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SYSTEMATIC AND ECOGEOGRAPHIC STUDIES ON CROP GENEPOOLS 6

# THE DISTRIBUTION OF *HIBISCUS* L. SECTION *FURCARIA* IN TROPICAL EAST AFRICA

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## FOREWORD

The International Jute Organisation (IJO) was established in January, 1984 to achieve the objectives laid down in the International Agreement on Jute\* and Jute Products, 1982. The Headquarters of the Organisation is in Dhaka, Bangladesh and at present there are 32 members of which 5 are exporting countries: Bangladesh, China, India, Nepal and Thailand.

One of the main objectives of the Organisation is to develop the production of jute and jute products with a view to improving, *inter alia*, their quantity and quality for the benefit of importing and exporting members. IJO conducts research and development projects in the fields of agriculture, industry and market promotion.

The first and most important IJO project in the agricultural sector is the project, "Collection, Conservation, Characterisation and Exchange of Germplasm for the Development of Improved Varieties of Jute, Kenaf and Other Allied Fibres" (known as the Germplasm Project). This is a 5-year project which is being executed by IJO itself with the technical and scientific cooperation of the Food and Agriculture Organization of the United Nations (FAO) and the International Board for Plant Genetic Resources (IBPGR).

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\* For the purposes of the Agreement, "Jute" means *Corchorus capsularis* (white jute), *C. olitorius* (tossa jute), *Hibiscus cannabinus* (kenaf), *H. sabdariffa* (mesta and rosella) and allied fibre crops including *Urena lobata*, *Abutilon avicennae* and *Cephalonema polyandrum*.

The objective of the project is to develop high yielding varieties of jute and kenaf with superior fibre quality. The first 2-year phase of the project was implemented in September, 1987 and consisted of two Sub-projects, A (funded by the Asian Development Bank (ADB)) and B (funded jointly by the governments of Japan, Switzerland and the Netherlands).

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Six member countries of IJO, namely, Bangladesh, China, India, Nepal, Thailand and Indonesia account for about 95% of world jute and kenaf production. The first five are exporting countries which together account for about 98% of world exports of jute and jute goods. About 55% of the foreign exchange earnings of Bangladesh is derived from such exports.

Moreover, in jute producing areas, more particularly in Bangladesh and India, jute assumes high socio-economic importance because the livelihood of millions of small and marginal farming families depends on jute/kenaf production and utilization.

Despite the high socio-economic significance of jute and kenaf, no major breakthrough has been achieved in research relating to jute breeding and varietal improvement. The existing varieties are based on a narrow range of genetic variability and are constrained by low adaptability to agro-ecological conditions and susceptibility to several diseases and insect pests.

The starting point for the Germplasm Project, therefore, was to acquire new sources of genetic diversity and to make the material available to jute/kenaf scientists in the member countries for use in a coordinated regional programme of characterization, evaluation and breeding.

However, although the centres of diversity of *Corchorus olitorius* and *Hibiscus cannabinus* were known to be located in Africa, concise information on the occurrence and distribution of these and related species in Africa was not available in the literature. Such information is an essential requirement to facilitate the systematic and effective planning of germplasm collecting missions in a centre of diversity of a cultivated crop plant.

Consequently, in consultation with IBPGR, an Herbarium Consultant (Dr Jennifer M. Edmonds) was appointed to examine herbarium specimens of *Corchorus* and *Hibiscus* species in recognized herbaria in Europe and East Africa and to produce technical reports on the geographic distribution, habitats, fruiting patterns and phenotypic variation of the species concerned. This report on the distribution of *Hibiscus* species in East Africa was largely based on material in the East African Herbarium; that for *Corchorus* species in Africa was produced by the Consultant from an examination of material maintained in major herbaria in Kew (UK), Brussels (Belgium), Wageningen (the Netherlands) and Nairobi (Kenya).

These documents proved to be of immense value to the IJO Germplasm Project. Based on information in the reports, and in close collaboration with the IBPGR Regional Office in Nairobi, Kenya, five IJO missions were able to collect a total of 790 seed samples of species of *Corchorus*, *Hibiscus* and related bast fibre-bearing genera from Kenya and Tanzania in late-1987 and mid-1988. Samples of each accession are conserved in base storage in the IJO-designated Centralized Germplasm Repository at the Bangladesh Jute Research Institute. Seed sub-samples were also distributed to active collections in the Germplasm Project member countries for evaluation and use in breeding programmes.

The systematic approach taken jointly by IJO and IBPGR firstly to compile comprehensive background information on the occurrence and distribution of the genetic resources of a cultivated crop plant in a centre of diversity and then to use such information to collect germplasm from the existing genepool has proved to be most effective. It is suggested that such a strategy should be more widely adopted in the genetic resources programmes of other cultivated crops where the acquisition of a broad range of genetic variation for potential crop improvement is a primary objective.

*Harbans Singh*  
Executive Director  
*International Jute Organisation*

## 1. INTRODUCTION

### **1.1 General background**

The International Jute Organisation (IJO), as part of its project concerned with the "collection, concentration, characterisation and exchange of germplasm for the development of improved varieties of jute, kenaf and other allied fibres", required a general survey of *Corchorus* (jute) and *Hibiscus* (kenaf and rosella) species. The survey was to provide the necessary background data on which germplasm collecting expeditions could be based, by identifying those species of potential use in the future genetic improvement of jute, kenaf and rosella, and by identifying those countries and locations where collecting expeditions would be most profitable (1). A complete survey of those *Corchorus* species found in Africa was undertaken by Edmonds (1,2), but the size and taxonomic complexity of the genus *Hibiscus* prevented a comparable survey of this group within the timescale of the proposed IJO project. However, a brief survey of those *Hibiscus* species most closely related to kenaf and rosella, based on specimens in the East African Herbarium, was completed within the timescale available.

### **1.2 Importance of jute and kenaf and the necessity for increased yield and quality**

Most of the world's jute and jute-like fibres are grown in the Asia-Pacific Region, with Bangladesh, China and India producing around 88% of the world's supplies (3). In addition to constituting a major source of foreign exchange, these fibres also provide a major source of employment, especially in India and Bangladesh (1-3). However, despite the high socio-economic importance of jute and allied fibres, production of raw jute and fibre from kenaf has only marginally increased during the past decade, and has even shown a slight decline (of c.0.3% p.a.) during the last four years (3).

Among the constraints to higher and stable yields of jute and kenaf listed by the IJO (3) are: (i) scarcity of high yielding and stable varieties adaptable to diverse growing conditions; (ii) narrow genetic bases of the existing varieties; (iii) low adaptation to agro-ecological conditions (including temperature and photoperiod regimes) of the existing varieties; (iv) the susceptibility of existing varieties to several diseases and pests; and (v) the necessity for the adaptability of fibre crops to multiple cropping systems.

To overcome these constraints, the IJO recommended (3) that fibre and kenaf breeders should improve varieties by searching for, and subsequently incorporating, those genetic resources which would provide new strains with (i) photoperiod sensitivity, especially to allow more flexibility of sowing and harvesting times; (ii) tolerance to problem soils; (iii) tolerance to lower temperatures; (iv) tolerance to drought and flooding; (v) high photoperiod efficiency and tolerance to cloudiness; (vi) resistance to diseases and pests; (vii) improved fibre percentage and quality; (viii) cylindrical and more uniform stem diameter; (ix) high retting efficiency; (x) fast vegetative growth during the pre-flowering stage in kenaf; and (xi) spinelessness in *Hibiscus* species.

Germplasm capable of donating these characters is not readily available in existing fibre collections, so the IJO recommended that the potential availability of such desirable traits in related wild species should be investigated.

### **1.3 General taxonomy of *Hibiscus* section *Furcaria***

The genus *Hibiscus* exhibits considerable taxonomic complexity; it is composed of over 400 species which are in urgent need of revision. A taxonomic survey of this genus was clearly impossible within the timescale available, so the distribution of those species known to be most closely related to kenaf and rosella was examined.

Both kenaf (*H. cannabinus* L.) and rosella (*H. sabdariffa* L.) belong to *Hibiscus* section *Furcaria*. This is a natural group of around 40 species with two main centres of distribution, the major one being in tropical Africa and the lesser one in tropical America (5). Species belonging to this section are characterized by a calyx becoming leathery or succulent at maturity and having 10 prominent nerves or ribs, a median one to each of the five calyx lobes and a commissural one to each sinus where it branches, each branch forming a prominent ridge along the margin of each lobe; the epicalyx bracts (bracteoles) being numerous, free, or joined to the calyx only at the base, and frequently divided at the tip into an inner and an outer fork; and the stems and floral parts often being spiny (5).

The account of *Hibiscus* in *Flora Zambesiaca* (6), covering Botswana, Malawi, Mozambique and Zimbabwe, is probably the most recent revision of this genus for south-eastern Africa. Though it only deals with seven of the species included in this survey, the key to the Series *Furcaria* from this account has been included to facilitate the identification of these taxa. The species concerned are marked with an asterisk in the key.

### Keys to Series *Furcaria* species found in southeastern Africa (6)

- Bracts of epicalyx forked, or with a small appendage, or simple.  
 Calyx 10-nerved, a median one to each lobe and a commissural one to each sinus, the latter nerve bifurcating:
- Bracts of epicalyx clearly forked:
- Stipules broad, auriculate and +/- amplexicaul \**H. surattensis*
  - Stipules narrow, linear to subulate, not amplexicaul:
    - Plant not aculeate \**H. acetosella*
    - Plant +/- aculeate:
      - Peduncle up to 0.8 cm long:
        - Prickles stout, usually unbranched with swollen bases; calyx-lobes acute *H. torrei*
        - Prickles less developed, usually forked or stellate and only slightly swollen at the base; calyx-lobes acuminate:
          - Leaves membranous, usually obtuse at the base (rarely slightly cordate), up to 18 x 18 cm; plant erect, annual \**H. mastersianus*
          - Leaves chartaceous, usually somewhat cordate at the base, up to c.4 x 4 cm; plant +/- prostrate, usually perennial *H. hiernianus*
      - Peduncle 1-6 cm long *H. altissimus*
- Bracts of epicalyx not clearly forked (occasionally with a small appendage on the adaxial surface near the apex):
- Calyx fleshy, edible; plant not aculeate \**H. sabdariffa*
  - Calyx not fleshy; plant aculeate:
    - Stem (below the flowers) pilose, pubescent or puberulous (occasionally almost glabrous) as well as setose or aculeate; flowers white or yellow with dark centres; plant annual:
      - Calyx up to 2.5 cm long, with a +/- conspicuous gland on the median vein of each lobe; stems pubescent to puberulous (occasionally almost glabrous) as well as aculeate; leaf-lamina suborbicular to ovate-lanceolate in outline:
        - Flowers white greyish or pale yellow, with dark purple center; calyx-lobes acuminate or long-acuminate; gland on calyx-lobe conspicuous, usually at least 1-5 mm in diam. (rarely absent); leaf-segments usually narrowly elliptic to linear (occasionally broader); stems puberulous (rarely pubescent) to nearly glabrous (as well as aculeate) \**H. cannabinus*
        - Flowers yellow with dark red centre; calyx-lobes usually ovate, only shortly acuminate; gland on calyx-lobe less conspicuous, usually up to 1 mm in diam.; leaf-segments rhombic to oblanceolate; stems shortly stellate-tomentose (as well as aculeate) *H. meeusei*
      - Calyx 2.5-4 cm long, devoid of glands on the median veins of the lobes; stems with long flexuous hairs (as well as aculeate); leaf-lamina +/- flabelliform in outline \**H. mechowii*
    - Stem (below the flowers) tomentose, tomentellous or densely pubescent and with conspicuous short stout conical prickles, the bases of which remain as small knobs; flowers purple, reddish or pink (rarely white), with a darker centre; calyx densely setose; plant perennial, usually a shrub or small tree \**H. diversifolius* subsp. *rivularis*

## 2. MATERIAL EXAMINED

Herbarium material of *Hibiscus* species belonging to the section *Furcaria* was briefly examined in the East African Herbarium, Nairobi (EA). In addition to *H. cannabinus* and *H. sabdariffa*, Wilson (4) listed the following 11 East African taxa as belonging to the section *Furcaria*: *H. acetosella* Welw. ex Hiern, *H. altissimus* Hornby, *H. asper* Hook., *H. diversifolius* Jacq. subsp. *diversifolius*, *H. diversifolius* Jacq. subsp. *rivularis* Bremek. & Oberm., *H. diversifolius* Jacq. var. *witteanus* Hochr., *H. greenwayi* Bak.f., *H. mastersianus* Hiern., *H. mechowii* Garcke, *H. meeusei* Exell, and *H. surattensis* L. Of these, there was no East African material of *H. altissimus*, *H. asper* or *H. meeusei* in EA. However, material of two other species belonging to the section *Furcaria*, *H. radiatus* Cav. and *H. rostellatus* Guill. & Per., was represented in EA and included in this survey.

To facilitate the identification of some of these taxa, Tables 1 and 2, taken from Wilson & Menzel (5) are included, together with their illustrations of capsules and bracteoles (Fig. 1) and seeds (Fig. 2).

Table 1. Comparative morphology of 12 species of *Hibiscus*, section *Furcaria*

Species	apex of bract	calyx gland	flower color	calyx wool	foliage color	leaf lobing
<i>H. cannabinus</i>	entire	present	cream	present	green	variable
<i>H. acetosella</i>	forked	present	pink-yellow	absent	green-red	shallow, broad obcuneate margins
<i>H. radiatus</i>	forked to obscurely forked	absent	purpie-yellow	absent	green	deep, narrow, serrate margins
<i>H. sabdariffa</i>	channeled	present	cream	absent	green	variable
<i>H. surattensis</i>	forked	absent	yellow	absent	green	deep, narrow
<i>H. diversifolius</i>	entire	present	purple-yellow	absent	green	shallow, broad
<i>H. rostellatus</i>	forked	absent	yellow	absent	green	obscure
<i>H. meeusei</i>	forked	present	cream	absent	green	shallow, broad
<i>H. furcellatus</i> <sup>a</sup>	forked	present	lavender	absent	green	almost entire
<i>H. bifurcatus</i>	forked	present	lavender	absent	green	shallow, broad
<i>H. costatus</i>	forked	present	lavender	absent	green	unlobed
<i>H. aculeatus</i>	forked	present	yellow	absent	green	deep, narrow

Taken from Wilson, F.D. & Menzel, M.Y. (1964), *Economic Botany*, 18:85.

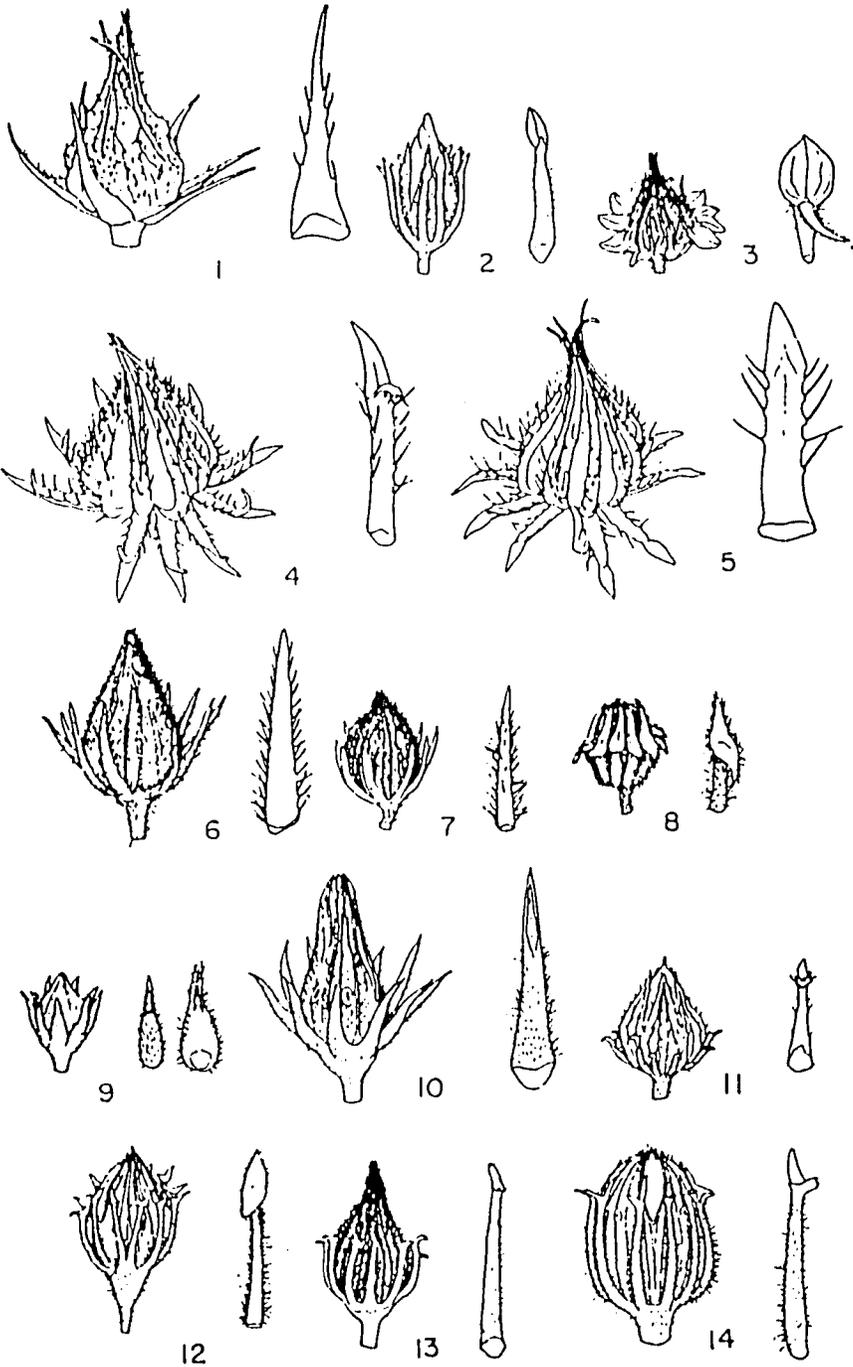
<sup>a</sup> *H. furcellatus*: bracteoles shorter than the calyx; *H. bifurcatus*: bracteoles longer than the calyx.

**Table 2.** Morphological differences between *H. cannabinus* and *H. sabdariffa*\*

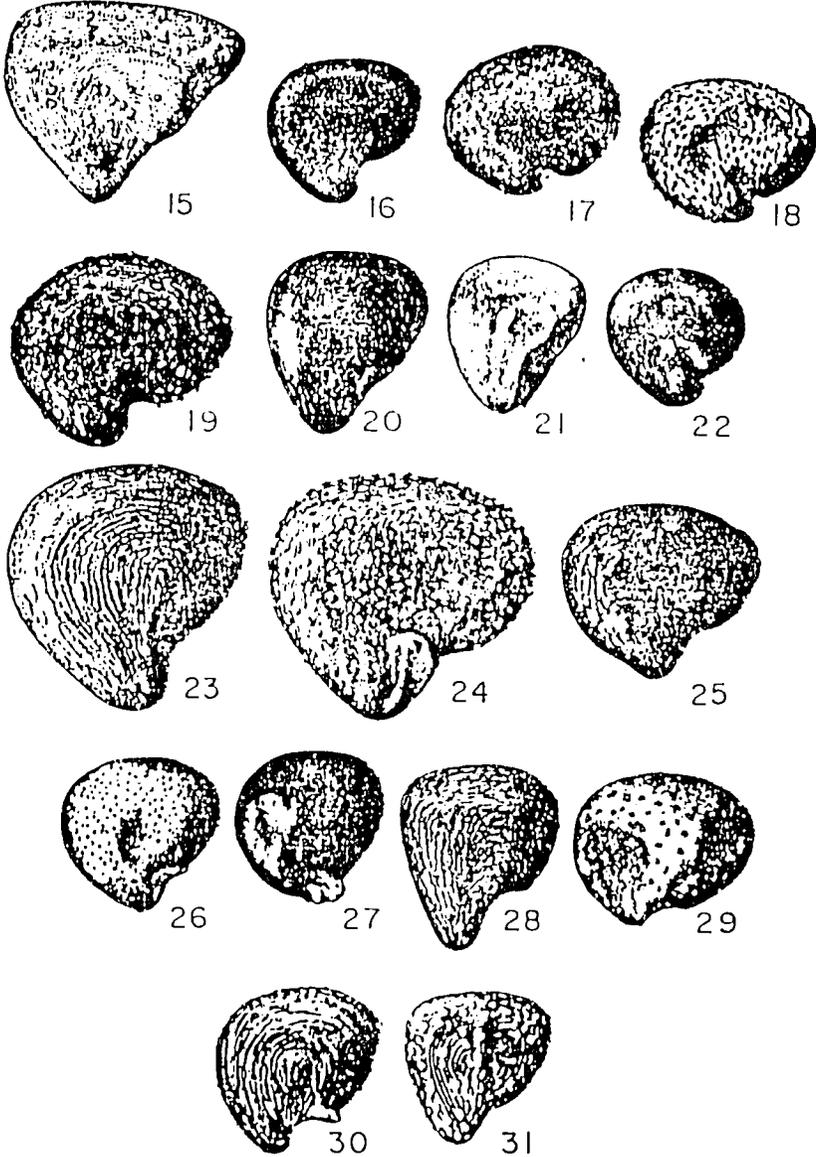
Plant Part	<i>H. cannabinus</i>	<i>H. sabdariffa</i>
1. apex of bracteole	entire	channeled
2. calyx pubescence	white, woolly tomentum	pubescent or glabrous, but without a woolly tomentum
3. calyx nectary	swollen	not swollen
4. shape of calyx lobe	acuminate	ovate to ovate-lanceolate
5. seed		
a. shape	irregularly subreniform	subreniform
b. surface markings	liberally dotted with pectinate scales	minutely pubescent
c. hilum	yellow-brown, inconspicuous	brownish-red, conspicuous

\* Taken from Wilson, F.D. & Menzel, M.Y. (1964), *Economic Botany*, 18:85.

**Fig.1.** Capsules (or buds) and bracteoles of 11 species of *Hibiscus*, section *Furcaria*. **1.** Kenaf, *H. cannabinus*, 'Everglades 41'; **2.** *H. acetosella*, "Merrit Island" (bud); **3.** *H. surattensis*, A59-70; **4.** *H. radiatus*, A59-53 (forked bracteoles); **5.** *H. radiatus*, A214 (entire bracteoles); **6.** *H. diversifolius*, A59-94; **7.** *H. diversifolius*, A60-207; **8.** *H. rostellatus*, A60-211; **9.** *H. sabdariffa*, A60-236 (fiber type); **10.** *H. sabdariffa*, A60-235 (edible type); **11.** *H. meeusei*, A60-188; **12.** *H. costatus*, A60-243; **13.** *H. furcellatus*, A59-87; **14.** *H. bifurcatus*, A59-153. Taken from Wilson, F.D. & Menzel, M.Y. (1964), *Economic Botany*, 18:86.



**Fig. 2** Seeds of 12 species of *Hibiscus*, section *Furcaria*. **15.** *H. cannabinus*, 'Everglades 41'; **16.** *H. cannabinus*, A60-206; **17.** *H. acetosella*, A59-126; **18.** *H. acetosella*, A59-152; **19.** *H. radiatus*, A59-53; **20.** *H. diversifolius*, A59-94; **21.** *H. diversifolius*, A60-207; **22.** *H. surattensis*, A59-70; **23.** *H. sabdariffa*, A59-92 (edible type); **24.** *H. sabdariffa*, A59-69 (grown for edible seeds); **25.** *H. sabdariffa*, A58-5 (fiber type); **26.** *H. costatus*, A60-243; **27.** *H. furcellatus*, A59-87; **28.** *H. bifurcatus*, A59-153; **29.** *H. aculeatus*, A59-114; **30.** *H. rostellatus*, A60-211; **31.** *H. meeusei*, A60-188. Taken from Wilson, F.D. & Menzel, M.Y. (1964), *Economic Botany*, 18:87.



### 3. DATA RECORDED

From the specimen labels of a total of 13 *Hibiscus* taxa, only the relevant distribution data, including the country, province and locality of collection, were recorded. These distribution data are given in full in Appendix I. When the material bore mature fruits, the month of collection was also recorded. These data are all further summarized below.

During this survey, no attempt was made to verify the identification of the species concerned in EA, or to analyse their diagnostic features. However, although the possible value of each of these taxa to future fibre breeding programmes could not be assessed during this brief investigation, such information has, where possible, been extracted from Wilson & Menzel (5) and is also included below.

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#### 4. SUMMARY OF THE DISTRIBUTION, FRUITING TIMES AND POTENTIAL VALUE OF *HIBISCUS* SECTION *FURCARIA* SPECIES IN TROPICAL EAST AFRICA

##### *H. acetosella* Welw. ex. Hiern

**DISTRIBUTION:** Tanzania and Uganda.

**TANZANIA:** *T1* (Mwanza Distr.); *T3* (Tanga Distr.); *T8* (Kilwa Distr.).

**UGANDA:** *U3* (Mbale Distr.).

**ALTITUDE:** 1100-1366 m.

**FRUITING:** *T1*; December. *T3* and *T8*; August.

**USES:** Leaves and shoots eaten in South West Africa; solution of leaves in water used as post-fever tonic in Angola; as an ornamental (5).

**GERMPLASM POTENTIAL:** Good genetic resistance to root-knot nematodes (4).

**CYTOLOGY:** Tetraploid ( $2n = 72$ ).

##### *H. cannabinus* L.

**DISTRIBUTION:** Kenya, Tanzania and Uganda.

**KENYA:** *K1* (Northern Frontier Distr.); *K2* (Turkana Distr.); *K3* (Baringo, Laikipia, Naivasha, Nakuru, Trans-Nzoia and Uasin Gishu Distr.); *K4* (Embu, Fort Hall, Kiambu, Kitui, Machakos, Meru, Nairobi and ?N. Nyeri Distr.); *K5* (Kisumu-Londiani and South Kavirondo Distr.); *K6* (Masai Distr.); *K7* (Kilifi, Kwale, Lamu and Teita Distr.).

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**TANZANIA:** *T1* (Biharamulo, Maswa, Musoma, Mwanza and Shinyanga Distr.); *T2* (Arusha, Masai, Mbulu and Moshi Distr.); *T3* (Lushoto and Tanga Distr.); *T4* (?Buha, Kigoma, Mpanda and Tabora Distr.); *T5* (Dodoma, Kondoa, Mpwapwa and Singida Distr.); *T6* (Kilosa, Morogoro and Uzaramo Distr.); *T7* (? Chunya, Iringa, Mbeya, Njombe and ? Rungwe Distr.); *T8* (?Lindi and Songea Distr.); *T9* (Pemba); *T10* (Zanzibar).

**UGANDA:** *U1* (Acholi, Karamoja and West Nile Distr.); *U2* (Ankole, Kigezi and Toro Distr.); *U3* (Busoga, ?Mbale and Teso Distr.).

**ALTITUDE:** Sea-level to 2666 m (*K*). 50-2000 m (*T*). Sea-level (*T10*). 725-1666 m (*U*).

**FRUITING:** *K1*; August. *K2*, September. *K3*, February, April to December. *K4*, February to September, December. *K5*, January, July, August and November. *K6*, April, June to October. *K7*, February, March, May, August, October to December. *T1*, March to July, October and December. *T2*, April, June to September. *T3*, July to September. *T4*, April-August, October. *T5*, April, June, July. *T6*, May to September. *T7*, April to July. *T8*, April and June. *T10*, August and October. *U1*, January, April, May, July, August and November. *U2*, March, May and December. *U3*, July, August and October.

**USES:** Leaves and flowers used as vegetable; seeds used for oil; various plant parts used in medicines and certain superstitious rites (5).

**GERMPLASM POTENTIAL:** Purple-flowered strains resistant to root-knot nematode species (4).

**CYTOLOGY:** Diploid ( $2n = 36$ ).

***H. diversifolius* Jacq.****subsp. *diversifolius***

**DISTRIBUTION:** Kenya, Tanzania and Uganda.

**KENYA:** **K1** (Northern Frontier Distr.); **K3** (Naivasha, Nakuru, Trans-Nzoia and ? Uasin Gishu Distr.); **K4** (Fort Hall, Kiambu and Nairobi Distr.); **K5** (Kericho, Central Kavirondo, North Kavirondo and South Nyanza Distr.); **K6** (Masai Distr.).

**TANZANIA:** **T1** (Bukoba, ?Maswa, Musoma and Mwanza Distr.); ?**T2** (?Masai Distr.); **T4** (Buha, Mpanda and Ufipa Distr.); **T7** (Iringa and Mbeya Distr.); **T8** (Songea Distr.).

**UGANDA:** **U2** (Ankole and Kigezi Distr.); **U4** (Masaka Distr.).

**ALTITUDE:** 1166-2833 m (**K**). 770-2550 m (**T**). 1140-2000 m (**U**).

**FRUITING:** **K1**; October. **K3**; January, April, May, August, October and December. **K4**; March to July, October and November. **K5**; September and December. **K6**; January, July, October and November. **T1**; March, April and July. **T4**; July and August. **T7**; August, September and October. **U2**; January and October. **U4**; May.

**USES:** Occasional use as fibre; ornamental use (5).

**GERMPLASM POTENTIAL:** Can be moderately resistant to root-knot nematodes (5).

**CYTOLOGY:** Octoploid ( $2n = 144$ ) and decaploid ( $2n = 180$ ) (5).

**subsp. *rivularis* Bremek. & Oberm.**

**DISTRIBUTION:** Kenya and Uganda.

**KENYA:** **K3** (Naivasha Distr.); **K4** (?Embu and South Nyeri Distr.).

**UGANDA:** **U2** (Kigezi Distr.).

**ALTITUDE:** 1566-2000 m (**K**). 2200-2700 m (**U**).

**FRUITING:** **K3**; November. **K4**; April, September and October. **U2**; September.

**var. *witteanus* Hochr.**

**DISTRIBUTION:** Kenya, Tanzania and Uganda.

**KENYA:** **K2** (West Suk Distr.); **K3** (Elgeyo, Naivasha, Nakuru and ? Trans-Nzoia Distr.); **K5** (Kericho Distr.); ?**K6** (?Masai Distr.).

**TANZANIA:** **T2** (Masai Distr.); **T4** (Kigoma or Mpanda Distr.); **T7** (Iringa and Njombe Distr.).

**UGANDA:** **U2** (?Ankole, Kigezi and ? Masaka or Mengo Distr.).

**ALTITUDE:** 2133-3000 m (**K**). 2000-2460 m (**T**). 2166-2500 m (**U**).

**FRUITING:** **K3**; January, February, May, September, November and December. **K5**; December. **K6**; ?November. **T2**; August. **T4**; July. **T7**; July, September, December. **U2**; February, May, July, October and December. **U4**; ?February.

***H. greenwayi* Bak. f.**

**var. *greenwayi***

**DISTRIBUTION:** Kenya and Tanzania.

**KENYA:** **K3** (Naivasha Distr.); **K4** (Kitui Distr.); **K6** (Masai Distr.); **K7** (Kilifi, Kwale, Mombasa and Teita Distr.).

**TANZANIA:** **T2** (Mbulu Distr.); **T3** (Lushoto and Tanga Distr.).

**ALTITUDE:** (?Sea-level) 66-2000 m (**K**). 500-1266 m (**T**).

**FRUITING:** **K4**; April, May and August. **K7**; January to March, June, August, September, November and December. **T2**; July. **T3**; January, and July to September.

**var. *megensis* J.P. Lebrun**

**DISTRIBUTION:** Kenya

**KENYA:** *K1* (Northern Frontier Distr.); *K4* (Kitui and ? Meru Distr.); *K7* (Teita Distr.).

**ALTITUDE:** 1133-2166 m (*K*).

**FRUITING:** *K1*; January, April, May, ? June and September. *K4*; February, May and ? June. *K7*; July.

***H. mastersianus* Hiern.**

**DISTRIBUTION:** Kenya and Tanzania.

**KENYA:** *K4* (Kitui Distr.).

**TANZANIA:** *T1* (Mwanza and Shinyanga Distr.); *T4* (Kahama, Nzega and Tabora Distr.); *T5* (Dodoma, Mpwapwa and Singida Distr.); *T7* (Iringa Distr.).

**ALTITUDE:** 900-1000 m (*K*). 900-2333 m (*T*).

**FRUITING:** *K4*; May. *T1*; May to July. *T4*; March to May. *T5*; March to June. *T7*; April and May.

**CYTOLOGY:** Diploid ( $2n = 36$ ).

***H. mechowii* Garcke**

**DISTRIBUTION:** Tanzania

**TANZANIA:** *T1* (Shinyanga Distr.); *T4* (Kigoma and Tabora Distr.).

**ALTITUDE:** 914 m.

**FRUITING:** May.

***H. radiatus* Cav.**

**DISTRIBUTION:** Kenya and Tanzania.

**KENYA:** *K7* (Kilifi and Kwale Distr.).

**TANZANIA:** *T3* (Tanga Distr.); *T4* (Tabora Distr.).

**ALTITUDE:** Sea-level (*K*). ? (*T*).

**FRUITING:** *K7*; October. *T3*; April. *T4*; February.

**USES:** Occasional use as a fibre; ornamental for showy flowers (5).

**GERMPLASM POTENTIAL:** Can be moderately resistant to root-knot nematodes (5).

**CYTOLOGY:** Tetraploid ( $2n = 72$ ).

***H. rostellatus* Guill. & Per.**

**DISTRIBUTION:** Tanzania and Uganda.

**TANZANIA:** *T1* (Mwanza Distr.); *T3* (Tanga Distr.); *T4* (Mpanda Distr.); *T6* (Uzaramo Distr.).

**UGANDA:** *U2* (Ankole and Eunyoro Distr.); *U4* (Masaka/Mengo/Mubende Distr.).

**ALTITUDE:** 67-800 m (*T*). 1000-1433 m (*U*).

**FRUITING:** *T3*; November to December. *T4*; June, July and November. *T6*; May. *U2*; February to March and October. *U4*; February.

**USES:** Source of fibre; leaves sometimes used for scouring, in solution as a laxative or as a vegetable (5).

**CYTOLOGY:** Tetraploid ( $2n = 72$ ).

***H. sabdariffa* L.**

**DISTRIBUTION:** Kenya and Tanzania.

**KENYA:** **K4** (Kiambu Distr.); **K5** (Kisumu-Londiani Distr.); **K7** (? Kwale Distr.).

**TANZANIA:** **T1** (Mwanza Distr.); ? **T6** (?Rufiji Distr.); ? **T8**.

**ALTITUDE:** 1200-2233 m (**K**). 1366 m (**T**).

**FRUITING:** **K4**; June. **K5**; November. **K7**; May. **T1**; April. **T6** or **T8**; June.

**USES:** Fibre; seeds eaten roasted or ground into meal; leaves and shoots eaten raw or cooked, as a sour-flavoured vegetable or condiment; fleshy fruiting calyces used like cranberries in jellies and confections; juice expressed and made into fresh or fermented drinks; various plant parts used as medicines for men and animals (5).

**GERMPLASM POTENTIAL:** High degree of genetic resistance to root-knot nematodes (5).

**CYTOLOGY:** Tetraploid ( $2n = 72$ ).

***H. surattensis* L.**

**DISTRIBUTION:** Kenya, Tanzania and Uganda.

**KENYA:** **K4** (Fort Hall, Meru and Nairobi Distr.); **K7** (Kilifi, Kwale and Lamu Distr.).

**TANZANIA:** **T1** (Mwanza Distr.); **T3** (Lushoto and Tanga Distr.); **T4** (Buha, Kigoma, Mpanda and ? Tabora Distr.); **T6** (Bagamoyo, Morogoro, Kilosa, Rufiji, Ulanga and Uzaramo Distr.); **T8** (Lindi, Kilwa and Songea Distr.); **T9** (Pemba); **T10** (Zanzibar).

**UGANDA:** **U2** (Ankole, Bunyoro and Kigezi Distr.); **U3** (Mbale Distr.); **U4** (Mengo Distr.).

**ALTITUDE:** (?Sea-level) 17-1235 m (**K**). 10-2550 m (**T**). Sea-level to 20 m (**T10**). 1000-1466 m (**U**).

**FRUITING:** **K4**; May, July and November. **K7**; January, April, June and October to December. **T3**; January, April and July to December. **T4**; February, August and October. **T6**; March to October. **T8**; May and June. **T9**; August. **T10**; May, June and August. **U2**; March, May, August and November. **U3**; January. **U4**; October.

**USES:** Source of fibre; leaves eaten raw or cooked, and sometimes for cough medicine (5).

**GERMPLASM POTENTIAL:** Resistant to root-knot nematodes (5).

**CYTOLOGY:** Diploid ( $2n = 36$ ).

## 5. CONCLUSIONS

### 5.1 *The distribution of Hibiscus section Furcaria in tropical East Africa*

It is clear, both from Appendix I and from the summary of localities from which herbarium material has been collected (see above), that *Hibiscus* species related to kenaf and rosella are widespread throughout tropical East Africa. The distribution of these species is further summarized in Fig. 4 where all those Districts from which the *Hibiscus* species in the EA herbarium were collected are ringed. From this Figure it can be seen that the various *Hibiscus* species occur in 30 of the 33 Kenyan Districts, in 38 of the 49 Tanzanian Districts and in 12 of the 14 Ugandan Districts. Moreover, this distribution can probably be considered as an under-estimate, since a very brief examination of the Kew (K) material indicated that these species have also been collected from localities not represented in EA.

Of the species concerned, wild populations of kenaf itself, *H. cannabinus*, are probably the most widely distributed, occurring throughout Kenya, Tanzania and Uganda (*cf.* Fig. 5, which is based on Kew (K) herbarium material). This species is thought to be native to Africa south of the Sahara, with its greatest morphological diversity occurring among strains from East Africa (4). It occupies habitats ranging from low-lying meadows, semi-arid grassland and thorn-bush plains to *Typha* swamp edges and streams; it is also a ruderal, occurring in cultivated and fallow fields, on waste ground, in villages and in fence- and hedge-rows (4,5). It is not, however, cultivated for its fibre in East Africa, probably because of the ubiquitous availability of the introduced fibre plant, sisal (*Agave sisalana* Perr.) (4).

In contrast, rosella, *H. sublariffa*, is comparatively rare in tropical East Africa where it predominantly occurs as a cultivar, and is used for its edible leaves and calyces (4). There were only a few specimens of this species in EA, collected from three Kenyan and two Tanzanian localities.

The species *H. mechowii*, thought to be a primitive form of *H. sabdariffa*, is similarly restricted in its distribution in this area, and was only represented by collections from two Tanzanian localities in EA. Since these two species both grow wild in eastern Africa, they may have originated in this region, from where they migrated southwestwards into Angola and the Congo. *Hibiscus sabdariffa*, like *H. cannabinus*, is thought to have first been domesticated in western Sudan before 4000 B.C. (5).

Among the other section *Furcaria* species of *Hibiscus*, the highly variable *H. diversifolius* appears to be the most widespread with subsp. *diversifolius* being a common, yellow-flowered, long-lived perennial of swamps and stream-sides in Kenya, Tanzania (4) and Uganda. The closely related purple-flowered subsp. *rivularis* occurs in similar habitats in Uganda (4) and Kenya, while the var. *witteanus* is apparently more widespread and is found in all three East African countries. This var. *witteanus* is apparently morphologically divergent from the two subspecies of *H. diversifolius*, and has been treated as a synonym of *H. berberidifolius* A. Rich. by Hauman in *Flore du Congo Belge et du Ruanda-Burundi* (Ed. by W. Robyns, 1963) (4). The validity of this synonymy was recently confirmed by Wilson (7), who established that *H. diversifolius* var. *witteanus* is a white, yellow or purple-flowered diploid ( $2n = 36$ ), that is morphologically distinguishable from the octoploid *H. diversifolius*. Wilson (7) gives a full morphological description of *H. berberidifolius*, together with illustrations, a map of its distribution in East Africa, and a table of characters by which it may be distinguished from *H. diversifolius*.

*Hibiscus surattensis* is a sprawling, highly ornamental vine, growing in poorly drained areas (4); it appears to be fairly common in tropical East Africa, where it has been collected from various Districts in Kenya, Tanzania and Uganda.

*Hibiscus greenwayi* is a large multi-stemmed, long-lived perennial of dry woods in south-eastern Kenya and north-eastern Tanzania, which is characterized by pendulous, funnellform, yellow flowers (4). Various specimens of the var. *greenwayi* in EA were collected from such Kenyan and Tanzanian Districts, whereas the var. *megensis* was represented by only a few specimens, collected from eastern Kenya.

The remaining *Hibiscus* species belonging to the section *Furcaria* seem to be relatively restricted in their distribution in tropical East Africa. *Hibiscus acetosella*, a red-foliaged ornamental (4) was collected from only three Tanzanian localities (where it is apparently found in "docryards" (4)) and from one Ugandan locality. Another ornamental, *H. radiatus*, which is closely related to *H. acetosella*, only occurs as an introduction in Africa, where it is usually found under cultivation (5). Only two collections from Kenyan coastal areas and two from Tanzanian localities were represented in EA. In contrast, *H. mastersianus* has been collected from various Tanzanian Districts, where it is apparently a common weed of cultivated fields in certain areas (4). However, this species seems to be comparatively rare in Kenya. Finally, *H. rostellatus*, though widely distributed in western Africa, seems to be confined to a few Districts of Tanzania and western Uganda in eastern Africa.

### **5.2 Potential use of East African *Hibiscus* species in future kenaf and rosella breeding programmes**

Although no attempt was made to evaluate the morphological diversity exhibited by these *Hibiscus* species, a brief literature survey indicated that many of them could be of considerable value in the genetic improvement of kenaf and rosella. This potential value is summarized below:

- i) The wild East African *Hibiscus* species, like those related to jute (1,2), seem to occupy a diverse range of habitats and soil types. Their incorporation into controlled breeding programmes could similarly broaden the genetic base of existing varieties and increase the adaptation of kenaf and rosella to diverse eco-geographical conditions. This is particularly relevant to the widespread collection of seed of *H. cannabinus* and *H. diversifolius*.

- ii*) The widespread distribution of wild populations of *H. cannabinus* together with the morphological diversity displayed by these collections is of particular importance, since such wild populations should be compatible with cultivated varieties and strains of kenaf. The widespread collection of seed of wild populations of *H. cannabinus* throughout its eco-geographical range in tropical East Africa should therefore provide germplasm of considerable genetic potential in future breeding programmes.
- iii*) Kenaf is particularly susceptible to root-knot nematodes (*Meloidogyne* spp.) while rosella can also be susceptible (5). However, a high degree of genetic resistance to these nematodes is known to exist in *H. acetosella*, while Wilson & Menzel (5) demonstrated that similar resistance is also exhibited by *H. rostellatus* and *H. surattensis*. These authors further demonstrated that different lines of *H. sabdariffa*, *H. radiatus* and *H. diversifolius* varied from being susceptible to resistant to these nematodes. Moreover, purple-flowered strains of *H. cannabinus* also proved to be resistant to these pests (4). Clearly, populations of these seven species should be extensively tested for their potential resistance to root-knot nematodes since it is highly probable that the East African *Hibiscus* taxa could provide germplasm of invaluable importance in future pest resistance research.
- iv*) Though not cultivated for their fibrous qualities in East Africa, *Hibiscus* species belonging to the section *Furcuria* could well provide germplasm for the improvement of fibre quality and yield in the two cultivated species. While this is particularly true of wild populations of *H. cannabinus* and of the more restricted *H. sabdariffa*, Wilson & Menzel (5) also reported that *H. diversifolius* subsp. *diversifolius*, *H. mechowii*, *H. rostellatus* and *H. surattensis* have all been used as occasional sources of fibre.
- v*) The IJO may also wish to consider the potential value of *Hibiscus* species as additional food sources in commercial fibre growing areas. Various *Hibiscus* species are obviously widely used as valuable food and medicinal plants throughout Africa.

As with jute, the actual potential of these *Hibiscus* species to kenaf and rosella economy cannot be evaluated until any material collected has been grown in fibre-producing countries, field tested in a variety of habitats, screened for potential pest resistance, assessed for photoperiod sensitivity and potential fibre quality and yield, and perhaps tested for its palatability in Asian communities (1,2). Similarly, success will be largely dependent on extensive controlled breeding programmes to determine the compatibility of the taxa collected with various strains of kenaf and rosella, and on the feasibility of transferring any desirable germplasm into these cultivated strains. Though these *Hibiscus* species form a polyploid series, comprising the diploid species *H. cannabinus*, *H. mastersianus* and *H. surattensis*, the tetraploid species *H. acetosella*, ?*H. mechowii*, *H. radiatus*, *H. rostellatus* and *H. sabdariffa*, and octoploid and decaploid strains of *H. diversifolius*, these differing ploidy levels do not seem to constitute an insurmountable barrier to the hybridization necessary for future breeding programmes. Wilson & Menzel (5), for example, reported hybridization between the tetraploid *H. acetosella* and the diploid *H. cannabinus* to be easy, as was the development of fertile allohexaploids from such crosses.

The results of this brief survey of the EA material of *Hibiscus* species related to kenaf and rosella therefore suggest that extensive collections of these species could provide *Hibiscus* germplasm of considerable potential for future fibre improvement programmes.

### 5.3. *The feasibility of collecting Hibiscus and Corchorus species simultaneously*

The tropical East African Districts from which the *Hibiscus* specimens in the EA herbarium were collected are shown in Fig. 4, while those from which *Corchorus* specimens have been collected are similarly shown in Fig. 6. Comparison of Figs 4 and 6 clearly demonstrates that it should be feasible to collect specimens of *Hibiscus* and *Corchorus* simultaneously. If anything, *Hibiscus* species are more widely distributed than those

of *Corchorus*, with the latter occurring in 24 of the 33 Kenyan Districts, 38 of the 49 Tanzanian Districts, and 10 of the 14 Ugandan Districts; comparable figures for *Hibiscus* species are 30, 38 and 12 respectively. Though there are certain Districts in which either jute-related or kenaf- or rosella-related taxa occur, it is likely that extensive collecting will reveal additional localities for all these fibre-related taxa. As pointed out above, the distribution data discussed in this report are only based on EA material; brief examination of Kew material indicated that some of the *Hibiscus* taxa concerned have also been collected from additional localities. Populations may therefore exist in Districts not indicated in Fig. 4.

The fruiting times of the *Hibiscus* specimens examined are summarized in Table 3. Again, a brief examination of Kew material indicated that the fruiting dates recorded from the EA specimens are probably an under-estimate of the fruiting spans of the species concerned. These EA fruiting times are combined with those of all the *Corchorus* specimens in Table 4, from which it is evident that, with a few exceptions, the major fruiting times coincide. Moreover, the optimal fruiting times for the various *Hibiscus* species also coincide with the times suggested by Edmonds (1,2) for the proposed collecting expeditions.

Finally, as far as the logistics of actually collecting plants of these two genera simultaneously are concerned, *Hibiscus* should be far easier to locate in the field than the often inconspicuous, weedy and small flowered *Corchorus* species. *Hibiscus* species are characterized by their large, conspicuous and usually brightly coloured flowers, and often by their imposing stature. For example, *H. diversifolius* can grow up to 10 m, *H. cannabinus* to 5 m, and *H. rostellatus* to 3 m, while *H. surattensis* is a large climber. Such species should therefore be comparatively easy to identify in natural vegetation.

### 5.4 Collecting expedition routes

It is concluded that the expedition routes outlined by Edmonds (1,2) for collection of *Corchorus* seed, should also be profitable for the collection of *Hibiscus* seed. The only exception recommended is that, where relevant, collecting should be extended to higher elevations on these routes. In general, *Hibiscus* taxa tend to occur on higher ground than *Corchorus* species, extending to altitudes of 3000 m; the highest elevation recorded for a *Corchorus* species was 2333 m.

The three major East African expeditions proposed by Edmonds (1,2) were:

- i)* Central Kenya (*K1, 3, 4, 4/7, 5 & 6*) in November 1987 through to January 1988.
- ii)* Coastal Kenya and Tanzania (*K7; T1, 2, 3, & 6-8*) in June to August 1988, and
- iii)* Inland Tanzania (*T1-7*) in June to August 1988.

It is therefore recommended that these three major expedition routes should be followed, at the times suggested, but that where relevant, collections should be extended to altitudes higher than those dictated by the *Corchorus* species. It is concluded that both the routes proposed and the times suggested for the expeditions should be equally profitable for *Hibiscus* and *Corchorus* germplasm collection.

Table 3. Fruiting dates recorded from *Hibiscus* specimens collected from tropical East Africa

MONTHS	Geographical districts of tropical East Africa																			
	K1	K2	K3	K4	K5	K6	K7	T1	T2	T3	T4	T5	T6	T7	T8	T10	U1	U2	U3	U4
January	X		X		X	X	X			X							X	X	X	
February			X	X			X				X							X		X
March				X			X	X		X	X	X	X		X			X		
April	X		X	X		X	X	X	X	X	X	X	X	X	X		X	X		
May	X		X	X			X	X		X	X	X	X	X	X	X	X	X		X
June	X		X	X		X	X	X	X		X	X	X	X	X	X				
July			X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	
August	X		X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	
September	X	X	X	X	X	X	X		X	X			X	X				X		
October	X		X	X		X	X	X		X	X		X	X		X		X	X	X
November			X	X	X	X	X			X	X			X			X	X		
December			X	X	X		X	X		X				X				X		

Table 4. Fruiting dates recorded from *Corchorus* (X) and *Hibiscus* (H) specimens collected from tropical East Africa

MONTHS	Geographical districts of tropical East Africa																			
	K1	K2	K3	K4	K5	K6	K7	T1	T2	T3	T4	T5	T6	T7	T8	T10	U1	U2	U3	U4
January	H		H	X	XH	H	XH	X		H	X		X	X			H	H	H	
February			H	XH	X		XH	X	X	X	XH		X	X	X	X		XH		H
March		X	X	XH			XH	XH	X	H	XH	XH	XH	X	XH		X	H	X	
April	XH		XH	XH	X	H	XH	XH	XH	H	XH	XH	XH	XH	XH		H	H		
May	XH		H	XH		X	XH	XH	X	X	XH	XH	XH	XH	XH	H	XH	H		XH
June	XH	X	XH	XH	X	XH	XH	XH	XH	X	XH	XH	XH	H	H	XH	X	X	X	X
July	X		XH	H	H	H	XH	H			XH	H	XH							
August	H	X	XH	H	XH	XH	XH	X	XH	H	H		XH	XH	XH	H	XH	H	H	
September	H	H	XH	XH	H	XH	XH		H	H			H	H		X		XH	X	
October	H		H	XH		H	XH	XH		H	H		XH	XH		XH		XH	H	XH
November	X		XH	XH	XH	H	XH	X		XH	H		X	XH			XH	H	X	
December	X		XH	XH	XH		XH	XH		XH				H			X	H	X	X

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## 8. APPENDICES

## APPENDIX I

***Distribution data extracted from Hibiscus section Furcaria specimens in the East African Herbarium***

Distribution data for various *Hibiscus* species related to kenaf and rosella were extracted from herbarium labels in the East African Herbarium, Nairobi (EA); a few specimens seen in the Herbarium Vadense, Wageningen (WAG) were also included. Only East African material, i.e. that collected from Kenya, Tanzania and Uganda, was examined. If the specimens were fruiting, the month of collection is given; absence of such a date usually means that the specimen was either in a flowering or purely vegetative state.

These distribution data are given in alphabetical order of species, followed by that of the appropriate three countries. Within each of these countries, the specimens are listed in numerical order of the appropriate Provinces (*K1-7*, *T1-10* and *U1-4*), followed by the alphabetical order of the Geographical Districts (see Table of Geographical Divisions of the *Flora of Tropical East Africa* in Appendix II).

**Abbreviations used:**

' = feet

km = kilometres

m = metres

mi = miles

***H. acetosella*****TANZANIA****T1:** Mwanza Distr., Ukiruguru; 4100'. Dec.**T3:** Tanga Distr., Muheza, on Hwy A14 between Tanga and Segera. Aug.**T8:** Kilwa Distr., Kilwa. Aug.**Previous Page Blank**

**UGANDA**

**U3:** Mbale Distr., Bukedi Distr., near Mulanda Gombolola, 0°40'N, 34°0'E;  
1100 m.

***H. cannabinus*****KENYA**

**K1:** Northern Frontier Distr., Northern Prov., Moyale, 3°32'N, 39°03'E;  
1080 m. Apr.

**K1:** Northern Frontier Distr., Northern Prov., Moyale; 3600'. Aug.

**K1/4:** Northern Frontier/N. Nyeri Distr., Ngare Njimo (? Ngare Ndere)  
River; 600 m. Aug.

**K2:** Turkana Distr., Southern Turkana at Kaptir at banks of River Turkwel;  
2000'. Sep.

**K2:** Turkana Distr., Songot; 2800'.

**K3:** Baringo Distr., Loruk. Oct.

**K3:** Laikipia Distr., Kisima Farm; 1700 m. Jun.

**K3:** Naivasha Distr., 01 Longonet Ranch; 6200'. Jul.

**K3:** Naivasha Distr., 01 Longonet; 6300'. May + Dec.

**K3:** Naivasha Distr., E of Lake Naivasha, c.100 yds from shore; 1860 m.  
Apr.

**K3:** Naivasha Distr., base of Mt. Longonot; 6800'.

**K3:** Naivasha Distr., Kenya Rift Valley, Kedong Experimental Ranch at  
foot of Mount Longonot. Nov.

**K3:** Naivasha Distr., Naivasha; 6000'. Feb. + Dec.

**K3:** Nakuru Distr., Elburgon; 7000'. Sep.

**K3:** Nakuru Distr., 20 km W of Nakuru on Hwy A104. Aug.

**K3:** Trans-Nzoia Distr., Mount Elgon; 6500-7500'. Oct.-Nov.

**K3:** Trans-Nzoia Distr. Elgon.

**K3:** Trans-Nzoia Distr., Kitale near Kamakoiawa; 6200'. Sep.

**K3:** Trans-Nzoia Distr., Kitale, Robinson Farm.

**K3:** Uasin Gishu Distr., Kaptagat; 8000'. Feb.

**K3:** Uasin Gishu Distr., Kipkarren; 5500'. Oct.

**K3:** Uasin Gishu Distr., Soy; 6000'.

- K3:** Uasin Gishu Distr., Turbo; 6000'. Jul.  
**?K3:** Bogoria, S E Lake; 5000'. Oct.  
**?K3:** R. Mzoia area, Koey's Bridge. Aug.  
**K36:** Naivasha/Masai Distr., Mount Suswa, 01 ... Onyoke; 1822'. Sep.  
**K36:** Naivasha/Masai Distr., Mount Suswa; 5300'. Aug.  
**K36:** Naivasha/Masai Distr., Kedong Valley, Kedong Ranch; 6000'. May.  
**K4:** ? Embu Distr., Embure (?Muirnatetus); 3800'. Jun.  
**K4:** Fort Hall Distr., Makuyu. Dec.  
**K4:** Fort Hall/Kiambu/Machakos Distr., Thika, roadside in front of Blue Post Hotel; 4900'. May.  
**K4:** Fort Hall/Machakos/Kiambu Distr., Thika, NW of railroad trestle across Thika River; 4900'. Dec.  
**K4:** Fort Hall/Machakos/Kiambu Distr., Thika, roadside along Haile Selassie Road; 4900'. Feb. + Jun.  
**K4:** Kiambu Distr., 25 km E of Thika on Thika-Garissa road; 1500 m. Jul.  
**K4:** ? Kiambu Distr., Ruiru. Jun.  
**K4:** Kitui Distr., N Kitui, c.5 mls N of Migwani. May.  
**K4:** Machakos Distr., Makueni; 5000'. Aug.  
**K4:** Machakos Distr., 3.5 mls N of Nunguni; 1890 m. May.  
**K4:** Machakos Distr., Kiboko Res. Station.  
**K4:** Meru Distr., Meru. Jun.  
**K4:** ? Meru Distr., Maubre (? Maua). Jul.  
**K4:** Meru Distr., Meru Nat. Park, road between Mughwango N and S swamp; c.650 m. Dec.  
**K4:** Meru Distr., Meru Nat. Park, Murera River, 38°07'E, 00°16'N; 2500'. May.  
**K4:** Meru Distr., Meru Nat. Park, Bisanadi Plains, 38°10'E, 00°08'N; 2300'. Mar.  
**K4:** Meru Distr., Meru Nat. Park, Mughwango Plains, 38°09'E, 00°08'N; 2100'. May.  
**K4:** Meru Distr., Meru Nat. Park, Leopard Rock Camp. Jun.  
**K4:** Nairobi Distr., Nairobi; 5900'. Apr.  
**K4:** Nairobi Distr., Mbagathi; 6000'. Sep.

- K4:** Nairobi Distr., Nairobi Park; c.5600'. Apr. + Jun.
- K4:** Kindani Camp; 2500'. May.
- K4/6:** Nairobi/Masai Distr., Athi River. Jun.
- K4/6:** Nairobi/Masai Distr., Athi Plains; 5000'. May.
- ?K4/6:** Nairobi/Masai Distr., Athi Plains, 30 mls from Nairobi on Namanga road; 5000'. Jun.
- K5:** Kisumu-Londiani Distr., Nyanza, Thessalia Mission St. near Muhoroni; 1200 m.
- K5:** South Kavirondo Distr., S. Nyanza, Lambwa Valley. Aug.
- K5:** South Kavirondo Distr.; 3800'. Nov.
- K5:** Nyanza; 4000'. Jan.
- K5:** ? Kapsarok. 0°15', 35°05'; 1440 m. Jul.
- K6:** Masai Distr., Masai Mara Game Reserve, Soit Ololol Escarpment, south of Ratiandy and 13 km NW of Mara Serena Lodge; 1640-1760 m. Jul.
- K6:** Masai Distr., Narok, Elegesgonyik near Mara Bridge; 5700'. Apr.
- K6:** Masai Distr., Mara Masai Res., Talek, 53 mls SWS of Narok. Sep.
- K6:** Masai Distr., Masai, W of Lake Magadi. Oct.
- K6:** Masai Distr., Narok, near gully, Aitong; 5700'. Jun.
- K6:** Masai Distr., Narok, Olosendo Area, Trans-Mara; 5118'. Jun.
- K6:** Masai Distr., Talek River. Aug.
- K6:** Masai Distr., between Emporputia and Olkejo - Ngoro, c.22 mls from Magadi on road to Nairobi; 3025'. Jun.
- K6:** Masai Distr., Masai-Suswa .... ridge near Stafford Camp.
- K6:** Masai Distr., Mara River; 5500'. Oct.
- K7:** Garissa Distr., Boni Reserve.
- K7:** Kilifi Distr., near Malindi road, 5-8 ml E of Jilore Road, near forest boundary. Nov.
- K7:** Kilifi Distr., Jilori - Kakuyuni, W of Malindi, 3°13'S, 39°00'E; Feb. + Mar.
- K7:** Kilifi Distr., Mida.
- K7:** Kwale Distr., 29 km W of Mombasa on Hwy A109. Aug.
- K7:** Kwale Distr., Matuga (Coast); sea-level. Dec.
- K7:** Lamu Distr., 8 km on road from Mkunumbi to Witu. Mar.

- K7:** Lamu Distr., 2 km N of Hindi. Mar.  
**K7:** Lamu Distr., near Iwezo. Feb.  
**?K7?** Lamu Distr. (or **K1:** Garissa Distr.), Boni Reserve, about 4 km ENE of Mkondoni. Oct.  
**K7:** Teita Distr., Voi Railway Bridge; 1900'. May.  
**K7:** Teita Distr., Voi, 3°23'S, 38°33'E; 600 m. Nov.  
**K?:** Kitoni Hot Springs; 150'. Jul.

### TANZANIA

- T1:** Biharamulo Distr., West Lake Province, Nyakahura; 5000'. Apr.  
**T1:** Biharamulo Distr., Lushunga, Biharamulo, west of Lake Province; 4500'. Oct. (WAG).  
**T1:** Maswa Distr., Lake Province, Malya.  
**T1:** Musoma Distr., Mwanza Region, 69 km S of Musoma turnoff towards Mwanza.  
**T1:** Musoma Distr., Mbono River; 4900'. Jun.  
**T1:** Musoma Distr., Banagi Hill. Jun.  
**T1:** Musoma Distr., 3 km N of Nyakahanga on road to Kenya border. Jul.  
**T1:** Mwanza Distr., Ngudu. Jul.  
**T1:** Mwanza Distr., Lake Prov., Ukerewe Island. Mar. + Apr.  
**T1:** Mwanza Distr., Ukiriguru; 4100'. Dec.  
**T1:** Mwanza Distr., Ilula, 35 km S of Mabuija on Mwanza-Shinyanga Road. Jul.  
**T1:** Shinyanga Distr., Shinyanga, Usuhe (?Usule).  
**T1:** Shinyanga Distr., Old Shinyanga; 3800'. May.  
**T1/2:** Musoma/Maswa/Masai Distr., Western Serengeti, near Kirkasis; 5000'. Mar.  
**T2:** Arusha Distr., Momela, Ngurdoto Nat. Park; 5000'. Jun.  
**T2:** Arusha Distr., 5 km S of Serengeti turn-off on Arusha-Babati Road. Aug.  
**T2:** Arusha Distr., 15 km W of Arusha on Hwy A104. Jul.  
**T2:** Arusha Distr., 32 km E of Arusha turn-off to Moshi. Jul.  
**T2:** Arusha Distr., 18 km E of Arusha turn-off towards Moshi. Jul.

- T2:** Arusha Distr., Ol Donyo Sambu; 4500'. Jul.
- T2:** Masai Distr., Endulen. Apr.
- T2:** Masai Distr., S. Masai-Oldonyo; 5000'. Sep.
- T2:** Masai Distr., Olduvai; 3500'. Aug.
- T2:** Masai Distr., M-Towambu region, road to Ngorongoro Crater. Jul.
- T2:** Masai Distr., Ardai Plains, Eastern Plateau area. Jun.
- T2:** Mbulu Distr., L. Manyara Nat. Park; 3250'. Mar. + Apr. + Jun.
- T2:** Mbulu Distr., Bagayo R.; 3300'. Jun.
- T2:** Moshi Distr., Lyamungu, Machame; 4300'. Sep.
- T2:** Moshi Distr., Mwika, Kilimanjaro East; 4000'.
- T3:** Lushoto Distr., Tanga Region, Mkumbara, 18 km W of Mambo (?Maubo) on Hwy B-1. Jul. + Aug.
- T3:** Lushoto Distr., Tanga Region, 33 km N of Musoma-Mwanza road. Jul.
- T3:** Lushoto Distr., Mombo, W. Usambaras; 4000'. Jul.
- T3:** Lushoto Distr., Mombo, W. Usambaras; 1500'. Aug. + Sep.
- T3:** Lushoto Distr., W. Usambaras, Mtarawanda; 1200'. Jul.
- T3:** Tanga Distr., Korogwe Distr., Kisarake near Mnyuzi Railway St. Jul.
- T3:** Tanga Distr., Handeni-Korogwe road.
- T3:** Tanga Distr., Tanga, 1 km E of Mambo on Hwy. B-1. Aug.
- T3:** Lushoto/Tanga Distr., Korogwe Distr., Luengera Valley. Aug.
- T3:** ?Mkuraya Ranch; 50 m. Aug.
- T4:** ?Buha Distr., Kasulu, Heri Hospital. Jul.
- T4:** Kigoma Distr., Kabogo, Kabogo Head. Jun.
- T4:** Mpanda Distr., Mahali Mountains; 750-900 m. Jul.
- T4:** Mpanda Distr., N face of Musenabantu below summit; 6000'. Aug.
- T4:** Tabora Distr., Tabora, 14 mls NW Old Mwanza road; 1120 m. Jun.
- T4:** Tabora Distr., Talikwa; 4000'. Apr.
- T4:** Tabora Distr., Urambo; 3600'. Oct.
- T4:** Tabora Distr., near Tura. May.
- T4:** Tabora Distr., flood plain of Wala River, Urumwa; 4000'. May.
- T5:** Dodoma Distr., Itigi. Apr.
- T5:** Dodoma Distr., Itigi in mbuga; 4200'. Apr. + Jun.
- T5:** Dodoma Distr., Bahi on Dodoma to Manyoni Road; 3000'. Apr.

- T5:** Kondoia Distr., near Sambala; 4900'. Mar. + Apr.  
**T5:** Mpwapwa Distr., Kongwa; 3900'. Apr. + Jun.  
**T5:** Singida Distr., 120 km W of Singida on Nzega road. Jul.  
**T6:** Kilosa Distr., Ilonga; 1500-1600'. Jul. + Sep.  
**T6:** Kilosa Distr., Msaba, mile 6.9 from HQ; 1700'. Jun.  
**T6:** Kilosa/Morogoro Distr., Mkata Plain. May.  
**T6:** ? Morogoro Distr., mile 60 from D'Salaam to Morogoro; 300'. Aug.  
**T6:** Uzaramo Distr., Mtoni, near Dar es Salaam. Sep.  
**T7:** ? Chunya Distr., Lupa Forest Reserve, 95 mls Mbeya-Itigi road; 1400 m.  
 Jun.  
**T7:** Iringa Distr., Ruaha Nat. Park. May.  
**T7:** ? Iringa Distr., Mlale, Uhambya (?Uhimbila); 5100'. May.  
**T7:** Iringa Distr., IHEME; 6000'. Apr.  
**T7:** Mbeya Distr., Mbeya; 5500'.  
**T7:** Njombe Distr.; 6500'.  
**T7:** ? Rungwe Distr., Ipinda; 1700'. Jul.  
**T8:** ? Lindi Distr., Nachingwea; 1300-1600'. Jun.  
**T8:** Songea Distr., Litenga Hill; 1200 m. Apr.  
**T8:** Songea Distr., Kitai; 880 m. Apr.  
**T9:** Pemba; Vitongoje. Oct.  
**T9:** Pemba; near Mruwo .... Aug.  
**T10:** Zanzibar; Cheju Plain; sea-level. Aug.

#### UGANDA

- U1:** Acholi Distr., Lolim, Murchison Falls Nat. Park. Nov.  
**U1:** Acholi Distr., ? Adonji, Gulu; 3000'.  
**U1:** Karamoja Distr., Bokara Co., Iriri. May.  
**U1:** Karamoja Distr., Dodoth, Kidepo Nat. Park; 1050 m. Aug.  
**U1:** Karamoja Distr., Kidepo Valley, Apoka. Nov.  
**U1:** Karamoja Distr., Moroto; 4500'. Jul.  
**U1:** Karamoja Distr., Pian Co., Lodokeminet. Apr.  
**U1:** West Nile Distr., Jonam, Padyere and Ohoro. Jan.  
**U1B:** Karamoja/Mbale Distr., Greek River. May.

**U2:** Ankole Distr., Ruizi River; 4200'. Mar.

**U2:** Kigezi Distr., Kambuga; 5000'. May.

**U2:** Toro Distr., Toro Game Reserve, 8 km SW Sindikwa Triangulation Marker; 725 m. Dec.

**U3:** Busoga Distr., Mwiri Hill, 8 mls E of Jinja; 4450'. Aug.

**U3:** Busoga Distr., Nawanja Swamp near Iganga; 3700'. Jul.

**U3:** Teso Distr., Serere; 3600'. Oct.

### ***H. diversifolius***

#### **subsp. *diversifolius***

#### **KENYA**

**K1:** Northern Frontier Distr., Maralze (? Maralal); 6000'. Oct.

**K3:** Naivasha Distr., NW of Lake Naivasha, shore of South Lake; 1890 m. Jan. + Aug.

**K3:** Naivasha Distr.; 1890 m. Aug. + Oct. + Dec.

**K3:** Nakuru Distr., km 50 from Nakuru, km 207 from Nairobi. Aug.

**K3:** Nakuru Distr., Lake Nakuru Nat. Park; 5800'. May + Dec.

**K3:** Trans-Nzoia Distr., Mt Elgon, SW of Suam Saw Mills; 8500'. Dec.

**K3:** Trans-Nzoia Distr., Kitale roadside; 6200'. Oct.

**K3:** ?Uasin Gishu Distr., Kipiripiri (? Naivasha Distr., Kipiripiri). Oct.

**K3/4:** Fort Hall/Kiambu/Naivasha Distr., Thika, along the Chania river, west of the Nairobi-Fort Hill (Hall) Road; 4900'. Apr.

**K4:** Fort Hall Distr., Mitubiri. Apr.

**K4:** Fort Hall/Kiambu/Machakos Distr., Thika Distr., Nairobi Falls, 1°12'S, 37°03'E; 1440 m. Jul.

**K4:** Kiambu Distr., 13 km S of Thika on Nairobi-Thika Hwy; 5700'. Jul.

**K4:** Kiambu Distr., Lower Kabete; 5800'. Mar.

**K4:** Kiambu Distr., Manbre. Jul.

**K4:** Kiambu Distr., Katamayu and Ruiza River, Junction Kiambu Reserve; 6000'. Nov.

**K4:** Kiambu Distr., Kikuyu Reserve; 6000'. Oct.

- K4:** Nairobi Distr., Nairobi, E border of Karura Forest by Kiambu Road; 1650 m. Apr.
- K4:** Nairobi Distr., 9 km from Nairobi City on main road to Nakuru; 1660 m. Jun.
- K4:** Nairobi Distr., Chiromo Campus; 5500'. May.
- K5:** Kericho Distr., Sambret- Timbilil, SW ..... Forest; 7000'. Sep.
- K5:** Central Kavirondo Distr., Maboko Island; 3500'. Dec.
- K5:** North Kavirondo Distr., Kakamega.
- K5:** South Nyanza, ICIPE, Mbita Point Field Station, Lake shore; 1330 m. Dec.
- K6:** Masai Distr., Narok, River Entasekera; 7100'. Jul.
- K6:** Masai Distr., Olchoro Oiroiuwa Gorge (Njorowa); 5800'. Oct.
- K6:** Masai Distr., Narok, Osilalei area, 12 km SW of Maji Moto; 2030 m. Jan.
- K6:** Masai Distr., Narok, Morijo, 2<sup>o</sup>42'S, 35<sup>o</sup>50'E; 7000'. Nov.

#### TANZANIA

- T1:** Bukoba Distr., Korogwe Distr., Lake Mujanu (Rwakanjunju); 1290 m. Jul.
- T1:** Musoma Distr., 8 km N of Nyakanga on Hwy B-6. Jul.
- T1:** Musoma Distr., 15 km S of Musoma turn-off towards Mwanza. Jul.
- T1:** Mwanza Distr., Lake Province, Ukerewe Island. Apr.
- T1:** Mwanza Distr., Geita Distr., Sengerema/Nyamazugu; 3800'. Apr.
- ?T1:**?Mwanza Distr., roadside between Sengerema and Nzugu (?Nzuhe); 4000'. Mar.
- ?T1/2:**?Maswa/Masai Distr., ?Ngorono - Sambu border. Jul.
- T4:** Buha Distr., Kakombe Valley; 770 m.
- T4:** Mpanda Distr., near the Mugombasi River, W of Kapalgulu, north of Mahali Peninsula; 2550 m. Jul.
- T4:** Mpanda or Kigoma Distr., Kibwesa; 3350'. Jul.
- T4:** Ufipa Distr., Nsanga Forest; 1800 m. Aug.
- T7:** Iringa Distr., 10 mls S of Sao Hill; 5500'. Aug.
- T7:** Iringa Distr., Mufindi Distr., near Mninga, c.5 mls W of Lugoda Forestry. Sep.
- T7:** Iringa Distr., Kisitu Ridge; 5500'. Oct.

- T7:** Iringa Distr., Image Mt., about 30 mls E of Iringa and S of Gt. N. Rd.; 2100 m.
- T7:** Mbeya Distr., near Teine Village in Bundali Hills; 2050 m.
- T7:** Mbeya Distr., (Malila; Ibaba), Ilengo, Umalila; 7000'. Aug.
- T7:** Mbeya Distr., Usangu Flats, Luhanga, 8°55'S, 33°55'E; 1050 m. Aug.
- T7:** ?Mbeya Distr., Mlale, Ulambya. Oct.
- T8:** Songea Distr., Ndenga, Matengos.

#### UGANDA

- U2:** Ankole Distr., Bwaza Au....., Ruizi River; 4300'. Jan.
- U2:** Ankole/Toro Distr., Kankuranga Island, Lake George, Queen Elizabeth State Park; Toro. Jan.
- U2:** Kigezi Distr., Lake Mutande; 6000'. Oct.
- U4:** Masaka Distr., Masaka, 2-3 km S of Kasokero, 0°22'S, 31°58'E; 1140 m. May.

#### *subsp. rivularis*

#### KENYA

- K3:** Naivasha Distr., Naivasha; 6000'. Nov.
- K4:** Embu Distr., between Chuka and Embu; 4700'. Jul.
- K4:** ?Embu Distr., Karue; 5500'. Apr. + Sep.
- K4:** South Nyeri/Embu Distr., Thiba. Oct.

#### UGANDA

- U2:** Kigezi Distr., on the volcano Kisoro; 2200-2700 m. Sep. (WAG).

#### *var. witteanus*

#### KENYA

- K2/3:** West Suk/Elgeyo Distr., Cherangani; 6400'.
- K3:** Naivasha Distr., near Gilgil; 7000'. Sep.
- K3:** Nakuru Distr., Molo, 35°42'E, 0°13'S; 2600 m. Jan. + May.
- K3:** Nakuru Distr., c.5 ml NE of Londiani, 35°39'E, 0°9'S; 9000'. Feb.

- K3:** Nakuru Distr., Londiani, 35°36'E, 0°09'S. Nov.  
**?K3?** Trans-Nzoia Distr., Mt. Elgon; 7800'. Dec.  
**?K3/6?** Nakuru/Masai Distr., Ruahu, Kik, Mau Mts. Nov.  
**K5:** Kericho Distr., Nyanza Prov., Kimugu Tea Estate, 22 ml due NE of Kericho, 35°18'E, 0°22'S. Dec.

### TANZANIA

- T2:** Masai Distr., Monduli Distr., Loliondo; 7000'. Aug.  
**T4:** Kigoma or Mpanda Distr., Ujamba. Jul.  
**T7:** Iringa Distr., Mufindi Kisaoni; 6200'. Oct.  
**T7:** Iringa Distr., Msonza (?Msombe), Dabaga; 6300'. Jul.  
**T7:** Njombe Distr., Igeri, 9°40'S, 34°40'E; 7380'. Dec.  
**T7:** Njombe Distr., Mdapo Forest, 9°46'S, 34°47'E; 2070 m. Nov.  
**T7:** ?Njombe Distr., between Lisitu and Lugalawa, 9°48'S, 34°43'E; 2000 m. Sep.

### UGANDA

- U2:** Kigezi Distr., Mt. Mgahinga; 7000-7500'. Feb. + Oct.  
**U2:** Kigezi Distr., Kachwekano Forest; 6500-6800'. May + Jul.  
**U2:** Kigezi Distr., Behungi Hill; 8000-8200'. Dec.  
**U2 or U4:** Ankole (**U2**) or Masaka or Mengo (**U4**) Distr., Gayaza Road. Feb.

### *H. greenwayi*

#### var. *greenwayi*

### KENYA

- K3/6:** Naivasha/Masai Distr., 5 km SW 01 Doinyo, Ngiro (?Nyuki); 1600 m.  
**K4:** Kitui Distr., Mutomo Hill plant sanctuary, 1°51'S, 38°13'E; 900-1000 m. May.  
**K4:** Kitui Distr., Yakaseva, Voo Location; 2000 m. Aug.  
**K4:** Kitui Distr., Mutomo, 1°51'S, 38°13'E; 900-1000 m. Apr.  
**K4/7:** Kitui/Teita Distr., Tsavo Nat. Park East, near Lugard's Falls. Aug.  
**K6:** Masai Distr., Narok Distr., Idungisho area, Nakiami Hill, 15 km E of Narosura; 1550 m.

- K7:** Kilifi Distr., 25 mls NW Malindi; 200'. Nov.  
**K7:** Kilifi Distr., Mtwapa. Feb.  
**K7:** Kilifi Distr., Kibarani, Coast. Feb. + Aug.  
**K7:** Kilifi Distr., Rabai; 400'. Feb.  
**K7:** Kwale Distr., N of Taru town. Jan.  
**K7:** Kwale Distr., 8 km E of Mackinnon Road. Aug.  
**K7:** Kwale Distr., 30 km E of Mombasa on Hwy A109. Aug.  
**K7:** Kwale Distr., Kinango; 700'. Jan.  
**?K7:?** Kwale Distr., Keru, Mackinnon Road. Feb. + Jun.  
**K7:** Mombasa Distr., Mombasa-Voi; 1500'. Jan. + Nov.  
**K7:** Mombasa Distr., Mombasa to Mach. Road, Mazeras. Dec.  
**K7:** Mombasa Distr., Mombasa to Mackinnon Road, 54 mls from Mombasa; 1400'. Jan.  
**K7:** Teita Distr., Mt. Kasigau; 4500'. Mar. + Sep. + Oct.

#### TANZANIA

- T2:** Mbulu Distr., N end of Lake Eyassi (?Esasi); 3800'. Jul.  
**T3:** Lushoto Distr., Flora of SW Uмба Steppe, Mnazi; 1500'. Jan. (**P.J. Greenway 2034**: Type Collection).  
**T3:** Lushoto Distr., W Usambara, Kijango-Magoma. Aug.  
**T3:** ?Lushoto Distr., N of Mombe (?Mombo); c.500 m. Sep.  
**T3:** Tanga Prov., Samu Sambu (?Sawe). Jul.

#### *var. megensis*

#### KENYA

- K1:** Northern Frontier Distr., Dandu, 3°26', 39°54'E; 3400'. May.  
**K1:** Northern Frontier Distr., Furroli, N.P., 3°42'N, 38°0'E; 4500-6500'. Sep.  
**K1:** Northern Frontier Distr., N side of Lolokwi Mt., 28 km NNW of Archers post (?); 1200 m. Apr.  
**K1:** Northern Frontier Distr., Mathews Range; 4000'. Jan.  
**K1:** Northern Frontier Distr., Marsabit Distr., Huri Hills; 4300'. Apr.  
**K1A:** Northern Frontier/Meru Distr., Lewa (?Leura) Dam, 20 km SW of Isiolo, 37°20'E, 00°10'N; 5400'. Jun.

**K4:** Kitui Distr., Mwingi Distr., Yambyu Dam. Feb.

**K4:** Kitui Distr., Mile 7 Kangonde/Embu Road. May.

**K7:** Teita Distr., Tsavo West, Hill c.4 km SE of Manda (?) Hill, NE of Murka area; 4100'. Jul.

### ***H. mastersianus***

#### **KENYA**

**K4:** Kitui Distr., Mutomo Hill plant sanctuary, 1°51'S, 38°13'E; 900-1000 m. May.

#### **TANZANIA**

**T1:** Mwanza Distr., Mwanza Region, 27 km E of Geita on Hwy B-163. Jul.

**T1:** Shinyanga Distr., Lubaga (?). Jun.

**T1:** Shinyanga Distr., Shinyanga. May.

**T4:** Kahama Distr., Kahama - Kishima. Mar.

**T4:** Nzega Distr., Mwanhala sub-station. Apr.

**T4:** Nzega Distr., 4°13'S, 33°11'E. May.

**T4:** Tabora Distr., Tabora, Tabora Boy's School; 1300 m. May.

**T4:** Tabora Distr., Tabora; 4000'. Apr.

**T4:** Tabora Distr., Mhuala River near Tura. May.

**T5:** Dodoma Distr., Itigi. Apr.

**T5:** Dodoma Distr., Itigi in mbuga. Apr. + Jun.

**T5:** Dodoma Distr., Kazikazi; 4200'. May.

**T5:** Dodoma Distr., road to Itololu from Kesese; 7000'. Mar.

**T5:** Mpwapwa Distr., Kongwa; 3300'. Apr.

**T5:** Mpwapwa Distr., Mpwapwa; 3500'. Mar.

**T5:** Singida Distr., Iramba Plateau, wooded slopes; 4000'. Apr.

**T5:** Singida Distr., Mwenge Sec. School; 1520 m. Apr.

**T7:** Iringa Distr., Ruaha Nat. Park, 7 km NW of Msembe; 940 m. May.

**T7:** Iringa Distr., Msembi-Mbagi Junction Track, mile 5.9; 2700'. Apr.

*H. mechowii***TANZANIA**

**T1:** Shinyanga Distr., Shinyanga.

**T4:** Kigoma Distr., Lukoma, L. Tanganyika shore; 914 m. May.

**T4:** Tabora Distr., Urambo. May.

*H. radiatus***KENYA**

**K7:** Kilifi Distr., Kibarani. Oct.

**K7:** Kwale Distr., Matuga - Coast; sea-level. Oct.

**TANZANIA**

**T3:** Tanga Distr., Moa. Apr.

**T4:** Tabora Distr., Uzumbwa. Feb.

*H. rostellatus***TANZANIA**

**T1:** Mwanza Distr., Ukerewe Island.

**T3:** Tanga Distr., Pongwe - Mawari; 200'. Nov.

**T3:** Tanga Distr., Steinbruch Forest Reserve, near Maweni, W of Tanga, 39°01'E, 5°06'S; 80 m. Dec.

**T3:** Tanga Distr., Magila near Muhoza; 600'. Nov.

**T4:** Mpanda Distr., Mahali Mts., Myako; 780 m. Jul.

**T4:** Mpanda Distr., Mahali Mts., Kasoge; 800 m. Jun. + Nov.

**T6:** Uzaramo Distr., Msimbazi stream, Pugu sisal estate, 18 km WSW of Dar es Salaam; 82 m. May.

**UGANDA**

**U2:** Ankole Distr., Ruizi River; 4300'. Feb.

**U2:** Ankole Distr., Nyamweru River Bridge, Congo Road, Q.E. Nat. Park; 3000'. Mar.

*U2*: Bunyoro Distr., Budongo Forest; 1050 m. Oct.

*U4*: Masaka/Mengo/Mubende Distr., W Buganda, 2 km E of Budo (?Buddu), edge of swamp. Feb.

### *H. sabdariffa*

#### KENYA

*K4*: Kiambu Distr., Kikuyu; 6699'. Jun.

*K5*: Kisumu-Londiani Distr., Nyanza, Thessalia Mission near Muhoroni; 1200 m. Nov.

*K7*: ?Kwale Distr., Mshihu (?), 10 km S of Raunisi (?) near Lurgalunga. May.

#### TANZANIA

*T1*: Mwanza Distr., Ukiriguru; 4100'. Apr.

*T8*: ?Utete Distr. (?T6: Rufiji Distr.), Nawanje Hills. Jun.

### *H. surattensis*

#### KENYA

*K4*: Fort Hall Distr., 5 ml N; 4500'. May.

*K4*: Meru Distr., Chika (?Embu Distr.), Kithituni, Mt Kenya Forest Reserve; 1235 m. Nov.

*K4*: Nairobi Distr., near Nairobi; 6300'. Jul.

*K7*: Kilifi Distr., Mida, Arabuko-Sokuke Forest Reserve, 15 mls S of Malindi; 50'. Dec.

*K7*: Kilifi Distr., Kibarani Coast, Kili. Jan. + Oct.

*K7*: Kwale Distr., Shimba Hills Development Scheme at Kidongo; c.300 m. Dec.

*K7*: Kwale Distr., Shimba Hills, Marere Pumping Station; 700'. Apr.

*K7*: Kwale Distr., Shimba Hills Nat. Park, Longa Magandi Forest; 400 m. Nov.

*K7*: Kwale Distr., Buda Forest; 60 m. Dec.

*K7*: Kwale Distr., Mrima Hill, 4°29'S, 39°16'E; 100-300 m. Jun.

**K7:** Kwale Distr., Coast, Digo county, Mrima Hill below forest, 40 mls SW of Mombasa; 260 m. Dec.

**K7:** Lamu Distr., Mararani Airstrip, 2°18'S, 41°18'E; c.20 m. Apr.

### TANZANIA

**T3:** Lushoto Distr., Korogwe Distr., Gereza East, Mnyusi. Jul.

**T3:** Lushoto Distr., E. Usambaras, Amani, 5°05'S, 38°40'E; 3000'. Aug. + Dec.

**T3:** Lushoto/Tanga Distr., Usambara Mts., Bombole (?Bomole), Amani East. Sep.

**T1:** Mwanza Distr., Ukerewe Island.

**T1:** Mwanza Distr., Rubya Ranch, Ukerewe Island, Mt. Ukiriguru.

**T3:** Tanga Distr., Kwamkoro Forest Reserve. Oct.

**T3:** Tanga Distr., 1 km E of Muheza on Hwy A14. Aug.

**T3:** Tanga Distr., 5 km S of Tanga, 39°05'E, 5°06'S. Jan.

**T3:** Tanga Distr., Mapila near Muheza; 600'. Nov.

**T3:** Tanga Distr., Muheza Distr., Kihuhwi Forest Reserve. Apr.

**T4:** Buha Distr., Kasakela Chimpanzee Reserve, 16 mls N of Kigoma.

**T4:** Kigoma Distr., Gombe Stream Reserve, N of Kigoma. Aug.

**T4:** Mpanda Distr., Kingwe-Mahali Peninsula, Kalya; 2550 m. Aug.

**T4:** Mpanda Distr., Kasoge, Mahali Mts, c.800 m. Feb.

**T4:** ?Tabora Distr., Gombo (?e) National Park, Kakombe; 950 m. Oct.

**T6:** Bagamoyo Distr., Bana Forest Reserve. Aug.

**T6:** Morogoro Distr., Mluguru Mt.; 1100 m. Mar.

**T6:** Morogoro Distr., Manyangu Forest Reserve. Sep.

**T6:** Morogoro Distr., Mgeta; 800. Oct.

**T6:** Kilosa Distr., Mandege, 06°20'S, 37°00'E; 4000-4500'. Apr. + Jun.

**T6:** Kilosa Distr., at Ruaha River within 1 km E of Kidatu Bridge; c.400 m. Jul.

**T6:** Rufiji Distr., near Mkindu River, 2 mls SE of Chazi, 50 mls NW of Morogoro; 900'. May.

**T6:** Rufiji Distr., Utete; 100'. Jun.

**T6:** Rufiji Distr., Kirongwe; 30'. Aug.

**T6:** Ulanga Distr., Kihogozi, Ifakara. Sep.

- T6:** Uzaramo Distr., Dar es Salaam. Jun.  
**T6:** Uzaramo Distr., Pugu Hills Forest Reserve, Msimbazi Valley; 100 m. Aug.  
**T6:** Uzaramo Distr., Kisarawe Distr., Coastal Region. Oct.  
**T6:** Uzaramo Distr., Dar es Salaam Airport; 180'. Aug.  
**T8:** Lindi Distr., Selous Game Reserve, c.5 km NW of Kingupira, 8°26'S, 38°32'E; 125 m. Jun (WAG).  
**T8:** Kilwa Distr., Malemba Selous, 38°25'E, 3°40'S; 800 m. Jun.  
**T8:** Songea Distr., by track beyond Matagoro Mission, SE of Songea; 1110 m. May.  
**T9:** Pemba, Mkoani. Aug.  
**T10:** Zanzibar, Jozani Forest, 6°15'S, 39°25'E; 10-20 m. Aug.  
**T10:** Zanzibar, Chwaka, Mile 17; sea-level. May + Jun.

#### UGANDA

- U2:** Ankole Distr., Ruizi River; 4000'. Mar.  
**U2:** Bunyoro Distr., Bundongo (?Rabongo) Forest, Nyabylya (?Nyal'ya), Masindi. Nov.  
**U2:** Bunyoro Distr., Rabongo Forest, Murchison Falls Nat. Park; 3000'. Aug.  
**U2:** Kigezi Distr., Ishasha Gorge, forest edge; 4400'. May.  
**U3:** Mbale Distr., Budadiri; 4360'. Jan.  
**U4:** Mengo Distr., Entebbe, grassland; 3850'. Oct.

**APPENDIX II**

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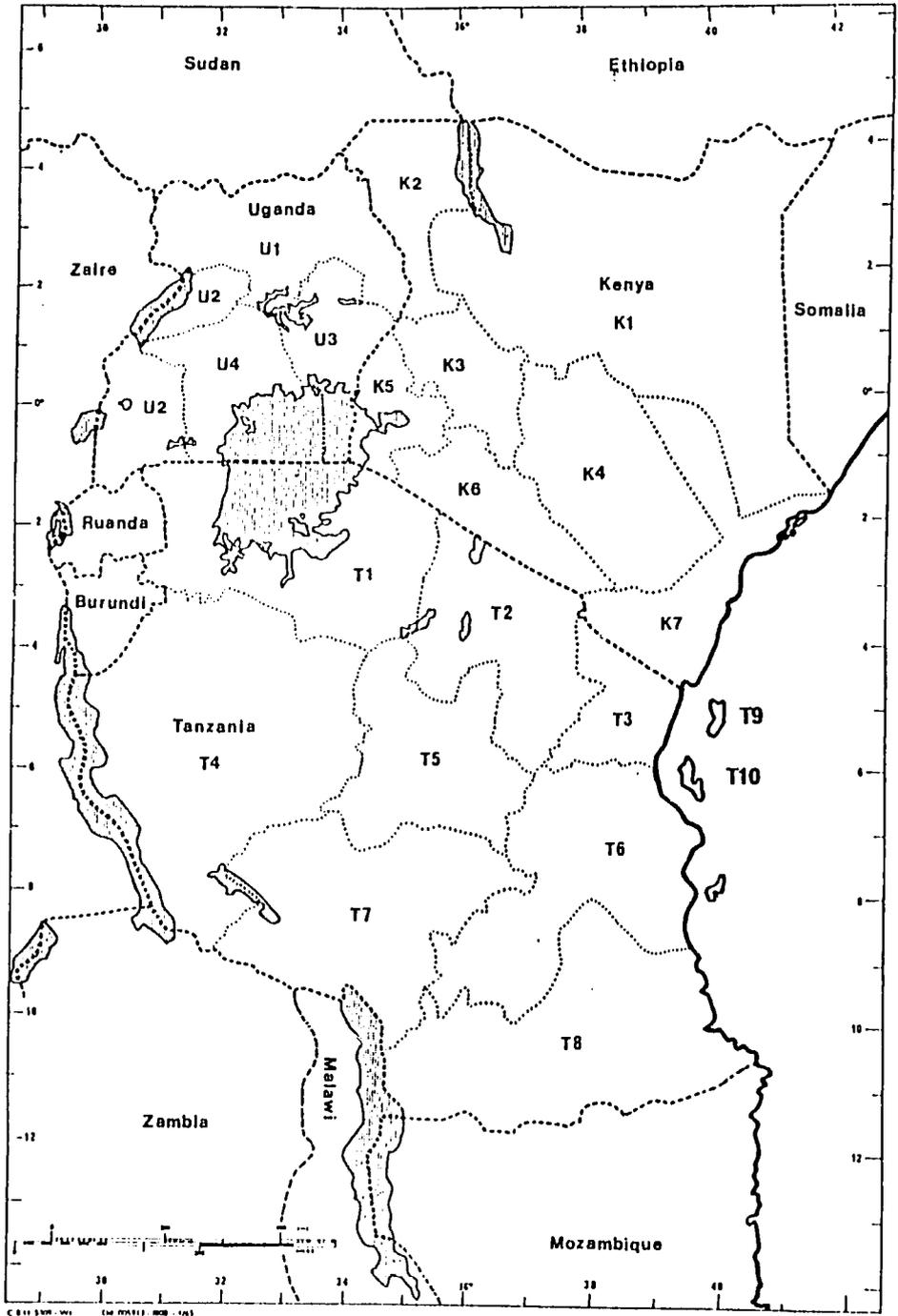


Fig. 3. Geographical districts of tropical East Africa

GEOGRAPHICAL DIVISIONS OF THE FLORA OF TROPICAL EAST AFRICA

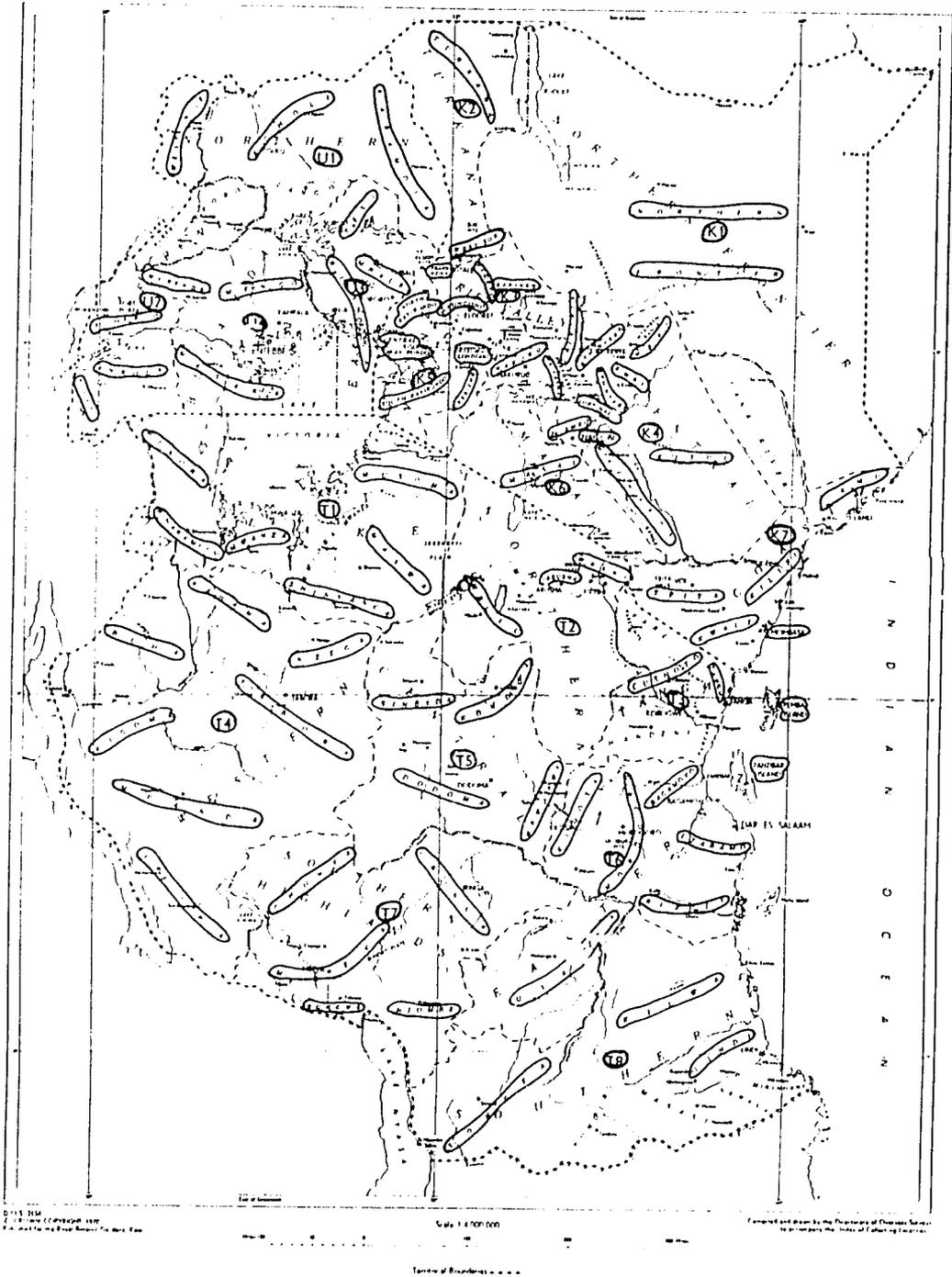


Fig. 4. Distribution of *Hibiscus* species in tropical East Africa

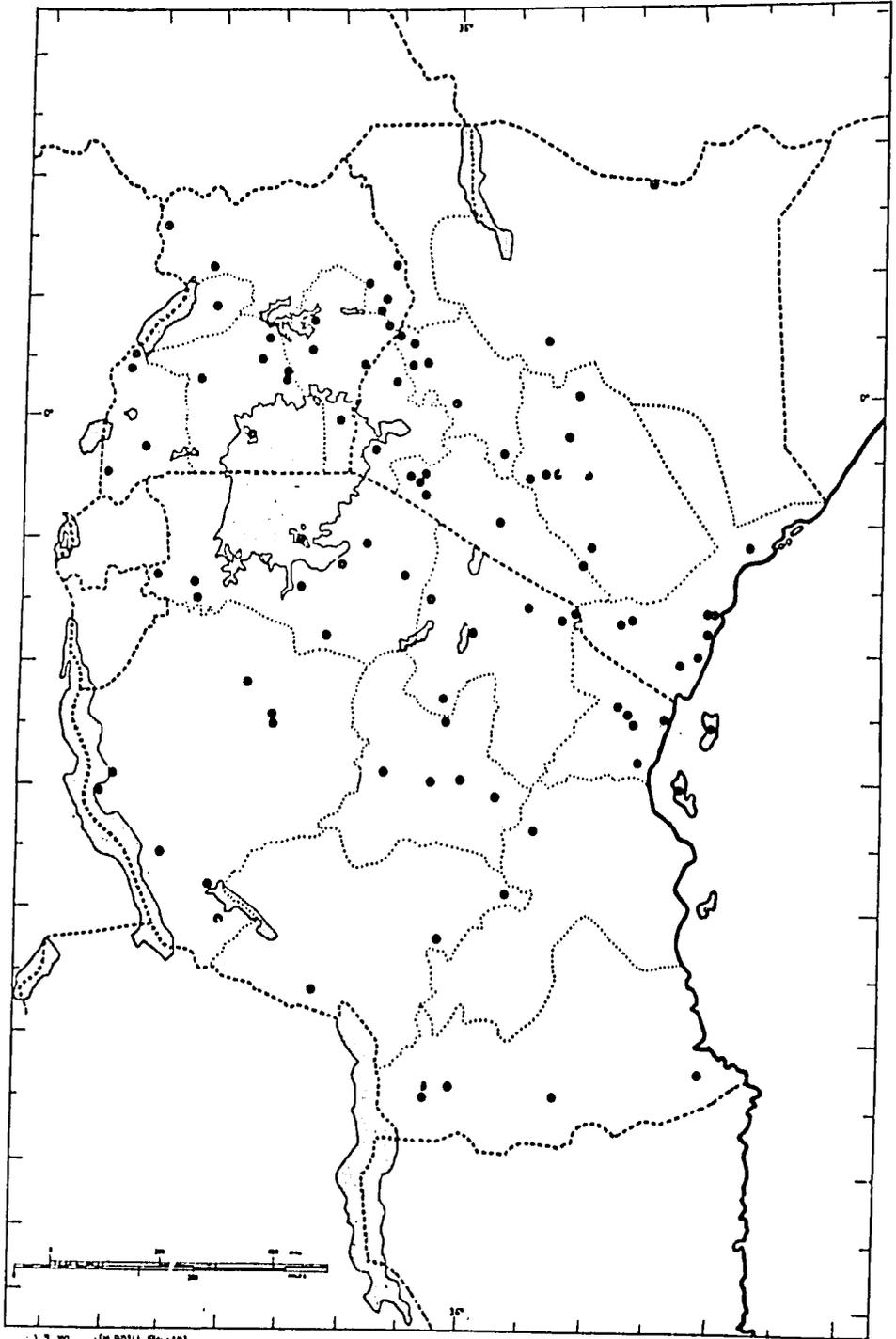


Fig. 5. Distribution of *Hibiscus cannabinus* L. in tropical East Africa

GEOGRAPHICAL DIVISIONS OF THE FLORA OF TROPICAL EAST AFRICA

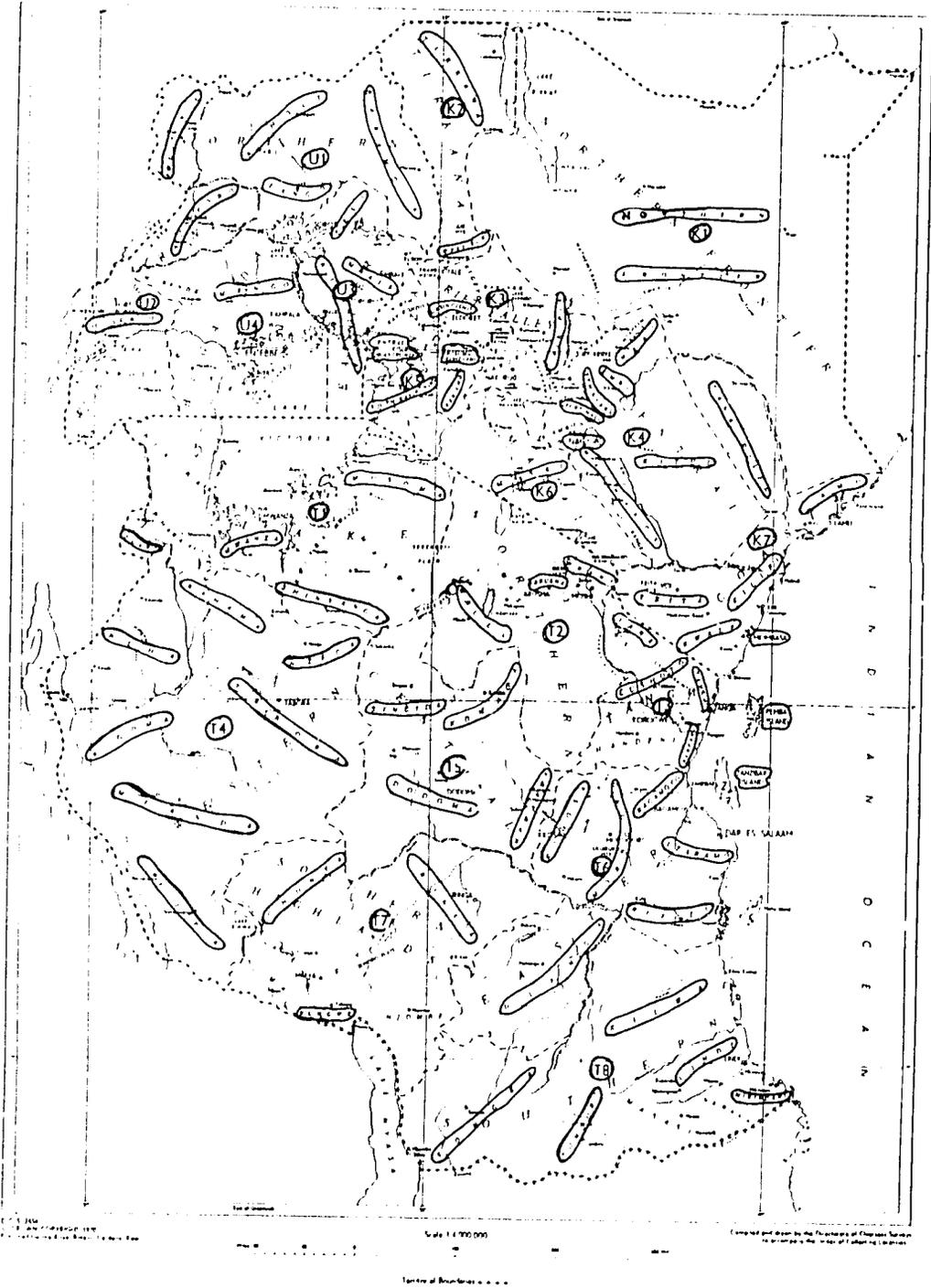


Fig. 6. Distribution of *Corchorus* species in tropical East Africa

**Table 5.** Geographical divisions of the *Flora of Tropical East Africa*

Province		District
<b>Kenya</b>		
K1	Northern Frontier	Northern Frontier
K2	Turkana	Turkana, West Suk
K3	Rift Valley	Trans-Nzoia, Uasin Gishu, Nandi, Elgeyo, Baringo, Laikipia, Ravine, Nakuru, Naivasha
K4	Central	North Nyeri, South Nyeri, Fort Hall, Kiambu, Nairobi, Meru, Embu, Machakos, Kitui
K5	Nyanza	North Kavirondo, Central Kavirondo, South Kavirondo, Kisumu-Londiani, Kericho
K6	Masai	Masai
K7	Coast	Teita, Kwale, Mombasa, Kilifi, Tana River, Lamu
<b>Tanzania</b>		
T1	Lake	Bukoba, Biharamulo, Ngara, Mwanza, Kwimba, Shinyanga, Maswa, Musoma, North Mara
T2	Northern	Masai, Mbulu, Arusha, Moshi
T3	Tanga	Pare, Lushoto, Handeni, Tanga, Pangani
T4	Western	Buha, Kahama, Nzega, Kigoma, Tabora, Mpanda, Ufipa
T5	Central	Singida, Kondo, Dodoma, Mpwapwa
T6	Eastern	Kilosa, Morogoro, Bagamoyo, Uzaramo, Rufiji, Ulanga
T7	Southern Highlands	Chunya, Mbeya, Iringa, Rungwe, Njombe
T8	Southern	Songea, Kilwa, Tunduru, Masasi, Lindi, Newala, Mikindani
T9	Pemba Island	
T10	Zanzibar Island	
<b>Uganda</b>		
U1	Northern	West Nile, Acholi, Lango, Karamoja
U2	Western	Bunyoro, Toro, Ankole, Kigezi
U3	Eastern	Teso, Busoga, Mbale
U4	Buganda	Masaka, Mengo, Mubende

Adapted from Diana Polhill, *Flora of Tropical East Africa*. Index of Collecting Localities.