

SYSTEMATICS AND EVOLUTION OF ELEUSINE CORACANA (GRAMINEAE)¹

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ABSTRACT

Finger millet (*Eleusine coracana* (L.) Gaertn. subsp. *coracana*) is cultivated in eastern and southern Africa and in southern Asia. The closest wild relative of finger millet is *E. coracana* subsp. *africana* (Kennedy-O'Byrne) Hilu & de Wet. Wild finger millet (subsp. *africana*) is native to Africa but was introduced as a weed to the warmer parts of Asia and America. Derivatives of hybrids between subsp. *coracana* and subsp. *africana* are companion weeds of the crop in Africa. Cultivated finger millets are divided into five races on the basis of inflorescence morphology. Race *coracana* is widely distributed across the range of finger millet cultivation. It is present in the archaeological record of early African agriculture that may date back 5,000 years. Racial evolution took place in Africa. Races *vulgaris*, *elongata*, *plana*, and *compacta* evolved from race *coracana*, and were introduced into India some 3,000 years ago. Little independent racial evolution took place in India.

ELEUSINE Gaertn. is predominantly an African genus. Six of its nine species are confined to tropical and subtropical Africa (Phillips, 1972). One species occurs in South America, one species extends from Ethiopia into Arabia, and one species is a pantropical weed but native to Africa and Asia. Finger millet, *E. coracana* (L.) Gaertn., is cultivated in southern and eastern Africa, and across most of southern Asia (Hilu and de Wet, 1976a). The cereal is African in origin, was domesticated some 5,000 years B.P. in eastern Africa, and introduced into India as a crop 3,000 years ago (Hilu, de Wet and Harlan, 1979). African and Indian cultivated complexes have been isolated from one another until historical times. This separation provides an opportunity to contrast racial evolution in Africa where the crop is sympatric with its wild progenitor, with racial evolution in India where wild *E. coracana* subsp. *africana* (Kennedy-O'Byrne) Hilu & de Wet is absent.

MATERIALS AND METHODS—Germplasm collections of *Eleusine coracana* filed with the Genetic Resources Unit of the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) were planted near Pa-

tancheru in India, and studied morphologically. These include 698 accessions from the Indian subcontinent and Sri Lanka, 648 accessions from Africa, and 63 accessions of uncertain origin. Twelve quantitative and nine qualitative characters were recorded for each accession. Data are derived from observations on at least ten plants in each accession. These observations were compared with field studies in Malawi (Africa) and the states of Andhra Pradesh and Orissa in India, and with studies of herbarium specimens filed at the Rijksherbarium, Leiden (L) and Royal Botanic Gardens, Kew (K). Quantitative characters scored are days to flowering (DFL), plant height (PLH), number of basal tillers (NBT), number of inflorescences on the major culm (NIN), flag leaf length (FLL) and width (FLW), length of flag leaf sheath (LFS), peduncle length of terminal inflorescence (PDL), inflorescence length (INL), length of longest inflorescence branch (LIB), width of major inflorescence branch (WIB), and number of inflorescence branches (NIB). Accessions were classified into six major groups based upon overall appearance, with the following sample sizes: Subsp. *africana* (wild and weed) $N = 15$; subsp. *coracana*, race *coracana* $N = 206$, race *elongata* $N = 88$, race *plana* $N = 287$, race *compacta* $N = 202$, race *vulgaris* $N = 635$. Discriminant analysis (direct method, Nie et al., 1975) was used to assess separation of groups using the above characters. Qualitative characters studied are degree of plant pigmentation, growth habit, degree of glume prominence, degree of inflorescence compact-

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ness, fruit color, degree of lodging at time of maturity, degree of senescence at time of maturity, overall disease resistance, and yield potential. Data are filed as permanent descriptors for each of the *Eleusine* accessions in the gene bank at ICRISAT. Specimens of a majority of collections studied are filed with the Crop Evolution Herbarium (CEL).

SYSTEMATICS—Finger millet is variable (Table 1). This led to considerable controversy about its origin and evolution. De Candolle (1886) and Copley (1956) suggested that finger millet was domesticated in India, and that its wild progenitor is the pantropical weed, *E. indica* (L.) Gaertner. Porteres (1951, 1958, 1970) and Mehra (1963) proposed that this cereal originated in Africa from the native *E. africana* Kennedy-O'Byrne. Vavilov (1951) suggested that finger millet could have been domesticated independently in Africa and India, and Kennedy-O'Byrne (1957) and Jameson (1970) identified *E. africana* and *E. indica* as the respective progenitors of African and Indian cultivars.

Phillips (1972) suggested that *E. indica* and *E. africana* are conspecific, and recognized these taxa as subspecies of *E. indica*. Cytologically *E. africana* ($2n = 36$) and *E. indica* ($2n = 18$) are distantly related, with little homology obvious between their basic genomes (Chennaveeraiah and Hiremath, 1974). In contrast, hybrids between *E. africana* ($2n = 36$) and *E. coracana* ($2n = 36$) are fully fertile. These two taxa hybridize where they are sympatric in Africa, and derivatives of such crosses often occur as weeds in cultivated fields. Comparative morphological and cytological studies reveal that *E. africana* is conspecific with *E. coracana*, and that *E. africana* is the progenitor of finger millet (Hilu and de Wet, 1976a). These two taxa were combined, and *E. africana* was recognized as a subspecies of *E. coracana* by Hilu and de Wet (1976b). Stabilized, weedy derivatives of crosses between wild and cultivated *E. coracana* resemble either the cultivated or wild complex in inflorescence morphology.

1. *Eleusine coracana* (L.) Gaertn. subsp. *coracana* Fruct. et Sem. 1: 8, t. 1. 1778. Type: Illustration in Plukenet, Phytographia t. 91, f. 5. 1691. *Cynosurus coracana* L., Syst. Nat. Ed. 10, 2: 875. 1759. *Cynosurus coracanus* L., Sp. Pl. ed. 2: 106. 1762. *Eleusine cerealis* Salisb., Prodr. Stirp.: 19. 1795, nom. superfl. *Eleusine sphaerosperma* Stokes, Bot. Mat. Med. 1: 149. 1812, nom. superfl. *Eleusine stricta* Roxb., Hort. Beng.: 8. 1814, nom. nud. *Eleusine to-*

TABLE 1. Parameters for quantitative characters of *Eleusine coracana* subsp. *africana* (wild and weed) and races of subsp. *coracana*. Mean (standard deviation) range. See materials and methods for explanations of character acronyms. Lengths and widths in cm except FLW and WTB in mm

Char.	Wild and weed	Coracana	Elongata	Plana	Compacta	Vulgatis
DFL	76.7 (12.0) 63-86	74.3 (7.0) 61-90	81.3 (6.9) 68-95	82.4 (3.9) 69-93	80.5 (5.7) 66-93	70.3 (7.4) 54-99
PLH	115.0 (22.9) 90-135	113.6 (13.1) 80-145	115.4 (19.3) 80-165	110.0 (15.8) 60-150	106.4 (13.3) 75-145	95.3 (14.2) 55-140
NBT	8.7 (5.1) 3-13	8.6 (4.1) 3-23	9.2 (4.0) 3-20	4.8 (2.1) 1-13	4.6 (2.1) 1-14	8.1 (3.7) 2-37
NIN	8.0 (6.0) 2-14	2.9 (1.5) 1-7	2.8 (1.6) 1-9	2.2 (1.2) 1-7	2.0 (1.0) 1-6	3.6 (2.0) 1-12
FLL	30.0 (6.0) 24-36	35.3 (6.6) 16-50	41.4 (8.1) 28-70	37.7 (7.0) 20-60	38.7 (6.9) 26-60	34.2 (6.6) 16-56
FLW	8.3 (2.9) 5-10	12.1 (2.7) 10-20	13.9 (3.8) 10-20	14.9 (3.4) 10-20	16.9 (2.7) 10-20	11.0 (2.0) 10-20
LFS	14.0 (1.0) 13-15	12.0 (1.9) 8-16	11.2 (2.0) 8-16	9.9 (1.6) 6-15	9.0 (1.8) 5-14	10.7 (1.7) 6-16
PDL	28.3 (4.5) 24-33	23.8 (2.5) 18-32	21.4 (4.3) 10-30	22.6 (3.6) 10-32	20.4 (4.5) 8-32	22.1 (3.4) 8-32
INL	17.0 (3.0) 14-20	18.5 (1.5) 10-16	18.5 (3.9) 12-32	12.6 (2.4) 7-20	9.5 (1.9) 6-14	8.2 (1.7) 4-15
LJB	11.0 (3.0) 8-14	8.4 (1.1) 6-11	14.7 (3.1) 10-24	9.6 (1.7) 6-15	6.5 (1.0) 6-10	5.5 (1.0) 2-8
WTB	6.3 (5.8) 3-13	11.2 (2.2) 10-15	9.8 (1.4) 5-15	12.6 (3.2) 10-20	11.7 (2.5) 10-20	11.1 (2.2) 5-16
NIB	12.7 (2.9) 11-16	8.7 (2.5) 5-19	8.5 (2.6) 5-16	7.0 (1.6) 4-13	7.9 (2.0) 4-15	7.8 (1.6) 5-16

cussa Fresen., Mus. Senck. 2: 141. 1837. *Eleusine coracana* (L.) Gaertn. var. *stricta* (Roxb.) Nees, Fl. Afr. Austr. 1: 251. 1841. *Eleusine luo* Welw., in Apont. Phyto. Geog.: 591. 1858, nom. nud. *Eleusine dagussa* Schimper in Regel, Garten Flora 21: 205. 1872. *Eleusine coracana* (L.) Gaertn. vars. *alba*, *atra*, *fusca* Koern., Handb. Getreid. 1: 329. 1885. *Eleusine coracana* (L.) Gaertn. var. *tocussa* (Fresen.) Franch., Bull. Soc. Hist. Nat. Autun 8: 377. 1895. *Eleusine indica* var. *stricta* (Roxb.) Chiov. in Nuov. Giorn. Bot. Ital. 26: 83. 1919. *Eleusine stricta* (Roxb.) Chiov., vars. *rufoabbreviata*, *fuscoabbreviata*, *alboabbreviata*, *rufoelongata*, *fuscoelongata*, *alboelongata*, Cif., in Atti Ist. Bot. Univ. Pavia ser. 5, 2: 172. 1944. *Eleusine pilosa* Gilli, Ann. Naturhist. Mus. Wien 69: 50. 1965.

Subspecies *coracana* includes all cultivated finger millets. Plants are annual, tufted, erect or with geniculately ascending culms that are up to 165 cm high and sometimes root from the lower nodes. Culms are commonly branched from the upper nodes to produce secondary inflorescences. Leaf-blades are linear to linear-lanceolate, up to 70 cm long and 20 mm wide. Inflorescences are digitate, often with one or more racemes some distance below the main cluster of 4–19 branches. Inflorescence branches are slender to robust, up to 24 cm long, reflexed when slender, or incurved at the tip when robust, sometimes with secondary branches. Spikelets are 6–9 flowered and 6–10 mm long, overlapping and mostly arranged in two rows along one side of the rachis. Glumes are unequal and shorter than the spikelet. The grain is white, red, brown or black; up to 2 mm long, more or less globose, with the surface finely striated.

Inflorescence shape is variable. The digitately arranged branches may spread out and become reflexed, or they may be erect and incurved, often forming a fist-like structure. Inflorescence shape, correlated with geographic distribution, allowed Hilu and de Wet (1976b) to recognize three races of cultivated finger millet. Hussaini, Goodman and Timothy (1977) extended this study to a larger collection and distinguished twelve groups on the basis of principal component or canonical variate analyses of a number of inflorescence and vegetative traits. Indian material showed clinal variation, with southern and eastern cultivars forming phenotypic extremes. Cultivars from Ethiopia and Uganda appeared morphologically distinct from those of the rest of Africa or India. Our comparative morphological study of the ICRISAT collections resulted in the rec-

ognition of five cultivated races with eleven distinct cultivated complexes.

2. *Eleusine coracana* subsp. *africana* (Kennedy-O'Byrne) Hilu & de Wet, Econ. Bot. 30: 202. 1976. Type: South Africa, Cape Province, Kimberly district, Warrenton-on-Vaal, Wilman H.K. 1, March 1950 (K, Holotype). *Eleusine africana* Kennedy-O'Byrne, Kew Bull. 12: 65. 1957. *Eleusine indica* subsp. *africana* (Kennedy-O'Byrne) S.M. Phillips, Kew Bull. 27: 259. 1972.

Wild finger millet is a tufted annual, with slender and geniculately ascending culms that branch at the lower nodes. Flowering culms are up to 135 cm tall, with leaf-blades up to 36 cm long and 10 mm wide. Inflorescences are digitate, composed of 3–13 (rarely more) slender and ascending branches, with one or a few branches often arranged some distance below the digitate cluster (Fig. 1). Inflorescence branches are 8–17 cm long and rarely more than 5 mm wide, with the spikelets arranged in two rows on one side of the rachis. Spikelets are 4–9 flowered and 5–8 mm long. Glumes are shorter than the spikelet, lanceolate-oblong in profile, rarely over 5 mm long and narrowly winged along the keel. Lemmas are lanceolate in profile and up to 6 mm long. The palea is distinctly winged along the keels. Grains are 1.0–1.8 mm long, elliptic in outline and the surface is shallowly ridged.

Eleusine coracana is predominantly self-fertilized. Subspecies *africana*, however, does cross occasionally with subsp. *coracana* to produce fully fertile hybrids. Derivatives of such crosses are aggressive colonizers. Hilu and de Wet (1976a) recognized two weedy races of finger millet. The common weed differs from its wild relative primarily in occupying habitats that are continuously being disturbed by man. This weed extends across the range of finger millet cultivation in Africa. The other weed race is characterized by a well developed terminal raceme of loosely arranged spikelets with as many as 15 subdigitately arranged branches below it (Fig. 2). This weed occurs in cultivated fields and has been collected around Dedza and Kota Kota in Malawi, and Iringa in Tanzania. Plants that mimic cultivated finger millet in vegetative as well as inflorescence morphology, but with spikelets that disarticulate at maturity also occur as weeds in Malawi. Most of these are first generation hybrids but some represent hybrid derivatives of such crosses.

The weedy *E. indica* and *E. coracana* subsp. *africana* are widely sympatric in Africa, with *E. indica* extending to Asia. In Africa, *E. indica*

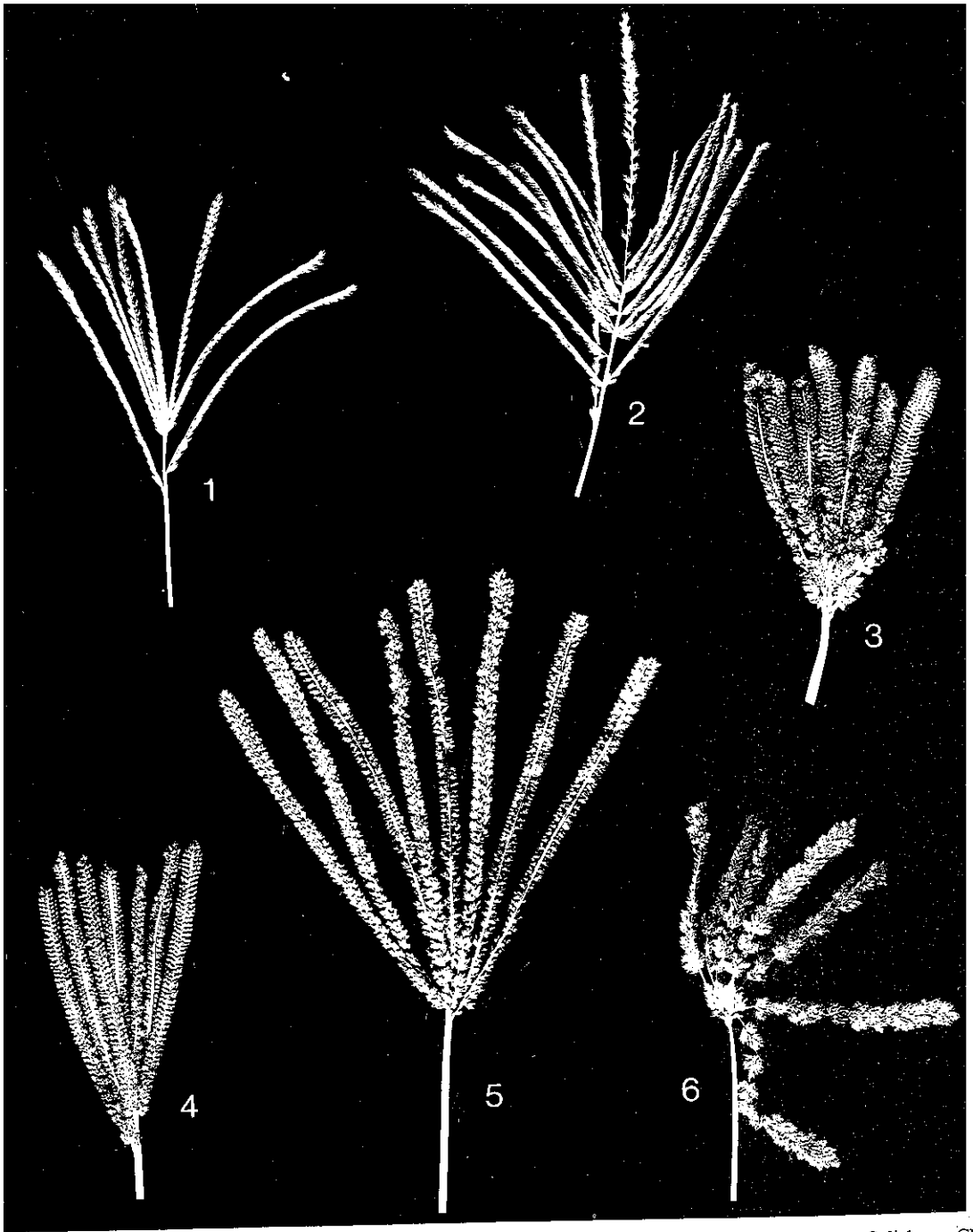


Fig. 1-6. Variation within *Eleusine coracana*. $\times 0.32$. 1-2. Subsp. *africana*. 1. Wild. Zimbabwe, nr. Salisbury, CEL 3694. 2. Weed. Malawi, Dedza, CEL 4254. 3-6. Subsp. *coracana*. 3. Race *coracana*. Uganda, Soroti, CEL 4344. 4-6. Race *elongata*. 4. Malawi, Tumbondela, I.E. 2608 (CEL). 5. Malawi, Chikwawa, I.E. 2604 (CEL). 6. India, Sikkim, I.E. 2312 (CEL).

occurs primarily along the eastern and western coastal plains while subsp. *africana* is primarily found along the eastern and southern highlands. Subspecies *africana* is commonly more robust than *E. indica*, with the grain shallowly ridged rather than obliquely striate (Phillips, 1972).

RACIAL EVOLUTION IN FINGER MILLET—Inflorescence morphology is associated with grain yield, and is used by farmers to distinguish complexes of cultivars (Fig. 3–13). The most primitive cultivars are characterized by inflorescences with spreading branches that are straight or slightly incurved at the tip when mature. Some of these cultivars resemble robust specimens of subsp. *africana*, except that they lack the ability of natural seed dispersal (Fig. 3). These cultivars are common in Africa, but are also grown in southern and eastern India. This complex includes the African and Indian highland races recognized by Hilu and de Wet (1976b). Indian and African cultivars can not consistently be separated on the basis of inflorescence morphology. A second group of African and Highland Indian cultivars is characterized by spreading inflorescence branches. Cultivars with 10–18 cm long branches are grown in eastern Africa and in southern and eastern India (Fig. 4), while those with branches up to 24 cm long are typically East African (Fig. 5). African collections have more slender racemes than those of Indian cultivars, allowing the branches to become reflexed at maturity. Individuals in fields of these cultivars sometimes have spikelets arranged in clusters along the rachis (Fig. 6). A distinct group of cultivars is grown from Ethiopia south to Zambia. Typical representatives of this complex are characterized by spreading inflorescence branches with large spikelets arranged in two even rows along one side of the rachis (Fig. 7). The spikelets in these cultivars are often over 10 mm long with the glumes narrowly lanceolate (Fig. 8). Similar to this group are cultivars from Africa and from southern and eastern India with large spikelets that are irregularly arranged, often almost surrounding the rachis (Fig. 9). The most advanced cultivars are characterized by highly proliferated inflorescence branches that are clumped together to form a large fist-like structure (Fig. 10). These cultivars have been collected in Uganda, Sri Lanka, southern India, and Nepal, but are probably more widely grown. The most commonly grown finger millets in Africa as well as India are characterized by relatively small inflorescences. Some cultivars have short branches that curve down giving the inflores-

cence a lily-like appearance (Fig. 11). Others have short but spreading branches that are twisted to form a starfish-shaped inflorescence (Fig. 12). The most widely distributed finger millets of this group are characterized by inflorescence branches that curve inward to form a loosely to tightly clenched fist-like structure (Fig. 13).

Comparative morphology, coupled with discriminant function analysis of quantitative characteristics suggests five taxonomic groups of cultivated finger millet (Fig. 14). A relatively low correspondence of 67% between a classification of plants based upon qualitative inflorescence morphology, and the results of the discriminant analysis classification routine, reflects racial intergradation in all quantitative characters studied (Table 1). Variation within each of the five groups is essentially continuous. The first two discriminant functions account for 94% of the variation. Characters contributing most to group separation on discriminant function 1 are length of the longest inflorescence branch, inflorescence length, and days to flowering, with standardized canonical discriminant function coefficient scores of 0.66, 0.33, and 0.24, respectively. Characters most important in separating groups on discriminant function 2 are flag leaf width (-0.62), days to flowering (-0.40) and number of major culm branches (0.36). The five races recognized are *coracana* (Fig. 3), *elongata* (Fig. 4–6), *plana* (Fig. 7–9), *compacta* (Fig. 10), and *vulgaris* (Fig. 11–13). Inflorescence types within races grade into one another so completely that the recognition of subraces becomes impossible.

Race coracana—Inflorescence morphology in race *coracana* is similar to that of wild finger millet. Race *coracana* probably gave rise to the other four races through selection under domestication (Fig. 14). Race *coracana* resembles wild subsp. *africana* in having 5–19 slender inflorescence branches that are 6–11 cm long, digitately arranged, ascending, and with the tips straight, slightly incurved or somewhat reflexed at time of maturity (Fig. 3). Some genotypes differ from wild finger millet primarily in being unable to disperse their spikelets without the help of man. They often resemble weedy genotypes (Fig. 2) in having a well developed central inflorescence branch. Race *coracana* is widely, but sporadically grown across the range of finger millet cultivation in Africa and India. It is particularly well adapted to agriculture in the East African highlands, and the Western Ghats of India. Higher yielding cultivars have the primary inflorescence branches divided near

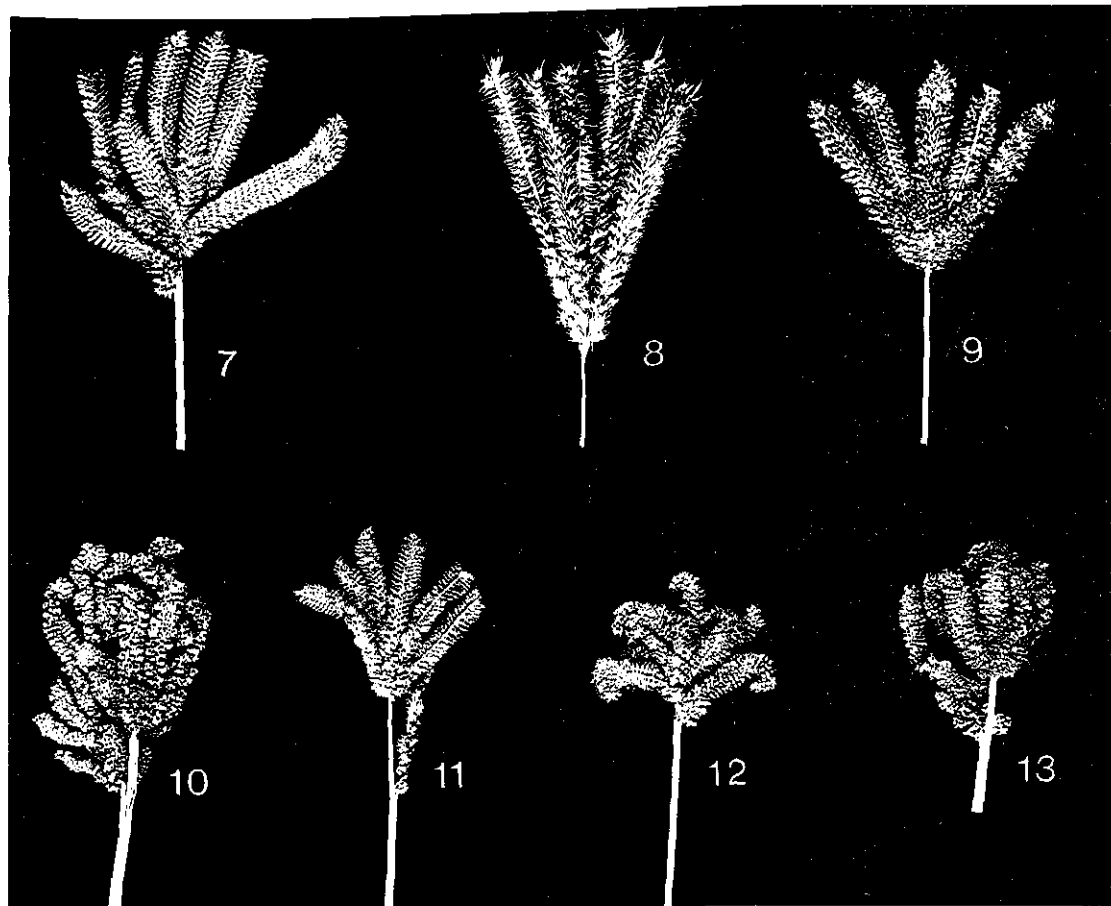


Fig. 7-13. Variation within *Eleusine coracana* subsp. *coracana*. $\times 0.32$. 7-9. Race *plana*. 7. Malawi, Choweaten, I.E. 2622 (CEL). 8. Malawi, Nchisa, I.E. 2644 (CEL). 9. Malawi, Chinguluwe, I.E. 2673 (CEL). 10. Race *compacta*. India, Tamil Nadu, CEL 4437. 11-13. Race *vulgaris*. 11. India, Uttar Pradesh, CEL 4165. 12. India, Maharashtra, I.E. 2289 (CEL). 13. Malawi, Mastade, I.E. 2622 (CEL).

the base. Some cultivars are drought tolerant and compete aggressively with weeds or other minor cereals under conditions of traditional agriculture. In India it is often sown as a secondary crop in fields of *Pennisetum americanum* (L.) Leeke (pearl millet) or *Sorghum bicolor* (L.) Moench (sorghum).

Race elongata—This race is morphologically the most distinct of the five races of finger millet. It is characterized by long slender inflorescence branches that are 10–24 cm long, digitately arranged, spreading and curved outward at time of maturity. A cultivar grown only in Malawi and adjacent Zambia has 15–24 cm long inflorescence branches (Fig. 5) and is locally referred to as “elephant foot” finger millet. The more common cultivars have 10–18 cm long inflorescence branches (Fig. 4) and are grown along the east African highlands and the

Eastern Ghats of India. These cultivars are often difficult to distinguish from robust specimens of race *coracana*, except that the inflorescence branches are longer and always reflexed at maturity. Indian and African cultivars cannot consistently be separated on the basis of morphology. They may have evolved independently in India and Africa under similar environmental conditions from race *coracana*. Since finger millet is an African crop, however, it seems more likely that the Indian genotypes were introduced from Africa. Individuals with spikelets arranged in clusters along the rachis occur within fields of race *elongata* across its range of cultivation in Africa. Branches are commonly reflexed giving the inflorescence a distinctive appearance (Fig. 6).

Race plana—This race is primarily African in distribution, is grown in Ethiopia and Ugan-

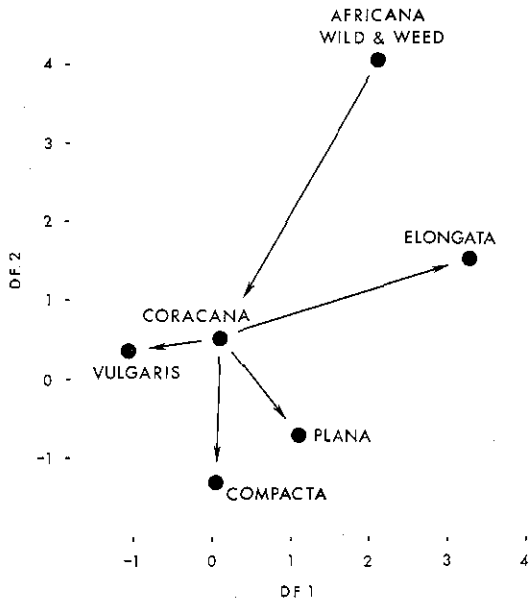


Fig. 14. Separation of group centroids for six *Eleusine* taxa on the first two functions from Discriminant Analysis. Arrows indicate putative origins of cultivated races.

da, and to some extent in the Eastern and Western Ghats of India. It is characterized by large spikelets (8.0–15.0 mm long) that are arranged in two, more or less even rows along the rachis, giving the inflorescence branch a flat ribbon-like appearance (Fig. 7). Some cultivars are characterized by spikelets 10.0–15.0 mm rather than 8.0–11.0 mm long (Fig. 8), and in others the fertile florets are so numerous that they almost surround the rachis at maturity (Fig. 9). This latter group resembles race compacta, except that the inflorescence branches are straight or reflexed, rather than incurved.

Race compacta—Members of this race are commonly referred to as cockscomb finger millets in both Africa and India. Spikelets are composed of nine or more florets, with the inflorescence branches divided at the base, ascending and incurved at the tip to form a fist-like inflorescence (Fig. 10). Indian cultivars almost always have an inflorescence branch located some distance below the 4–14 branches in the terminal cluster on the primary axis. African cultivars often lack this lower inflorescence branch. Race compacta is grown in Ethiopia and Uganda, and in northeastern India. It resembles cultivars of race vulgaris with fist-like inflorescences, but inflorescences of compacta are larger, and the lower raceme is rarely divided in vulgaris.

Race vulgaris—This is the common finger millet of Africa and Asia. It is grown from southern Africa to Ethiopia and Uganda, and from India to Indonesia. It is variable in size and growth habit. Three cultivar complexes are recognized on the basis of inflorescence morphology. Members of these complexes are frequently grown together in the same field, but some farmers maintain them as distinct. Inflorescence branches are reflexed (Fig. 11), twisted (Fig. 12) or incurved (Fig. 13), with all possible intermediates occurring where these complexes are grown together in the same field. In India, race vulgaris frequently follows irrigated rice (*Oryza sativa*) as a dry season crop. Some cultivars are drought tolerant while others are well adapted to areas of high rainfall. In the Eastern Ghats of India some genotypes are sown in nursery beds and transplanted to fields with the first rains of the season, to mature about 45 days later. Grains are cooked as rice, or ground into flour to make a porridge or unleavened bread. Stems and leaves are commonly fed to livestock.

DOMESTICATION OF FINGER MILLET—The species was domesticated in Africa. Its closest wild relative, *Eleusine coracana* subsp. *africana* is native to Africa. It is common along the highlands of East Africa and the grasslands of the southern African plateau, and extends into the coastal plains of East Africa and the forests of West Africa (Phillips, 1972). It was introduced to tropical and subtropical Australia, America, and South Asia as a weed. Subspecies *africana* crosses with subsp. *coracana* (finger millet) to produce fertile hybrids. It represents the progenitor of the cultivated finger millet, and is still harvested as a wild cereal in the African savanna during times of drought.

Finger millet is cultivated on the highlands of East Africa and the plateau of southern Africa. It is not adapted to the tropical forests of Zaire or West Africa, and rarely grown in the savanna west of Chad. In the West African savanna, finger millet is replaced as a minor cereal by the fonios, *Digitaria exilis* (Kippist) Stapf and *D. iburua* Stapf (Stapf, 1915; Porteres, 1955, 1976). It was probably domesticated in an area extending from western Uganda to the highlands of Ethiopia (Harlan, 1971). Wild finger millet is particularly abundant in this region and domesticated finger millet is grown extensively there.

The antiquity of cereal cultivation in Africa south of the Sahara is not known. Harlan, de Wet and Stemler (1976) suggested that domestication of native African food plants started at the beginning of the present dry period

of the Sahara, some 5,000 years ago. Hilu et al. (1979) indicated that this cereal could have been grown in Ethiopia at that time. Archaeological material excavated at Axum resembles race *plana* which is the principal finger millet still grown in Ethiopia. If this archaeological material dates from 3,000 B.C., as suggested by Hilu et al. (1979), the cereal must be substantially older as a crop in Africa, since *plana* is a highly evolved race. The cereal reached India during the first millenium B.C. (Vishnu-Mittre, 1968). It became widely distributed in southern Africa during the expansion of iron working technology (Summers, 1958). Suggestions of Davies and Gordon-Gray (1977) that finger millet, sorghum and pearl millet were cultivated in South Africa by the "latter part of the third millenium B.C." are probably not correct (Oliver Davies, pers. comm.). A more likely date for this cereal assemblage in southern Africa is early iron age, some 800 years ago.

Finger millets in Africa and India are similar in adaptation and morphology. This is not surprising. African and Indian cultivars of finger millet are grown in similar habitats. Finger millets grown in the Ghats of India and highlands of East Africa, or the coastal plains of East Africa and tropical South India belong to the same races, respectively. Similarly, guinea sorghums grown in high rainfall areas of the Eastern Ghats of India resemble those widely cultivated in the fog belt of the East African highlands (de Wet, 1978). Racial evolution in finger millet occurred in Africa before this cereal was introduced into India.

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