-6.2 cm wide; pubescent.	Simple; stipulate; alternate; lobed or lanceolate; base cuneate; apex acute; margin serrate; 11.9-18.7 cm long and 8.1-14.2 cm wide	Simple; stipulate; alternate; lobed or broadly ovate; base cordate; apex acuminate; margin serrate; 10.1-15.5 cm long; 13.6-19.1 cm wide.
Venation	Primary veins straight in course; digitate; lateral nerve number in pairs per leaf 6-7; alternate; palmate; more prominent on the abaxial side than on the adaxial side.	Primary veins straight in course; digitate; lateral nerve number in pairs per leaf 5-7; alternate; palmate; more prominent on abaxial than adaxial.	Primary vein straight in course; digitate; lateral nerve number in pairs per leaf 6-9 in number on each side of the primary vein; alternate; type palmate; more prominent on abaxial than on adaxial side.	Primary vein straight in course; digitate; lateral nerve number in pairs per leaf 7-9; often alternate but occasionally opposite at the base; type palmate; more prominent on the abaxial side than on the adaxial side.
Flower	Solitary and axillary	Solitary and axillary	Solitary and axillary	Solitary and axillary
Pedicel	Green; pubescent; 1.5-3.6 cm long	Green with tinges of red occasionally; glabrous; 3.0-5.5 cm long	Green; pubescent; 0.7-0.9 cm long	Green; pubescent; 0.7-1.1 cm long.
Epicalyx	Acicular; free at base; 8-11 in number; 0.7-0.8 cm long and 0.1-0.2 cm wide.	Shape linear with a foliaceous appendage on the back; pubescent; free at the base; 9-11 in number; 1.8-2.3 cm long and 0.7-0.9 cm wide.	Shape linear-lanceolate; free at the base; 8-10 in number; pubescent; 1.3-1.6 cm long and 0.2-0.4 cm wide.	Lanceolate; pubescent; free at the base; number of bracteoles 5-6; 1.2-2.9 cm long and 0.2-0.5 cm wide.

Table 2 continued:

Sepal	Pubescent; green; conate at base; pentamerous; shape lanceolate; 1.3-1.5 cm long and 0.6-1.0 cm wide.	Green-red; pubescent; conate at base; shape lanceolate; pentamerous; 2.0-2.3 cm long and 0.8-1.0 cm wide.	Pubescent; green; conate at the base; shape lanceolate; pentamerous; 2.1-2.5 cm long and 0.6-0.7 cm wide	Green; pubescent; conate at base; lanceolate; pentamerous; 1.1-2.3 cm long and 0.5-0.8 cm wide.
Petal	Lemon yellow with very deep red base, pentamerous; shape obovate; 3.8-4.8 cm long and 2.2-3.8 cm wide.	Lemon yellow with deep red base; pentamerous; 5.8-6.7 cm long and 4.1-5.0 cm wide; shape obovate.	Lemon yellow with yellow base; pentamerous; shape obovate; 4.1-4.9 cm long and 3.5-4.3 cm wide.	Golden yellow, purple-brown at the base; sparsely pubescent; pentamerous; shape obovate; 7.6-8.5 cm long and 5.3-6.4 cm wide.
Stamen	0.3-0.4 cm long; filament red; anther yellow.	0.2-0.3 cm long; filament red; anther dark red		0.4-0.6 cm long; filament dark red; anther dark red.
Style and Stigma	Style light red; 1.8-2.1 cm long; stigma dark red	Style light red; 1.8-2.1 cm long; stigma dark red	0.9-1.4 cm long; white; stigma white-cream	Style white-red; 3.0-3.5 cm long; stigma dark red
Fruit	Capsule; shape round; apex acuminate; 1.3-1.5cm long and 2.0-2 cm in Diameter.	Capsule; shape elongate-conical; 1.4-1.8 cm long and 1.4-1.6 cm in diameter; apex aristate.	Capsule; shape conical; apex acuminate; 1.7-2.1 cm long and 1.9-2.3 cm in diameter	Capsule shape ovoid; shape of apex aristate; 2.1-2.8 cm long and 1.9-2.4 cm in diameter.
Seed	Usually 20-22 per fruit; 0.2-0.3 cm long and 0.1-0.2 cm wide.	Usually 22-25 per capsule, 0.2-0.3 cm long and 0.1-0.2 cm wide.	25-29 per capsule; 0.3-0.4 cm long and 0.2-0.3 cm wide	Number per capsule 84-89; 0.1-0.3 cm long and wide

4. Discussion

Hutchinson and Dalziel (1958) reported some morphological attributes for the *Hibiscus* species. These include leaf shape, sepal shape, presence or absence of epicalyx, epicalyx shape and presence or absence of lobes on leaves. The morphological attributes investigated in this study are the same to a large extent with those of Hutchinson and Dalziel (1958). However, a few salient morphological characters not recorded by these authors which may enhance the taxonomic status of the *Hibiscus* species in Nigeria will be discussed. These include habit, leaf bases, stipule shape, petal shape, fruit shapes and apices.

(a) Habit in *Hibiscus*

Two important habits can be used in the taxonomy of the *Hibiscus* species studied. Apart from *H. surattensis* which is procumbent, all others are erect. Perenniality is encountered in *H. tiliaceus* and *H. sterculiifolius*. *H. rostellatus* is an annual-perennial, others are annuals.

(b) Leaf bases

Leaf bases are generally cordate except in *H. acetosella* where it is rounded and *H. sabdariffa* where it is cuneate. *H. scotellii, H. surattensis* and *H. acetosella* have deeply lobed leaves, *H. vitifolius* var. *vitifolius*, *H. lunarifolius, H. rostellatus, H. sabdariffa, H. physaloides* and *H. sterculiifolius* are not as deeply lobed while *H. tiliaceus* is not lobed.

(c) Nature of stipules

The species of *Hibiscus* studied can be delimited based on the shape of the stipules. Acicular stipules are present in *H. physaloides, H. vitifolius,* var. *vitifolius, H. scotellii.* They are acicular-linear in *H. rostellatus* and *H. lunarifolius;* linear in *H. acetosella, H. sabdariffa* and *H. sterculiifolius;* foliaceous-spathulate in *H. tiliaceus* and foliaceous-orbicular in *H. surattensis*. With the exception of *H. tiliaceus* having a spathulate petal shape, all the other species of *Hibiscus* studied have obovate petals.

Table 3: Morphological description of *H. tiliaceus*, *H. sterculiifolius*, *H. acetosella*

	H. tiliaceus (Figure 1E)	*H. sterculiifolius* (Figure 2A)	*H. acetosella* (Figure 2B)
Habitat	They are common in mudflats near the sea; also cultivated as ornamental plants around buildings and along roadside.	A weed found on roadside and on rocky grounds occasionally planted as an ornamental plant.	An ornamental plant commonly planted in front of houses, gardens and recreational places
Habit	A perennial small tree up to 9 m high.	A small shrub or tree; perennial; erect; up to 3.2 m high	An annual herb; erect; up to 1.7 m in height
Stem	Grey-green; glabrous	Grey-green; glabrous	Red; glabrous
Stipule	Paired; foliaceous-spathulate; 3.8-4.5 cm long and 1.3-2.1 cm wide.	Paired; shape linear; 0.2-0.3 cm long and 0.1-0.3 cm wide	Paired; shape linear; 0.9-1.3 cm long and 0.3-0.6 cm wide
Petiole	Outline is round-oval; 8.0-14.1 cm long	Round-oval; 5.3-7.8 cm long	Round-oval; 4.1-9.0 cm long
Leaf	Simple; stipulate; alternate; not lobed; shape broadly ovate; base cordate; apex acuminate; margin entire; 16.6-23.3 cm long and 17.9-24.5 cm wide.	Simple; stipulate; alternate; lobed or broadly ovate; base cordate; apex acute; margin serrate; 9.8-13.5 cm long and 10.8-14.1 cm wide	Simple; lobed or ovate; alternate; stipulate; base rounded; apex acute; margin serrate; 6.1-8.6 cm long and 5.8-8.0 cm wide
Venation	Primary vein straight in course; digitate; number of lateral nerves in pairs per leaf 7-9; alternate; type palmate; more prominent on abaxial than on the adaxial side.	Primary vein straight in course; digitate; lateral nerve in pairs per leaf 5-7; alternate; type palmate; more prominent on the abaxial than on the adaxial	Primary vein straight in course; digitate; lateral nerves in pairs per leaf 5-6; alternate; type palmate; more prominent on abaxial than adaxial
Flower	Solitary and axillary	Solitary and axillary	Solitary and axillary
Pedicel	Present; green-grey; glabrous 1.5-2.9 cm long	Green; slightly pubescent; 0.6-0.8 cm long	Red; glabrous; 0.4-0.8 cm long
Epicalyx	Lanceolate; conate at the base; number 9-11; 1.1-1.4 cm long and 0.3-0.4 cm wide.	Linear-lanceolate; conate at the base; number 9-11; pubescent; 0.6-0.8 cm long and 0.2-0.3 cm wide.	Acicular-ovate; pubescent; free at the base; 8-10 in number; 1.2-1.6 cm long and 0.2-0. 3 cm wide
Sepal	Glabrous; light green; conate at base; pentamerous; shape lanceolate; 4.1-4.7 cm long and 1.1-1.5 cm wide.	Pubescent; green; conate at base; shape lanceolate; pentamerous; 1.2-1.4 cm long and 0.5-0.6 cm wide	Red; pubescent; conate at the base; shape lanceolate; pentamerous; 1.5-2.0 cm long and 0.4-0.6 cm wide
Petal	Red-orange with deep red base; shape spathulate; pentamerous; 8.9-9.7 cm long and 2.4-2.8 cm wide	Golden yellow with deep red base; pentamerous; shape obovate; 4.1-4.7 cm long and 2.0-2.4 cm wide.	Red with very deep red colour at the base; pentamerous; shape obovate; 3.5-5.5 cm long and 1.5-3.0 cm wide
Stamen	0.3-1.2 cm long; filament red; anther yellow	0.1-0.2 cm long; filament dark red; anther red	0.3-0.5 cm long; filament dark red; anther dark red
Style and Stigma	Style red; 8.6-9.2 cm long; stigma red.	Style dark red; 2.0-2.4 cm long; stigma dark red.	Style red; 1.7-2.3 cm long; stigma dark red
Fruit	Capsule; shape ovoid; pubescent; apex acute; 2.9-3.3 cm long and 3.5-4.1 cm in diameter	Capsule; shape ovoid; apex acuminate; 1.4-1.6 cm long and 1.3-1.5 cm in diameter.	Capsule; shape elongate-conical; apex aristate; 1.7-2.0 cm long and 1.6-1.8 cm in diameter
Seed	Usually 79-83 in number per capsule; 0.4-0.5 cm long and 0.3-0.4 cm wide.	33-36 in number per capsule; 0.2-0.3 cm long and 0.1-0.3 cm wide	Number per capsule 19-22; 0.3-0.4 cm long and 0.2-0.3 cm wide.

Table 4: Morphological description of *H. rostellatus*, *H. physaloids*, and *H. scotellii*

	H. rostellatus (Figure 2C)	*H. physaloids* (Figure 2D)	*H. scotellii* (Figure 2E)
Habitat	A weed commonly found along roadside, waste places and occasionally on river banks	Weed commonly found on hill tops, but occasionally on level lands along roadsides or in bushes	A weed, often located on rocks or hills
Habit	A perennial shrub, often erect, but occasionally bent; up to 1.3 m high.	An annual woody herb; erect; up to 1.2 m high	A fibrous annual herb; erect, up to 1.4 m high
Stem	Green; pubescent; thorny	Green; covered with spreading pungent hairs	Green-red; pubescent
Stipule	Paired; shape acicular-linear; 0.5-0.8 cm long and 0.2-0.3 cm wide	Paired; shape acicular; 0.5-0.8 cm long and 0.1-0.4 cm wide	Paired; shape acicular; 0.2-0.4 cm long and 0.1-0.2 cm wide
Petiole	Round-oval; 5.3-11.3 cm long	Round-oval; 9.6-7.1 cm long	Outline is round-oval; 6.8-0.2 cm long
Leaf	Simple; stipulate; alternate; lobed or broadly ovate; base cordate; apex acute; margin serrate; 8.7-12.7cm long and 11.6-16.3 cm wide	Simple; with chalk-like incrustations at the base of the nerves beneath; stipulate; alternate; margin lobed; shape ovate; base cordate; apex acuminate; margin serrate; 9.3-10.8 cm long and 12.8-15.1 cm wide	Simple; stipulate; alternate; lobed or ovate; base cordate, apex acute; 7.5-9.1 cm long and 7.5-11.0 cm wide.
Venation	Primary vein straight in course; digitate; lateral nerve number in pairs per leaf 6-7; alternate; type palmate; more prominent on abaxial than on the adaxial	Primary vein straight in course; digitate; lateral nerve number in pairs per leaf 6-8; alternate; type palmate; more prominent on the abaxial than on the adaxial side	Primary vein straight in course; digitate; number of lateral nerve in pairs per leaf 7-9; alternate; palmate; more prominent on abaxial side than adaxial side.
Flower	Solitary and axillary	Solitary and axillary	Solitary and axillary
Pedicel	Green; pubescent; 1.8-2.1 cm long	Green with some brown tinges; pubescent; 5.7-8.5 cm	Green occasionally with red dots; glabrous; 0.5-0.9 cm long
Epicalyx	Shape linear with a lanceolate-foliaceous appendage at the back; free at the base; number 10-11; 1.3-1.6 cm long and 0.2-0.4 cm wide	Shape acicular; free at the base; very pubescent; number 7-10; 1.5-1.8 cm long and 0.1-0.2 cm wide	Shape linear-lanceolate; free at the base; number 7-9; 0.9-1.2 cm long and 0.2-0.3 cm wide.
Sepal	Pubescent; light green; pentamerous; conate at the base; ovate-lanceolate in shape; 1.8-2.1 cm long and 0.9-1.1 cm wide.	Pubescent; pentamerous; green; conate at base; shape of each bracteole lanceolate; 1.9-2.4 cm long and 0.6-0.8 cm wide	Light green with red dots that are hair bases; pentamerous; pubescent; conate at the base; shape lanceolate; 1.3-1.8 cm long and 0.4-0.6 cm wide.
Petal	Golden yellow with deep red base; pentammerous; shape obovate; 6.5-7.1 cm long and 4.1-6.1 cm wide	Lemon yellow with light red base; pentamerous; shape obovate; 4.0-5.4 cm long and 2.3-3.5 cm wide	Lemon yellow with deep red base; shape obovate; pentamerous; 5.2-6.3 cm long and 2.6-4.1 cm wide.
Stamen	0.3-0.5 cm long; filament dark red; anther light red	0.2-0.4 cm long; filament white-yellow; anther yellow	0.2-0.3 cm long; filament dark red; anther dark red
Style and Stigma	Style light red; 3.1-4.7 cm long; stigma dark red	Style white-yellow; 1.4-1.9 cm long; stigma white-yellow with red tinges.	Style light red; 2.0-2.6 cm long; stigma red
Fruit	Capsule; shape conical; apex acuminate; 1.8-2.2 cm long and 2.0-2.3 cm in diameter	Capsule; shape conical; apex acuminate; 1.3-1.5 cm long and 1.2-1.3 cm in diameter.	Capsule; shape conical; apex acuminate; 1.4-1.7 cm long and 1.3-1.5 cm in diameter
Seed	Number per capsule 14-18; 0.3-0.5 cm long and 0.2-0.3 cm wide.	Usually 56-61 per capsule; 0.1-0.3 cm long and 0.1-0.2 cm wide	Number of seed per fruit 20-24; 0.2-0.3 cm long and 0.1-0.3 cm wide

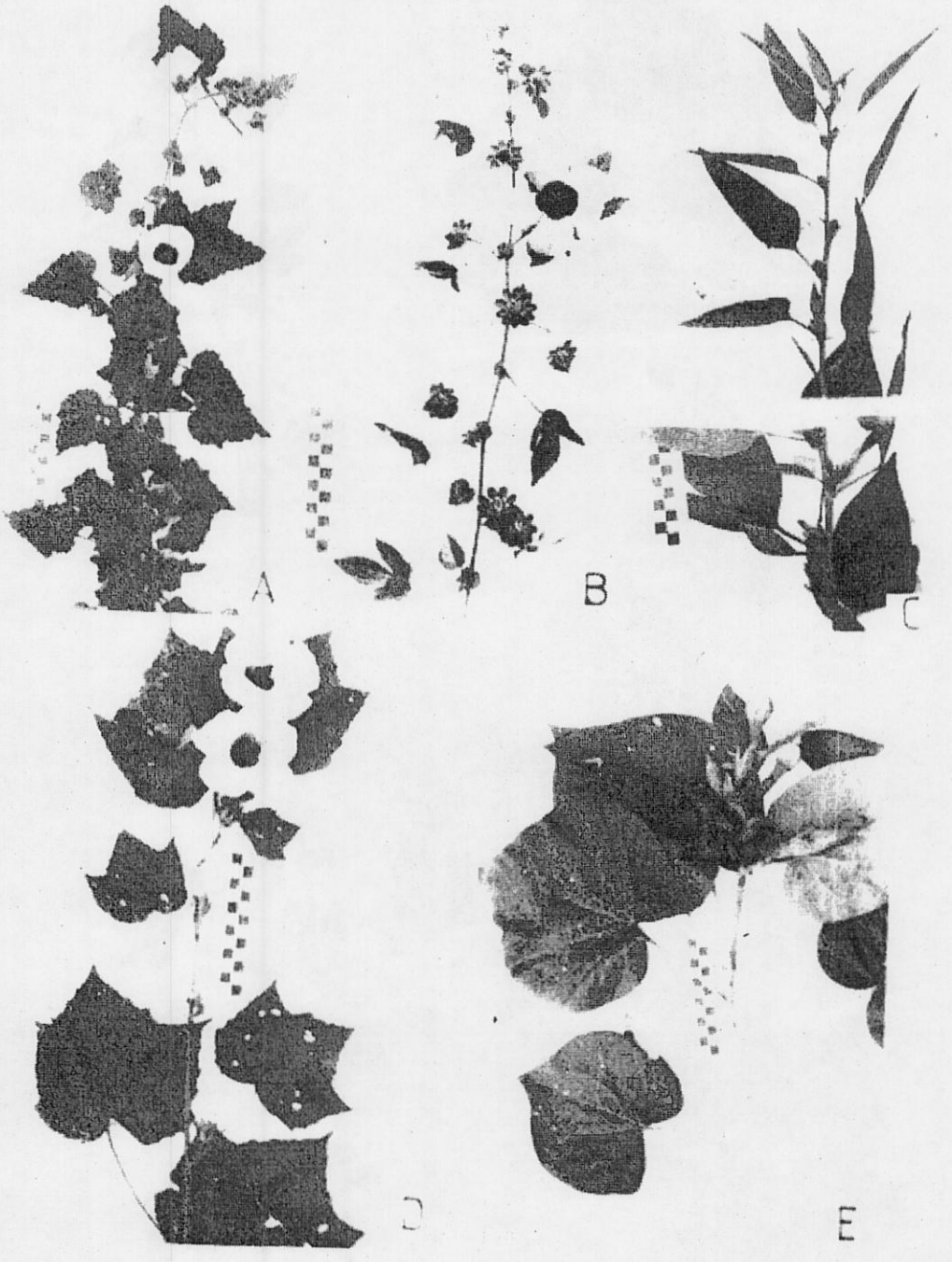

Figure 1: Vegetative and floral morphology of the species of *Hibiscus*.

A. *H. vitifolius* var. *vitifolius*

B. *H. surattensis*

C. *H. sabdariffa*

D. *H. lunarifolius*

E. *H. tiliaceus*

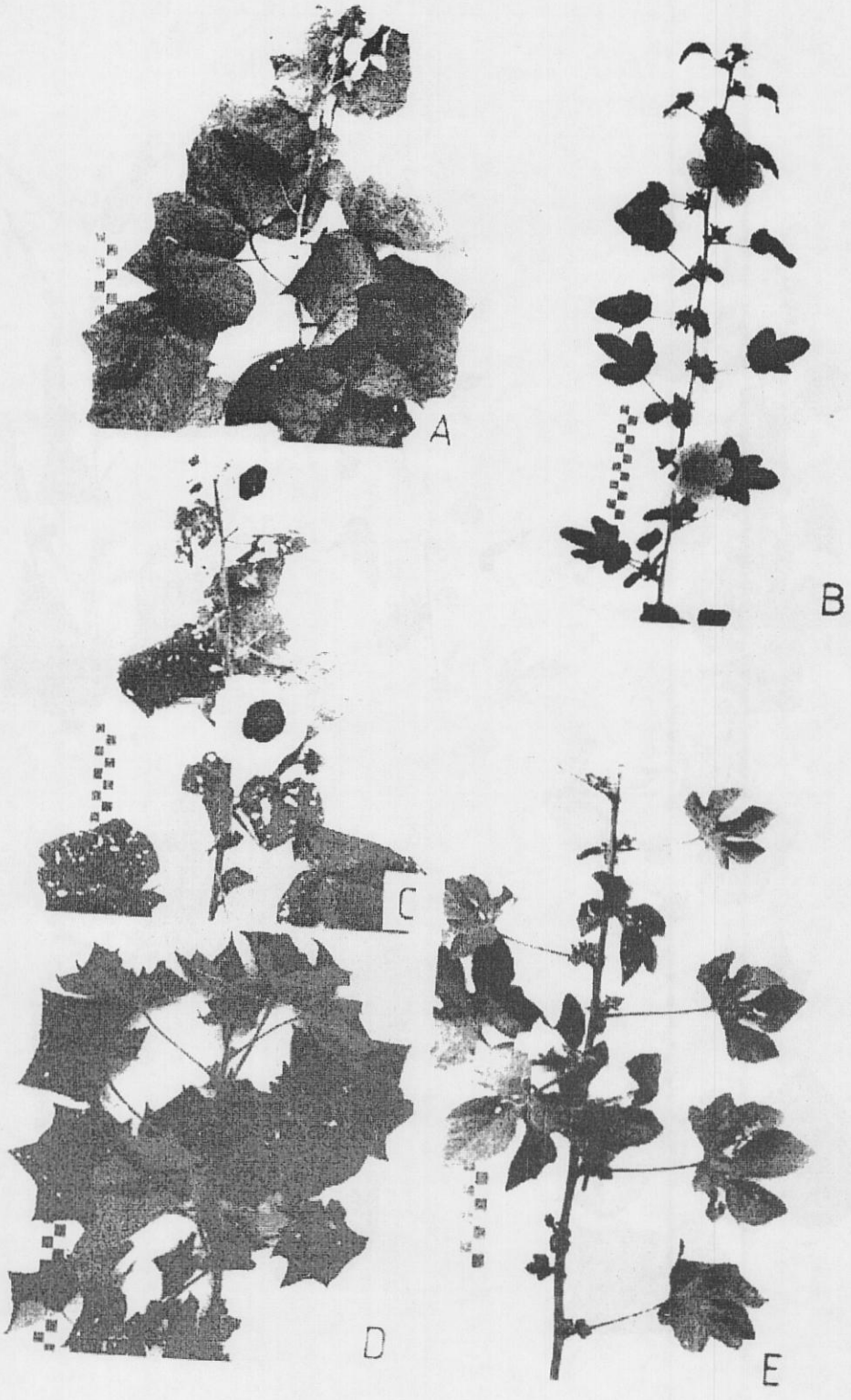

Figure 2: Vegetative and floral morphology of the species of *Hibiscus*.

A. *H. sterculiifolius*
B. *H. acetosella*
C. *H. rostellatus*
D. *H. physaloides*
E. *H. scotellii*

Table 5: Summary of the important vegetative morphological characters in *Hibiscus* Linn.

Characters	PLANT HABIT		LEAF SHAPE			LEAF BASE			LEAF APEX		LEAF MARGIN		STIPULE SHAPE			
Species	Procumbent	Erect	Ovate	Broadly ovate	Lanceolate	Cordate	Rounded	Cuneate	Acute	Acuminate	Serrate	Entire	Acicular	Linear	Foliaceous-orbicular	Foliaceous-spathulate
H. vitifolius var. vitifolius	-	+	+	-	-	+	-	-	+	-	+	-	+	-	-	-
H. tiliaceus	-	+	-	+	-	+	-	-	-	+	-	+	-	-	-	+
H. physaloides	-	+	+	-	-	+	-	-	+	+	+	-	+	-	-	-
H. surattensis	+	-	+	-	-	+	-	-	+	-	+	-	-	-	+	-
H. acetosella	-	+	+	-	-	-	+	-	+	-	+	-	-	+	-	-
H. scotellii	-	+	+	-	-	+	-	-	+	-	+	-	+	-	-	-
H. lunariifolius	-	+	-	+	-	+	-	-	-	+	+	-	+	-	-	-
H. rostellatus	-	+	-	+	-	+	-	-	+	-	+	-	+	-	-	-
H. sterculiifolius	-	+	-	+	-	+	-	-	+	-	+	-	-	+	-	-
H. sabdariffa	-	+	-	-	+	-	-	+	+	-	+	-	-	+	-	-

KEY: + Present
- Absent

Table 6: Summary of the important floral morphological characters in *Hibiscus* Linn.

Species / Characters	PETAL SURF-ACE		PETAL SHAPE		PETAL COLOUR					PETAL BASE COLOUR			EPICALYX SHAPE			EPICAL-YX AT BASE		FRUIT SHAPE			FRUIT APEX			FRUIT SIZE	
	Pubescent	Glabrous	Spatulate	Obovate	Golden Yellow	Lemon Yellow	Red	Red-orange	Deep red	Light red	Purple-brown	Yellow	Acicular	Lanceolate	Acicular-ovate	Linear-lanceolate	Free	Connate	Number of epicalyx	Round	Ovoid	Conical	Elongate-conical	Acuminate	Acute	Aristate	Length (cm)	Diameter (cm)
H. vitifolius var. vitifolius	-	+	-	+	-	+	-	-	+	-	-	-	+	-	-	-	+	-	8-11	+	-	-	-	+	-	-	1.3-1.5	2.0-2.2
H. tiliaceus	-	+	+	-	-	-	-	+	+	-	-	-	-	+	-	-	-	+	9-11	-	+	-	-	-	+	-	2.9-3.3	3.5-4.1
H. physaloides	+	-	-	+	-	+	-	-	-	+	-	-	+	-	-	-	+	-	7-10	-	-	+	-	+	-	-	1.3-1.5	1.2-1.3
H. surattensis	-	+	-	+	-	+	-	-	+	-	-	-	-	-	+	-	+	-	9-11	-	-	-	+	-	-	+	1.4-1.8	1.4-1.6
H. acetosella	-	+	-	+	-	-	+	-	+	-	-	-	-	-	+	-	+	-	8-10	-	-	-	+	-	-	+	1.7-2.0	1.6-1.8
H. scotellii	-	+	-	+	-	+	-	-	+	-	-	-	-	-	+	-	+	-	7-9	-	-	+	-	+	-	-	1.4-1.7	1.3-1.5
H. lunariifolius	+	-	-	+	+	-	-	-	-	-	+	-	-	+	-	-	+	-	5-6	-	+	-	-	-	-	+	2.1-2.8	1.9-2.4
H. rostellatus	-	+	-	+	+	-	-	-	+	-	-	-	-	-	-	+	+	-	10-11	-	-	+	-	+	-	-	1.8-2.2	2.0-2.3
H. sterculiifolius	-	+	-	+	+	-	-	-	+	-	-	-	-	-	-	+	-	+	9-11	-	+	-	-	+	-	-	1.4-1.6	1.3-1.5
H. sabdariffa	+	-	-	+	-	+	-	-	-	-	-	+	-	-	-	+	+	-	8-10	-	-	+	-	+	-	-	1.7-2.1	1.9-2.3

KEY: + Present
- Absent

(d) Fruit characteristics

Fruit shape varies from round, conical, elongate-conical to ovoid, while the apex varies from acuminate, acute to aristate. Shape is ovoid and apices are acute, aristate or acuminate in *H. tiliaceus, H. lunarifolius* and *H. sterculiifolius* respectively. Shape is round with acuminate apex in *H. vitifolius* var. *vitifolius*. Conical shape and acuminate apex are found in *H. physaloides, H. scotellii* and *H. rostellatus*. Elongate-conical shape and aristate apex are characteristic of *H. surattensis* and *H. acetosella,* but apex is acuminate in *H. sabdariffa*. Fruit size clearly delimits *H. tiliaceus* from the other species. It is clearly longer and broader. The pairs *H. physaloides* and *H. sterculiifolius, H. surattensis* and *H. acetosella*; *H. rostellatus* and *H. sabdariffa* have close fruit size relationships.

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