

THE GENUS *CYNODON* RICH. EX PERS. IN INDIA

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ABSTRACT

The paper deals with the taxonomy and economic aspects of the Indian species of the genus *Cynodon* Rich. ex Pers. The nomenclatural history of the genus and the value of different morphological characters in its taxonomy are discussed. The genus is represented in India by three indigenous species, viz. *C. dactylon* (L.) Pers., *C. barberi* Rang. et Tad. and *C. arcuatus* J. S. Presl ex C. B. Presl, and one form of the species *C. barberi*, viz. *C. barberi* Rang. et Tad. f. *longifolius* Jain. *C. plectostachyus* (K. Schum.) Pilger has been introduced into India for fodder.

The botanical description, vernacular names, etymology, synonymy and references to selected published literature and illustrations are given; the distribution, ecology and economic aspects are also discussed. All specimens examined during this study are cited; an index of the numbered exsiccata is provided.

A conspectus of synonymous names shows the present nomenclatural position of the numerous binomials published either under the genus *Cynodon*, or for the Indian species of this genus.

INTRODUCTION

The genus *Cynodon* (fam. Gramineae, subfam. Pooideae, tribe Chlorideae) is well known for its cosmopolitan species, *C. dactylon* (L.) Pers. The taxonomy of this genus has been confused due to intergrading forms between species; this necessitated a close study of the genus. About 500 herbarium specimens, including type material of *C. barberi* Rang. et Tad., *C. intermedius* Rang. et Tad. and *C. dactylon* Pers. var. *suberectus* Haines and several sheets authenticated by Dr. N. L. Bor, were critically examined.

The material in the following herbaria was received on loan or was otherwise examined:

Central National Herbarium, Calcutta (CAL); Forest Research Institute, Dehra Dun (DD); Blatter Herbarium, Bombay (BLAT); Botanical Survey of India, Allahabad (BSA); Botanical Survey of India, Coimbatore (MH); Botanical Survey of India, Dehra Dun (BSD); Botanical Survey of India, Poona (BSI); Botanical Survey of India, Shillong (ASSAM); National Botanic Gardens, Lucknow (LWG); Industrial Section, Botanical Survey of India, Calcutta, (BSIS).

ETYMOLOGY AND NOMENCLATURAL HISTORY OF THE GENUS

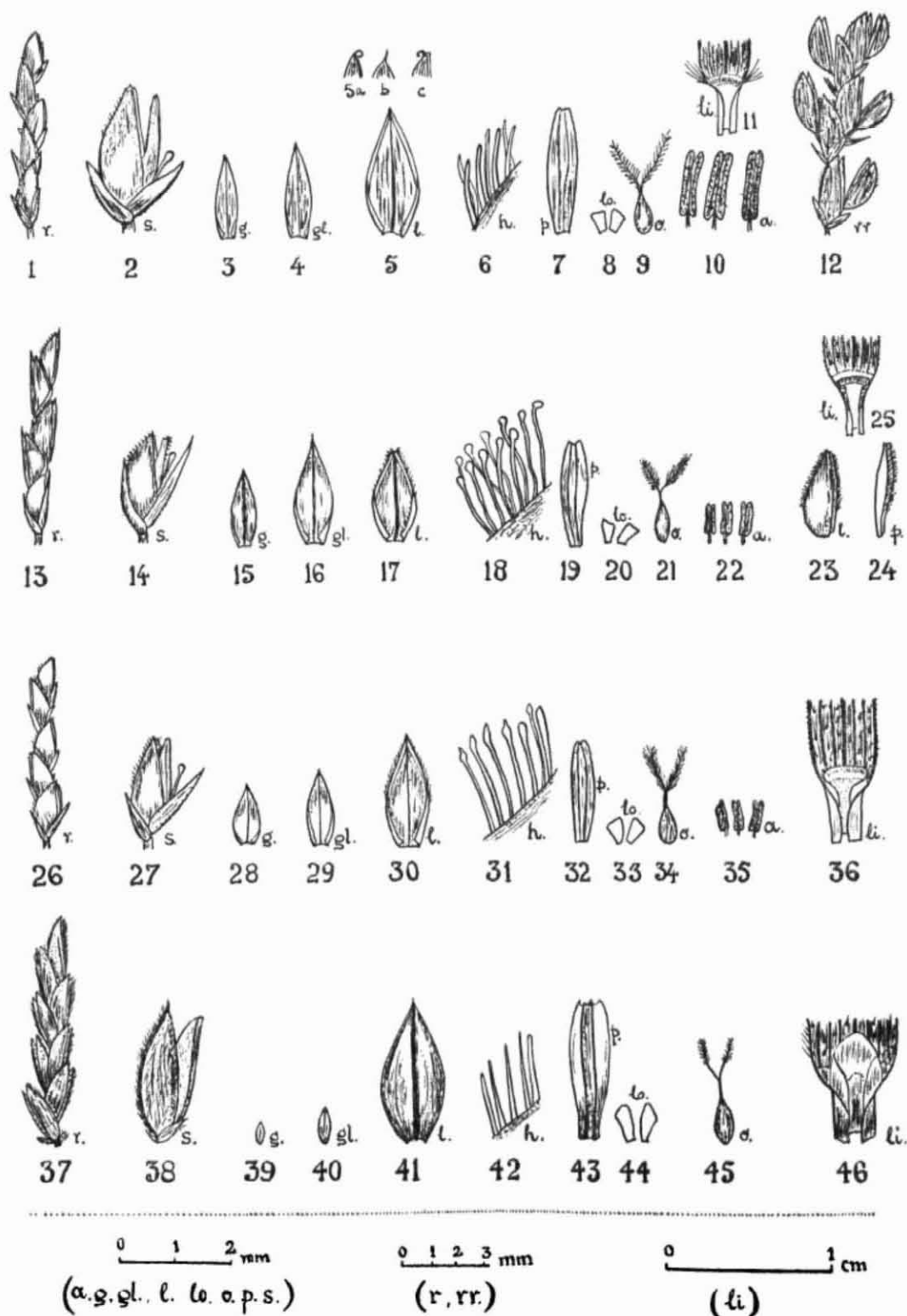
The word *Cynodon* is derived from the Greek words *Kyon*, a dog, and *Odous*, tooth; which seem to refer to the sharp, hard, tooth-like scales of the rhizomes.

Several grasses belonging to this genus have been described earlier under the genera *Panicum* L., *Capriola* Adanson, *Dactylon* Villars and *Fibichia* Koel.

The word *Cynodon* first appeared in Persoon's "Synopsis Plantarum" in 1805, for the grass *Panicum dactylon* L. Kuntze (1891) pointed out that Adanson's (1763) name *Capriola* was assigned to this grass earlier and has priority over *Cynodon*; he, therefore, made the combination *Capriola dactylon* (L.) Kuntze. Holm (1898) discussed the question of the generic name *Capriola vis-a-vis Cynodon*. He tried to prove that the scope of the genus *Capriola* is vague, includes more than one grass and that Adanson had not associated the name to any specific grass. Stent (1927) discussed the views of Kuntze and Holm. Adanson, while providing the name *Capriola*, had *Panicum dactylon* in mind, and *Capriola* (1763) certainly had priority over *Cynodon* (1805). However, due to the universal usage of the name *Cynodon* for a cosmopolitan and economically important grass, the generic name *Cynodon*, though a later homonym, has been rightly conserved (International Code Bot. Nomen. 1956).

There has been difference of opinion also regarding the authorship of the generic name *Cynodon*. As the name first appeared in Persoon's "Synopsis Plantarum", Bentham, Hooker, Stapf, Hackel, Kunth and several other authors have put Persoon as the authority for the genus. But, Persoon in his book attached Richard's name to the generic name *Cynodon*, and therefore, Richard ex Persoon is the correct authority for the generic name *Cynodon*.

Some binomials published under the genus *Cynodon* do not actually belong to this genus, but refer to grasses of other genera; a brief account of some such names is given in the later part of this work.



Figs. 1-12. *Cynodon dactylon*. Figs. 13-25. *C. barberi*. Figs. 26-36. *C. arcuatus*. Figs. 37-46. *C. plectostachyus*.
a. anthers; g. lower involucre glume; gl. upper involucre glume; h. hairs; l. lemma; li. ligule; lo. lodicules;
o. gynoecium; p. palea; r. part of a raceme; rr. part of a raceme with two-flowered spikelets; s. spikelet.

The information on anatomy, chromosome numbers and economic uses given below is based on earlier published literature; for this, relevant references are cited.

MORPHOLOGICAL CHARACTERS AND THEIR VALUE IN TAXONOMY OF *CYNODON*

Hurcombe (1947) studied *Cynodons* cultivated in South Africa and discussed the reliability and constance of certain characters. Hubbard (1954) and Jain (1960) discussed the practical utility of various endo- and exomorphological characters in grass systematics. Bor has discussed the importance of different morphological characters in several genera monographed by him (e.g. Bor 1952) and also in the family Gramineae as a whole (Bor 1941 and 1960); these observations have been of immense help in evaluating the characters in the genus *Cynodon*.

The vegetative shoot

The colour of the plant parts varies with age and habitat.

Roots: Roots vary according to habitat and are of no use in classification.

Shoots: Three types of shoots are met with in this genus; the erect or ascending culms ending in inflorescence, the stolons or creeping stems and the rhizome or the underground shoots. Presence or absence of rhizomes is a reliable distinguishing character (Hurcombe, *loc. cit.*; Bor 1952).

Sheaths: Leaf-sheaths are generally terete, and clasp the stem firmly; in *C. barberi* f. *barberi* the leaf-sheaths are strongly compressed and almost keeled.

Leaves: The ligule varies from a minute ring of white hairs to a ciliate membranous band about .5 mm long. The size and texture of the ligule are fairly constant within a species.

Leaves: Leaves (i.e. leafblades beyond the sheath) vary in breadth within a narrow range from about 2 mm to 5 mm; their length varies from 1 cm to about 20 cm; thus on one extreme are the leaves almost ovate in shape (as in some specimens of *C. barberi* f. *barberi*), and on the other, the narrowly linear leaves, as in most plants of *C. dactylon*. The leaves are generally pointed towards apex of the culm (i.e. form an acute angle with the culm), but in *C. barberi* f. *barberi*, leaves are often even at right angles to the culms.

The number of primary nerves in the leaves is a useful character in the genus (Hurcombe, *loc. cit.*). In Indian species, the primary nerves are either 5

or 7, rarely 9. The number is generally constant for a species. *C. dactylon* has 5 primary nerves (Fig. 11) and *C. arcuatus* and *C. barberi* almost always have 7 (Figs. 25, 36). The character of primary nerves has proved very helpful in preliminary and quick sorting of *C. arcuatus* and *C. barberi* from the bulk of the material kept under *C. dactylon*. The number of primary nerves on the leaves has not been mentioned in Indian floras; the only exception seems to be Haines (1924) who described the leaves of his new variety *C. dactylon* Pers. var. *suberectus* thus: 'leaves 2-3" long by .15-.22" broad, acuminate, rather strongly 3-nerved each side of the midrib'. This variety has been found to be synonymous with *C. arcuatus*.

Metcalf (1960) has reviewed the literature on anatomy of the leaves and has described the abaxial epidermis and transverse sections of the lamina of *C. dactylon*. Most of the anatomical characters are constant; the papillae on the abaxial epidermis, however, vary considerably in appearance and frequency; the frequency of intercostal short-cells is also very variable.

Inflorescence

The inflorescence comprises a few slender, digitate, sub-digitate, umbelled or fascicled spikes. In one specimen (Assam, s. l. No. 1195, CAL) the spikes are almost racemose.

Spikes: The number of the spikes varies from 2 to 8; but the range of variation within a species is not much; e.g., in *C. barberi*, the number is usually 3-5, (more than 5 not seen so far); in *C. arcuatus* 5-8; in *C. dactylon* it is generally 4-5.

The size of the spikes is smallest in *C. barberi*, usually 2-4 cm long; in *C. dactylon* it varies from 2-6 cm and in *C. arcuatus* it is 5-10 cm long. Arber (1934) has illustrated the disposition of racemes at preanthesis, anthesis and post-anthesis stages; before anthesis the racemes remain erect and contracted, rather partly enclosed in the sheath; at anthesis they become spread out and remain so at postanthesis stage also.

Spikelet: The spikelets are laterally compressed and unawned. Their size varies from 1.5 to 3.5 mm; it is fairly constant for some species, e.g. in *C. barberi* and *C. arcuatus*, spikelets are 1.5-2 mm long, but in *C. dactylon* the size varies from less than 2 mm to about 3 mm.

Involucral glumes: The relative size of the glumes and lemmas has been usefully employed in

the taxonomy of the genus *Cynodon* (Bor 1960 ; Hurcombe, loc. cit.). The lower glume is much smaller than the spikelet in all the Indian species (Figs. 2, 14, 27 & 38).

The upper glume is important as it protects the hyaline palea ; it varies from about half to a little more than the length of the lemma. Its size is almost constant within a species and has been employed to separate *C. barberi* from other Indian species ; in *C. barberi*, the upper glume is longer than or at least subequal to lemma (Fig. 14) ; in other Indian species it is about half the length of the lemma. Since in *C. barberi*, the upper glume is the longest part of the spikelet, it forms the apex of the spikelet and gives a distinct appearance to the spikelet (Fig. 14), and to the spike as a whole (Fig. 13).

Lemma : The lemma forms the body of the spikelet and conforms to the length of the spikelet in *C. arcuatus* and *C. dactylon*. The apex of the lemma in *C. dactylon* is generally described as truncate or mucronate. Actually it varies from almost rounded to a mucronate or minutely but distinctly aristate apex. In some specimens a fine mucro arises not quite from the tip but from a little below at the back of the lemma. The mucro is straight, incurved or sometimes recurved (Figs. 5a, b, c).

The ciliate hairs on the lemma and sometimes on palea (*C. barberi*) render very useful diagnostic character. They are always present on the keel and margins of the lemma. They show up after moistening the specimen with water or glycerine ; sometimes a little teasing with needle is necessary. Rarely has a spikelet been seen without any trace of hairs.

Four types of hairs have been observed in the Indian species of *Cynodon*. A magnification of 30-50 is required to see these distinctions.

The commonest type are the simple hairs, pointed or rounded, but not at all swollen at tips (Fig. 6). These are characteristic of *C. dactylon* ; these are sometimes present, mixed with the second and third type, on lemma of *C. arcuatus* also.

The second type are swollen near the end, i.e. have a roundish bulging near the tip. The swollen part is about 2 times as broad as the body of the hair ; the tip is again narrowed beyond the bulging (Fig. 31). This type is present in *C. arcuatus* and also in small numbers in some specimens of *C. dactylon*.

The third type of hairs gradually broaden from about middle to the tip, are rounded at the tip ; (rather club shaped) and are rare (Fig. 31). These

have been seen at the base of lemma in some specimens of *C. arcuatus* and *C. dactylon*.

It is worthy of note that specimens of *C. dactylon* with obtuse tipped lemma generally have only simple hairs ; those with aristate tips have a fair mixture of the third type of hairs, sometimes also of second type.

The fourth type of hairs are very distinctly clavellate, i.e. have a conspicuously broad and rounded or capitate tip. The swollen tip is abruptly 2-3 times broader than the body of the hairs (Fig. 18). These hairs distinguish *C. barberi* and are a sure test for that species. In those specimens of *C. barberi*, where upper glume is not distinctly longer (or even little shorter) than lemma, such clavellate hairs confirm the species.

Specimens of *C. dactylon* from hilly regions generally have fewer and shorter hairs on lemma.

Palea : The palea is membranous, linear oblong and 2-keeled (Figs. 7, 19, 24, 32 & 43). It is generally shorter than or subequal to lemma. It was found to be longer than the lemma in some specimens.

The two nerves of the palea are usually closer below and far apart above. The keels of the palea are scabrous and devoid of hairs, except in *C. barberi* (Fig. 24), in which clavellate hairs are always present on keels of palea.

Rhachilla : In all the Indian species the rhachilla is produced beyond the insertion of uppermost lemma ; its length varies from about $\frac{1}{3}$ to $\frac{2}{3}$ of the spikelet. It is concealed at the back of the palea between its two keels and is easily pushed out by a little pressure at the base of the palea. The rhachilla is sometimes crowned by a reduced floret or a rudimentary lemma.

Lodicules : There are two small, obovate, cuneate lodicules (Figs. 8, 20, 33 & 44) ; these are similar in all the species.

Androeceum : The anthers vary in size from about .5 mm to 1.75 mm. The size is constant within a species. The anthers are uniformly small (about .5 mm) in *C. barberi* (Fig. 22) and *C. arcuatus* (Fig. 35) and large (1-1.5 mm) in *C. dactylon* (Fig. 10).

Gynaeceum : The gynaeceum consists of a one-celled ovary, 2 styles and two plumose stigmas.

Presence of a second floret : The spikelets are 1-flowered, and the presence of only one fertile floret and absence of any imperfect floret above it

characterises the genus *Cynodon* (and distinguishes it from many genera of the tribe Chlorideae).

Exceptions to this rule have, however, been noticed and many spikelets with two fertile florets (Fig. 12) have been observed in some specimens [ASSAM: *Gustav Mann*? 1195; MADRAS: Kodaikanal, 7000 ft.—*Saulieres*, 1199; Nilgiris, 1834—*Perrottet* 1319; PAKISTAN: Peshawar—*Stewart* 4; CANARY—*Lemann*, *Dessvaux*; CENTRAL CHINA: Hupeh 1885-88—*Henry* 1365 (all CAL); Cherat, 4000 ft. 1892—*Collett* s.n. (DD)].

Occasional occurrence of such spikelets in which the rhachilla terminates in a second well-developed floret has been reported also by Stent (1927). Dr. N. L. Bor (in a personal communication) commented on such specimens thus: "Phylogenists explain this phenomenon as a throw back to the times when *Cynodon*, like most of the Chlorideae, was several-flowered and by reduction has now become one-flowered".

CYNODON Rich. ex Pers. nom. cons.

Cynodon Richard in Persoon, Synop. Pl. 1: 85, 1805; Dalzell & Gibson, Bomb. Fl. 297, 1861; Stewart, Punj. Pl. 253, 1869; Bentham & Hooker, Gen. Pl. 3: 1164, 1883; Duthie, Grass. N. W. India 32, 1883; Symonds, Grass. Indian Penin. 12, 1884; Duthie, Ill. Grass. N. W. India t. 33, 1886; Duthie, Fodd. Grass. N. India 52, 1888; Hooker, Fl. Br. India 7: 288, 1896; Lisboa, Bomb. Grass. 104, 1896; Collett, Fl. Siml. 620, 1902; Prain, Beng. Pl. 1227, 1903; Cooke, Fl. Bomb. 1032, 1908; Graham, Grass. Sedg. Nagpur & Telin. 40, 1913; Sedgwick, Grass. Ahmedabad & Surat 116, 1914; Achariyar & Mudaliyar, S. Indian Grass. 248, 1921; Haines, Bot. Bih. & Ori. 966, 1925; Thakkar, Pl. Kutch 293, 1926; Stent, *Bothalia* 2: 274-288, 1927; Bews, World's Grass. 184, 1929; Arber, Gram. 155, 1934; Fischer in Fl. Mad. 1835; 1934; Blatter & McCann, Bomb. Grass. 249; 1935; Caius, J. Bomb. nat. Hist. Soc. 38: 556, 1936; Bor in Fl. Ass. 5: 125, 1940; Bor, *Indian For. Rec.* n. s. Bot. 2: 110, 1941; Rhind, Grass. Burma 36, 1945; Stewart, *Brittonia* 5: 446, 1945; Hucrombe, J. S. Afr. Bot. 13: 107, 1947; Bailey, Man. Cult. Pl. 143, 1949; Wealth of India 2: 420, 1950; Bailey, Stand. Cycl. Hort. 2: 939, 1953; Santapau, *Rec. bot. Surv. India* 16: 349, 1953; Hubbard, Grass. 335, 1954; Raizada, *Indian For. Rec.* n.s. Bot. 4: 93, 1954; Tiwari, *Indian For.* 80: 681, 1954; Bharadwaja et al., *Agra Univ. J. Res. (Sci.)* 5: 295, 1956; Lanjouw, Int. Code Bot. Nom. 234,

1956; Majumdar, *Bull. bot. Soc. Beng.* 10: 37, 1956; Senaratna, Grass. Ceylon 90, 1956; Sakharan Rao, J. Bomb. nat. Hist. Soc. 54: 687, 1957; Whyte, Grassl. Fodd. Res. India 363, 1957; Mitra, Fl. Pl. East. India 1: 166, 1958; Bor, Grass. Burma, Ceylon, India & Pak. 468, 1960; Metcalfe, Anat. Monocot. 1: 123, 1960; Chase & Niles, Index Grass Spp. 1: 516, 1962; Maheshwari, Fl. Delhi 390, 1963; Puri et al., *Rec. bot. Surv. India* 19(1): 149, 1964; Jain, *Indian For.* 92: 201 and 699, 1966; Jain, *Kheti* 19: 39, 1966; Jain, *Bull. bot. Surv. India* 8: 204, 1966.

Panicum Linn. Sp. Pl. 58, 1753 pro parte; Graham, Cat. Pl. Bomb. 236, 1839.

Capriola Adans. Fam. Pl. 2: 31, 1763.

Dactylon Villars, Hist. Pl. Dauph. 2: 69, 1787.

Fibichia Koel, Gram. Gall. & Germ. 308, 1802.

Perennial grasses with creeping stolons; sometimes rhizomatous. Culms terete, erect or ascending, glabrous. Leaf-sheaths glabrescent, compressed and keeled or rounded. Ligule a rim of hairs or a small lacinate membrane. Leaf-blades flat or complicate, rigid or flaccid, generally glabrescent, margins more or less scaberulous. Spikelets all alike, laterally compressed, alternately 2-seriate, imbricate, not jointed at the base, 1-flowered, (rarely 2-flowered), secund on a slender rhachis, of which 2-8 are fascicled or umbelled to form the inflorescence. Rhachilla jointed above the glumes, produced or not beyond the lemma, sometimes bearing a rudimentary lemma. Glumes subequal, or upper longer, thin, keeled, acute or mucronate, persistent or separately deciduous (in Indian species the lower glume is generally sub-persistent and the upper deciduous with lemma). Lemma broader than the glumes, longer or shorter than the upper glume, firmly membranous, boat-shaped, 3-nerved, the lateral nerves close to the margins, keel ciliate, awnless. Palea 2-keeled, containing a bisexual floret. Lodicules 2, minute. Stamens 3. Styles 2, free. Grain oblong, free within the lemma and palea.

Chromosome numbers: $x = 9, 10$.

Type species: *Cynodon dactylon* (L.) Pers. (Basionym: *Panicum dactylon* L.)

A small genus of about 25 species mostly tropical, namely South Africa, South Asia and Australia; one species cosmopolitan.

SPECIES IN INDIA

Hooker (1896) recorded only one species *C. dactylon* (L.) Pers. Authors of the major regional floras follow Hooker.

Rangachari and Tadulingam (1916, 1918) critically examined the material of this genus at their disposal and described two new species namely, *C. barberi* Rang. et Tad. and *C. intermedius* Rang. et Tad., both from South India.

Later workers either did not notice the discovery of these two species or considered them to be confined to South India; they continued to label almost all their *Cynodon* material as *C. dactylon*. An examination of the material in the Central National Herbarium revealed that both the new species described from South India have much wider distribution (Jain 1966a) in India and were collected on several occasions from northern, central or eastern India, even as far back as 1864.

Cynodon intermedius Rang. et Tad. has been considered to be synonymous with *C. arcuatus* J. S. Presl ex C. B. Presl (Bor 1960).

One new form of the species *C. barberi* Rang. et Tad. viz. *C. barberi* f. *longifolius* Jain has recently been described (Jain 1966b).

C. plectostachyus Pilger, an African species, has been introduced into India for its value as a good pasture, hay and soil-binding grass. To facilitate its identification, it is included in the key; its detailed description and illustration are also provided.

KEY TO SPECIFIC AND INFRASPECIFIC TAXA OF *CYNODON*

Culms slender, creeping below, inflorescence of digitate or umbellate spikes; glumes as long as or shorter than (but not less than half) the lemma:

Rhizomes present; ligule a ring of white hairs; leaves generally with 5 primary nerves, rigid; spikes 2-6, upto 6 cm long; spikelets 2-3 mm long; hairs on lemma simple, not clavellate, rarely some hairs slightly thickened at apex; palea not hairy; anthers large, 1 mm or longer.....1. *C. dactylon*

Rhizomes absent; ligule membranous, its margins lacinate or not; leaves mostly with 7 primary nerves; spikelets about 2 mm long; hairs on lemma all or most of them always clavellate or distinctly globular at tip; anthers small, .5 mm long:

Leaf-sheaths short, compressed; ligule membranous, ciliate on margins; spikes usually 3-5, 2-5 cm long; upper glume slightly longer than or subequal to lemma; palea bearing hairs on keels, hairs on lemma long and dense, distinctly clavellate and globular at tip, not pointed at tip:

Leaf-sheaths sharply keeled, leaves usually 1-3.5 cm long, 3-4 mm broad, generally obtuse and spreading; flowering branches erect or ascending, 2.5-13 cm long.....2. *C. barberi* f. *barberi*

Leaf-sheaths lightly compressed; leaves 4-7 cm long, 2-3 mm broad, acute and pointed; flowering branches generally erect, 15-30 cm high.
3. *C. barberi* f. *longifolius*

Leaf-sheaths lightly compressed; ligule membranous, usually not ciliate on margins; spikes numerous,

4-8, 5-10 cm long, generally slender, flexuous; upper glume distinctly shorter than lemma; hairs on lemma gradually thickened towards tip and often again abruptly narrowed or pointed at apex, sometimes simple also mixed; palea devoid of hairs.....4. *C. arcuatus*

Culms stout, much branched; inflorescence of several whorls of spikes; glumes very short; lemma bristly on margins.

5. *C. plectostachyus*

Cynodon dactylon (L.) Persoon, Syn. Pl. 1: 85, 1805; Dalzell & Gibson, Bomb. Fl. 297, 1861; Stewart, Punj. Pl. 253, 1869; Duthie, Grass. N. W. India 32, 1883; Symonds, Grass. Indian Penin. 12, 1884; Duthie, Fodd. Grass. N. India 52, 1888; Hooker, Fl. Br. India 7: 288, 1896 (excl. synonym *C. filiformis* Voigt); Lisboa, Bomb. Grass. 104, 1896; Collett, Fl. Siml. 620, 1902; Prain, Beng. Pl. 1227, 1903; Cooke, Fl. Bomb. 1032, 1908; Sedgwick, Grass. Ahmedabad & Surat 116, 1914; Achariyar & Mudaliyar, S. Indian Grass. 250, 1921; Haines, Bot. Bih. & Ori. 966, 1925; Thakar, Pl. Kutch 293, 1926; Stent, *Bothalia* 2: 274, 1927; Bews, World's Grass. 184, 1929; Fischer in Fl. Mad. 1835, 1934; Blatter & McCann, Bomb. Grass. 249, 1935; Bor in Fl. Ass. 5: 125, 1940; Bor, *Indian For. Rec. n.s. Bot.* 2: 110, 1941; Rhind, Grass. Burma 36, 1945; Stewart, *Brittonia* 5: 446, 1945; Hurcombe, J. S. Afr. Bot. 13: 107, 1947; Wealth of India 2: 420, 1950; Bailey, Stand. Cycl. Hort. 2: 939, 1953; Santapau, *Rec. bot. Surv. India* 16(1): 349, 1953; Hubbard, Grass. 335, 1954; Raizada, *Indian For. Rec. n.s. Bot.* 4: 93, 1954; Tiwari, *Indian For.* 80: 681, 1954; Bharadwaja et al. *Agra Univ. J. Res. (Sci.)* 5: 295, 1956; Majumdar, *Bull. bot. Soc. Beng.* 10: 37, 1956; Senaratna, Grass. Ceylon 90, 1956; Sakharan Rao, *J. Bomb. nat. Hist. Soc.* 54: 687, 1957; Whyte, Grassl. Fodd. Res. India 363, 1957; Mitra, Fl. Pl. East. India 1: 166, 1958; Bor, Grass. Burma, Ceylon, India & Pak. 469, 1960; Metcalfe, Anat. Monocot. 1: 123, 1960; Chase & Niles, Index Grass Spp. 1: 516, 1962; Maheshwari, Fl. Delhi, 390, 1963; Puri et al., *Rec. bot. Surv. India* 19(1): 149, 1964; Jain, *Indian For.* 92: 201, 1966; Jain, *Kheti* 19: 39, 1966.

**Panicum dactylon* L. Sp. Pl. ed. 1, 58, 1753; Roxburgh, Fl. Indica 289, 1832.

Digitaria dactylon (L.) Scop. Fl. Carn. ed. 2, 1: 53, 1772.

*The type specimens of these plants are not available to the author, and the synonymy is adapted from Bor (1960),

Dactylon officinale Vill. Hist. Pl. Dauph. 2: 69, 1787.

Paspalum dactylon (L.) Lamk. Tab. Encycl. Meth. Bot. 1: 176, 1791.

Digitaria littoralis Salisb. Prodr. Stirp. 19, 1796.

Milium dactylon (L.) Moench, Meth. Pl. Suppl. 67, 1802.

Fibichia umbellata Koel. Descr. Gram. 308, 1802.

Digitaria stolonifera Schrad. Fl. Germ. 1: 165, 1806.

Cynodon maritimus H. B. K. Nov. Gen. et Sp. 1: 170, 1816.

C. tenuis Trin. in Spreng. Neue Entd. 2: 63, 1821.

Chloris cynodon Trin. Gram. Unifl. 229, 1824.

Digitaria maritima (H. B. K.) Spreng. Syst. Veg. 1: 272, 1825.

Cynodon erectus J. S. Presl ex C. B. Presl, Reb. Haenk. 1: 290, 1830.

Agrostis bermudiana Tussac ex Kunth, Enum. Pl. 1: 259, 1833.

A. filiformis Koen. ex Kunth, loc. cit. 261, 1833.

Cynodon occidentalis Willd. ex Steud. Nom. Bot. ed. 2, 1: 463, 1840.

C. portoricensis Willd. ex Steud. loc. cit. 463, 1840.

Carpriola dactylon (L.) O. Kuntze, Rev. Gen. Pl. 2: 764, 1891.

Etymology: Dactylon is from the Greek *dactylos*, i.e. finger, alluding to the shape of the inflorescence.

Vernacular names: As far as possible the local names have been taken from herbarium sheets or regional floras. The Hindi names are given first, followed by other Indian languages in alphabetical order; then follow the regional names.

Hindi: *Dub*, *Hariyali*, *Kalighas*, *Ramghas*; Assam: *Dooboribon*; Beng.: *Durba*, *Dubh*, *Dubla*; Kanar.: *Ambatehullu*, *Garikaihullu*, *Karkerihallu*, *Kudigarikai*; Konkani: *Jirbankure*; Mal.: *Karukapullu*; Marathi: *Harala*, *Hariyali*; Punjabi: *Barawa*, *Dhub*, *Khabbal*, *Talla*, *Tilla*; Sanskrit: *Bhargavi*, *Durva*, *Granthi*, *Haritali*, *Ouruha*, *Shutupurvika*, *Suhusruveerya*, *Sveta*; Tam.: *Arugampullu*, *Aruhampul*, *Hariyali*, *Mooyarpul*; Tel.: *Gerichagaddi*, *Gurka*, *Hariyali*, *Harvali*; Bihar: *Dhobighas*; Bombay: *Nilidub*; Madhya Pradesh: *Dhupsa*; Mysore: *Kuke nottu*.

A perennial grass, extensively creeping by scaly rhizomes or by strong flat stolons, forming matted tufts. Culms 5 to about 30 cm tall, decumbent, finally erect, slender, glabrous, smooth. Leaf-sheath smooth, rounded, generally bearded at mouth. Ligule a ring of white hairs. Leaf-blades often conspicuously distichous on lower parts of culm and

barren shoots, linear, folded, convolute or flat, 2-15 cm long, 2-3 mm wide, acuminate, rigid or flaccid, glaucous, glabrous or hairy, smooth on lower surface, scaberulous above, margins rough; primary nerves usually five, two on each side of the midrib. Inflorescence of generally (2)4-5(8), 2-6(10) cm long, smooth, digitate (rarely subdigitate) green or purplish spikes; peduncles smooth; rhachis tumid and pubescent at the base, compressed or angular, scaberulous. Spikelets 1.7-2.8 mm long, 1-flowered, awnless, laterally compressed, sessile in two rows on one side of the rhachis and appressed to it; rhachilla disarticulating above the glumes and produced beyond the palea as a slender naked bristle (sometimes bearing a rudimentary lemma or even a second fertile floret). Glumes subequal, distinctly shorter than lemma, lanceolate, acute to subulate mucronate, 1-nerved, 1.25-1.8 mm long, keels smooth or scabrid. Lemma firm, obliquely oblong to semi-ovate, subobtuse or apiculate, sometimes shortly aristate (arista incurved, straight or recurved), 1.7-2.5 mm long, strongly compressed, keeled, 3-nerved, lateral nerves close to the margins; keel ciliate. Hairs simple, not clavellate, long, sometimes scanty. Palea linear oblong, shorter than lemma (or sometimes slightly longer and protruded), obtuse, 2-nerved, 2-keeled, keels scaberulous, not hairy. Lodicules 2, cuneate. Stamens 3, anthers oblong, 1-1.5 mm long. Stigmas purple. Grain oblong, 1 mm long.

Chromosome numbers: $2n = 30, 36, 40$.

Illustrations: Figs. 1-12.

Symonds 1886, t. 1; Duthie 1886, t. 33 (habit, spikelet, androecium, gynaecium); Achariyar and Mudaliyar 1921, t. 190 (habit), t. 191 (racemes, spikelet, glumes, hairs, androecium, gynaecium); Stent 1927, 282, t. 1 (T. S. leaf); Bews 1929, 10, t. 3D (spikelet); Wealth of India 1950, 420, t. (habit); Hubbard 1954, 334 (habit, ligule, spikelet, glumes, lemma, palea, androecium, gynaecium, grain); Senaratna 1956, t. 12 (habit, spikelet); Bor 1960, 470, t. 52 (habit, raceme, glumes, lemma, palea); Metcalfe, 1960, t. XII, 4 (T. S. leaf); Jain 1966c (habit, spikelet, hairs on lemma).

Type locality: Southern Europe.

Distribution: *C. dactylon* is a cosmopolitan species mostly in tropical and temperate areas.

Critical note: Fischer (1934) had reduced *C. intermedium* Rang. et Tad. as variety of *C. dactylon*; the former is treated here as a species distinct from *C. dactylon*, but synonymous with *C. arcuatus* J. S. Presl ex C. B. Presl.

Haines (1924) described a new variety called *C. dactylon* var. *suberectus* Haines. One of the two specimens cited by Haines in the original description (Rajmahal Hills, Kurz, s.n.) has been carefully examined and found to be exactly same as the type specimen of *C. intermedius* Rang. et Tad.; it is therefore treated here as a synonym of *C. arcuatus* Presl.

Hooker (1896) has erroneously included *C. filiformis* Voigt in the synonyms of *C. dactylon* Pers.; *C. filiformis* Voigt is actually synonymous with *Chloris dolichostachya* Lagasca.

Fodder: *C. dactylon* is a very valuable pasture grass and remains green even during hot and dry period of the year. An old Punjabi proverb says "Aur ghas jal jayengi dub rahegi Khub", i.e. the dub grass will flourish even when other grasses will be burnt down.

The grass can be fed either green or can be made into hay. Four cuttings can be taken each year, each cutting of about 7-8 quintals per acre.

A comparison of its contents at different times of the year shows that protein, calcium and phosphoric acid, all remain conspicuously high, although P_2O_5 tends to fall off towards the hot summer months and at the end of the period when cold ensues (Sen 1952).

All cattle like this fodder grass; horses are particularly fond of it.

It is reported that, if allowed to wilt under certain conditions, this grass develops hydrocyanic acid, but the content is negligible.

Lawns: This is one of the best grasses, and thus far the commonest one used, for lawns. The grass forms spreading mats on the surface of the soil. It can be readily propagated by cuttings and rootings; root cuttings are best put in wet weather. Propagation is possible by seed also. Lawns made of this grass are generally smooth, and stand drought well; but they are susceptible to frost (Wealth of India, 1950).

Soil conservation and fertility: *C. dactylon* is a good soil binder and has been recommended for soil conservation work. It has a beneficial effect on soil moisture. Experiments (Mandal, 1955) have shown that if *C. dactylon* or a mixture of this grass and legumes were grown in the previous year in a field, the nitrogen content, soil moisture and yield of maize were much higher.

Medicine: The grass is reported to be useful in

piles, dysuria, diarrhoea, epilepsy, syphilis, cuts and wounds, etc. (Kirtikar & Basu 1935, Caius 1936).

Food: The seeds of the grass can be eaten in time of want (Bor 1940).

Mythology: *C. dactylon* is associated with several religious ceremonies and rites of the Hindus. Brahmins of South India consider it sacred and associate it with Ganesha. In North India, few branches of the grass held together or tied with a red thread, are used as a brush for applying vermillion, turmeric, curd, oil, etc. on the body of the bridegroom. In the Vedas, the grass is addressed thus: "May Durva (*C. dactylon*) which rose from the water of life, which has a hundred roots and a hundred stems, efface a hundred of my sins and prolong my existence on earth for a hundred years" (Lisboa 1896).

Weed: The grass sometimes tends to become a serious pest of cultivable lands and is difficult to eradicate. Deep ploughing and hand digging during hot weather, and exposure to sun have been found useful for checking its spread. It can also be eradicated by putting the land under wheat for one year.

Ecology: *C. dactylon* grows in a variety of habitats; it prefers heavy soil but occurs also on sandy soil. It is the first perennial grass to appear on bare sandy soils which have received some protection; it is later joined by *Dichanthium* species.

Grasslands dominated by *Cynodon* are a subtype of the *Dichanthium-Cenchrus* type, and under protection, the *Cynodon* grassland does eventually develop to *Dichanthium-Cenchrus* type (Whyte 1957).

Under the pressure of grazing, *Dichanthium*, which is preferred by cattle, is repeatedly ousted; *Cynodon* holds on and resists elimination; but once *Cynodon* is eliminated, the grassland retrogresses to *Sporobolus-Aristida* type. *C. dactylon* occurs also on Usar soils.

The grass fairly stands trampling and is abundant on roadsides and pathways.

Herbarium specimens examined: KASHMIR: Gilgit, July 1885—Giles 248 (CAL); Jhelum valley, 3000 ft., 12 July 1891—Gammie s.n. (DD); Andarbag, 26 Jan. 1914—Fuller 35986 (CAL); Patni Top, Kud, 12 Aug. 1958—Nanda 1519 (CAL); Chandigam, Lolab valley, 13 June 1959—Rao 9438 (BSD); Loc.?—Rao 765 (CAL). Jammu, Kishtwar, Doda, 5000 ft., 17 July 1956—G. Saran & party 30062 (LWG); Pathankot Road, 9 Aug. 1956—G. Saran & party 30267 (LWG). HIMACHAL PRADESH:

Kulu, Manali, 25 June 1950—*Jain & Bharadwaja* s.n., (DD 113252); Simla, Bashahr, Bahli, 7900 ft., 13 June 1952—*Puri* 21076 (DD 1123141); Bagh, 6000 ft., 26 May 1954—*Ram Singh* 12771 (LWG); Paonta, 22 Mar. 1957—*Rau* 1962 (BSD); Jeori, 24 May 1962—*Nair* 21792 (BSD). PUNJAB: Amritsar, 22 Mar. 1960—*Vohra* 11296 (BSD). Bhatinda, 11 May 1963—*Nair* 27735 (BSD). Ferozepore, Lambi, 21 Feb. 1963—*Nair* 26231 (BSD). Gurgaon, 21 Dec. 1959—*Rao* 8423, 11012 and 11021 (BSD). Hansi, 13 Feb. 1963—*Nair* 25885 (BSD); Hansi, 8 May 1963—*Nair* 26541 (BSD). Hissar, Budopal, 1 Mar. 1962—*Nair* 19829 (BSD); Sirsa, Oho Bridge, 30 Apr. 1962—*Nair* 21608 (BSD); Hissar, 14 Feb. 1963—*Nair* 25911 (BSD); Sirsa, Chakka Jheel, 17 Feb. 1963—*Nair* 26018 (BSD); Sirsa, 10 May 1963—*Nair* 26592, Hissar, *Coldstream* s.n. (BSIS). Jullundur, Laroha, Feb. 1954—*Bakshi* 21 (DD 130098). Ludhiana, 17 Jan. 1899—*Herb. R.E.P.* (BSIS 11683-4). Sangrur, Yamunanagar, 6 May 1963—*Nair* 27515 (BSD); Jind, 8 May 1963—*Nair* 26526 (BSD). DELHI: New Delhi, 27 July 1955—*Srivastava* 22670 (LWG). UTTAR PRADESH: Agra, Kitham, Sep. 1951—*Bharadwaja* s.n. (LWG 13145), 4 Jan. 1956—*Kaul & party* 24775 (LWG); Aligarh, Hasayam, 30 Nov. 1951—*Narayanwami* 222(a) (CAL); Delhi Road, 4 Apr. 1954—*Kaul & party* 7956 (LWG). Allahabad, 6 Feb. 1963—*Misra* 5348 (BSA). Bahraich, Haralsari, 28 Nov. 1954—*Srivastava* 16549 (LWG). Banda, 1901—*Bell* 122B (CAL). Bulandshahr, 10 May 1955—*Satyawati Devi* s.n. (LWG 12960); Lakhaoti, 18 Feb. 1962—*Singh* 19419 (BSD); Bulandshahr, 20 Feb. 1962—*Singh* 19475 (BSD). Dehra Dun, Mussoorie, Kamptee falls, 6100 ft., 25 May 1960—*Saxena* 658 (DD 136570); Dehra Dun, Rajpur Road, 15 Apr. 1961—*Bhattacharya* 13880 (BSD); Dehra Dun, Sahasradhara, 3 July 1963—*Malhotra* 28156 (BSD). Etawah, 3 Aug. 1866—*s.l.* (CAL). Hapur, Babugarh, 1882—*s.l.* 9 (CAL); Mahoba, 22 July 1962—*Malhotra* 22829 (BSD). Jaunpur, 1916—*Allen G* 3 (CAL); Varanasi Road, 6 Mar. 1956—*G. Saran & party* 25070 (LWG). Kanpur, 2 Dec. 1949—*Verma* 16 (LWG). Kheri, Gola, 30 Mar. 1898—*Inayat* 22904 (DD); Lakhimpur Kheri, Kutra, 18 Apr. 1956—*G. Saran & party* 26372 (LWG). Lucknow, 25 Mar. 1955—*Kapur* 15382 (LWG); 15 Nov. 1956—*Bharadwaja & Mallik* 37696 (LWG); Amausi, 30 July 1957—*Patil* 452 (BSA); Lucknow—*s.l.* 43 (CAL); *s.l. Rau* 3841 (BSA); Mathura, 11 Aug. 1955—*Raizada* 4/55 (DD). Mirzapur, 6 Nov. 1953—*Srivastava* 21635 (LWG). Nainital, 12 May 1954—

Mrs. Jain 9439 (LWG); Tiffin Top, 13 May 1954—*Jain* 9449 (LWG); Garhwal, Lal Dhang Nursery, 12 May 1956—*Kapur & Jhamman* 27069 (LWG); Ramnagar, 20 May 1956—*Kapur & Jhamman* 27500 (LWG); Haldwani, 24 May 1956—*Kapur & Jhamman* 27780 (LWG). Raibareilly, 15 Mar. 1956—*Saran & party* 25998 (LWG). Varanasi, 6 Mar. 1956—*Saran & party* 25117 (LWG); Sarnath, 8 Mar. 1956—*Saran & party* 25288 (LWG). Bundelkhand, 21 Dec. 1886—*Duthie* 6580/a (BSI). BIHAR: Chota Nagpur, Raidec, Sirgooja, 8 Nov. 1883—*Clarke* 34317 C & D (CAL). Hazaribagh, Charwa Dam, Dec. 1954—*Srivastava* 21165 (LWG); Koderma, 3 July 1956—*Chandra & party* 28036 (LWG). Manbhum—*Campbell* 7599 (CAL). Monghyr, Oct. 1891—*Mokim* 1391 (CAL). Patna, 10 Mar. 1956—*Srivastava & party* 25570 (LWG). ORISSA: Ganjam, Chilka Lake, Barkuda Island, Apr. 1920—*Carter* 1508 (CAL); Ganjam, Dec. 1949—*Wight* 3034; Khurda, 1889—*Walsch* s.n. (CAL). Koraput, Kondakamberu, 25 Apr. 1963—*Raju* 848 (CAL). Padampur, 29 Oct. 1959—*Panigrahi* 20573 (ASSAM). WEST BENGAL: Burdwan, 13 Oct. 1894—*Nusker* 1189 (CAL). Calcutta, 13 Sep. 1915—*Debbarman* s.n. (CAL). Darjeeling, Victoria Falls, 16 May 1956—*Nayar & party* 30634 & 30639 (LWG). Howrah, Sibpur—*Kurz* s.n. (BSI); Sibpur, Botanic Garden, 15 Apr. 1965—*Jain* 3178 (CAL). Purulia, Pathardhi, 18 Sep. 1963—*Chatterjee* 223 (CAL). Sunderbans, Mutlah, Dec. 1868—*Kurz* (CAL); Mutlah, 5 Apr. 1874—*Clarke* 21705-C (CAL); Matla, 2 Oct. 1894—*Mokim* 1239 (CAL). West Midnapore, Sushnigeria, 1953—*Ganguly's collector* s.n.; loc.?—*Kurz* s.n. (CAL); loc.? 1858—*Hooker & Thomson* s.n. (CAL). ASSAM AND E. HIMALAYAS: Agartala, 30 Sep. 1914—*Debbarman* 113 (CAL). Block Mountain Expedition, Oct. 1888—*Duthie* 7598 (CAL). Dibrugarh, 1 Jan. 1901—*Bourne* s.n. (BSI); Dibrugarh, 2 Jan. 1901—*Chatterji* s.n. (CAL); Khasi & Jaintia Hills, 1878—*Gallatly* 93 (CAL); Dumpep, 30 May 1911—*Burkill & Banerjee* 34277 (CAL); K. & J. Hills, 20 Nov. 1936—*Sarma* s.n. (ASSAM); Chariwar, on way to Kameng Frontier Division, 21 Mar. 1957—*Panigrahi* 5477 (ASSAM). Sibsagar, Apr. 1844—*Jenkins?* s.n. (CAL). Tezpor, Baliparah, 5 Jan. 1901—*Chatterjee* s.n. (CAL). Tripura, Anandbazar to Sekhar Tiangsang, 2 Feb. 1962—*Deb* 27410 (ASSAM). Sarbhanga river, 24 Apr. 1957—*Rolla* 7176 (ASSAM). Nepal, Pokhara, 13 Apr. 1954—*Stainton, Sykes & Williams* 2439 (CAL); Bhulikhola, south of Dhorpatan, 3 May

1954—*Stainton, Sykes & Williams* 423 (CAL); Jomson, north of Tukucha, 24 June 1954—*Stainton, Sykes & Williams* 1390 (CAL); Arun valley, Dhoje, north of Chainpur, 24 Apr. 1956—*Stainton* 119 (CAL). SIKKIM, Rishap, 4 Apr. 1902—*Prain* s.n. (CAL). RAJASTHAN: Ajmer, 20 July 1886—*Lawrie* s.n. (DD); Ajmer, 2 Mar. 1896—*Prain* s.n. (CAL). Jaipur, 23 July 1955—*Raizada* 14/55 (DD). Jaisalmer, Nov. 1917—*s.l.* 4192 (BLAT); Badabag, 21 Aug. 1957—*Puri* 23187 (BSI). Jodhpur, Feb.-Mar. 1868—*King* s.n. (CAL); Oct. 1917—*Blatter* 4906 (BLAT); Merta Road, 22 July 1956—*Hiralal & party* 34867 (LWG); Marwar, 1868—*King* s.n. (CAL). Kota, Shahabad, 13 Aug. 1963—*Verma* 657 (BSA). Merwara, Todgarh, Sep. 1884—*Lawrie* 4946 (DD). Sirohi, Mt. Abu, Oct. 1916—*s.l.* A 178 (BLAT); Mt. Abu, 31 July 1957—*Vasavada* 22656 (BSI); Abu Road, 17 July 1959—*Puri* 56912 (BSI); Sirohi, Matarmata, 24 Oct. 1960—*Rao* 2095 (CAL); Kotadi, 23 Aug. 1957—*Puri* 21967 (BSI); Losal, 19 May 1959—*Stower* 15 (BSI). GUJERAT: Ahmedabad, 17 Aug. 1957—*Puri* 23907 (BSI); near Dungarpur, 8 Apr. 1954—*Kaul & party* 8623 (LWG). Banaskantha, May 1957—*Agric. Officer* s.n. (BSI). Bhavnagar, 11 Apr. 1954—*Kaul & party* 8749 (LWG); 14 May 1957—*Jain* 17965 (BSI). Broach, riverbed, 18 Mar. 1956—*Shah* 6988 (BLAT); Broach, 7 May 1957—*Jain* 17588 (BSI). Jamnagar, 17 July 1957—*Puri* 22072 (BSI). Junagadh, Dec. 1907—*Blatter* 3785 (BLAT). Kaira, Nadiad, 25 July 1957—*Toor* 14233 (BSI); Nadiad, 21 Sep. 1957—*Jain* 24307 (BSI). Mehsana, 28 Jan. 1957—*Mahajan*, 11283 (BSI). Rajkot, 20 Aug. 1952—*Bole* 526 (BLAT); Rajkot, 21 Oct. 1953—*Santapau* 16899 (BLAT); Rajkot, 21 Aug. 1957—*Albertson* 18045. Railam, Salakhedi, 15 Nov. 1957—*Vasavada* 27576 (BSI). Surat, Tapti bank, 2 May 1957—*Jain* 17203 (BSI); Dahej, 9 May 1957—*Jain* 17740 (BSI); Dumas, 13 Oct. 1957—*Toor* 25482 (BSI). Surendranagar, 5 Feb. 1957—*Jain* 11836 (BSI). Cutch, loc.?—*Stolizka* s.n. (CAL). Porbunder road, near Shavantirth, 18 Apr. 1954—*Kaul & party* 9153 (LWG). MADHYA PRADESH: Berar, 1892—*Dickinson* 33 (DD). Guna, *King* s.n. (CAL). Gwalior, Mar. 1890—*Maries* 293 (CAL). Khandwa, Sendwal, 17 Dec. 1888—*Duthie* 8495 (CAL). Mandla, 12 Feb. 1961—*Joseph* 12280 (MH). Rewa, 11 Feb. 1959—*Sebastine* 7709 (MH). Seoni, Korai Range, 15 Mar. 1915—*Div. Forest Off.* Saugor 24 (DD 12848); Dasan River Bank, 11 Nov. 1962—*Panigrahi* 5728 (BSA). Bagh Caves, 30 Dec. 1954—*Kaul & party* 18047 (LWG). MAHARASHTRA:

Bombay, July 1916—*McCann* 4234 (BLAT); Bombay, Tardeo, Mar. 1917—*Hallberg* 5397 (BLAT); Bombay, Aug. 1918—*McCann* A 180; (BLAT); Borivli, 28 Oct. 1952—*Fernandez* R 974 (BLAT); Juhu, 27 Dec. 1953—*Kaul & party* 6126 (LWG), 18 Apr. 1955—*Jain* 22268 (LWG); Mumbra, 13 July 1954—*Shenoy* 3767 (BLAT); Palgarh, Mahim, 5 Apr. 1959—*Toor* 51707 (BSI); Borivli, 30 June 1961—*Rolla* 32713 (BSI); Trombay, 26 Aug. 1961—*Shah* 10391 (BLAT). Chanda, Chimir, 9 Dec. 1889—*Duthie* 9926? (DD). Dhulia, Nandurbar, Ashta, 5 Jan. 1957—*Jain* 11044 (BSI); Nardana, 24 July 1959—*Jain* 56857 (BSI). Khandesh, Bor, Dec. 1916—*Blatter & Hallberg* 5482 (BLAT); Laling, 7 July 1956—*Mahajan* 4277 (BSI); Dedar Lake, 9 July 1956—*Mahajan* 4401 (BSI); Erandol, 19 Aug. 1956—*Mahajan* 6431 (BSI); Raver, 13 Mar. 1957—*Mahajan* 13269 (BSI); Laling, 18 July 1957—*Mahajan* 20522 (BSI). Kolhapur, Radhanagri—*Puri* 20148 (BSI). Nagpur, Maharajbagh, 9 Jan. 1962—*Agrawal* 30 (CAL). Nasik, Yeola, 10 Sep. 1906—*Mamlatdar of Yeola* s.n. (BSI); Deolali, Sep. 1917—*s.l.* 4570 (BLAT). Poona, Kirkee, 21 July 1902—*Garade* 587 (BSI); Khandala, June 1917—*s.l.* 27938 (BLAT); Purandhar, Dec. 1917—*s.l.* 5026 (BLAT); Dhond, 6 Sep. 1956—*Jain* 6124 (BSI); Walhe, 30 Sep. 1956—*Jain* 6587 (BSI); Toka Pravar-Sangam, 5 Nov. 1960—*Rolla* 68558 (BSI). Satara Mahabaleshwar, 4 Apr. 1956—*Puri* 184 (BSI); Mahabaleshwar, 7 May 1961—*Rolla* 71671 (BSI). Thana, Kanheri, 8 May 1903—*Gammie* 16268 (BSI). ANDHRA PRADESH: Godavari, Mandupata, 17 Mar. 1902—*Barber* 4275 (MH); Dwarapudi, 3 Apr. 1902—*Barber* 4308 (MH); Kovuur, 17 Apr. 1902—*Barber* 4335 (CAL); Jhummagaddi Lanka, 1 May 1902—*s.l.* 4348 (MH); Bicavole, 7 July 1902—*Barber* 4373 (MH); Gobanapalam, 25 Jan. 1958—*Subramanyam* 5156 (MH). Hyderabad, Adikmet, 19 Aug. 1940—*Suxena* 275 (DD 88028); Hyderabad, Dec. 1953—*Kaul & party*, s.n. (LWG); Golconda Fort, 2 Jan. 1954—*Kaul & party*, 6523 (LWG); Bolavaram. Kondrukota, 8 Mar. 1962—*Raju* 153 (CAL); Karimnagar, Kodimial, 17 July 1964—*Subbarao* 20078 (MH); Nagarjunakonda valley, 13 July 1961—*Thothathri* 9637 (CAL). Vishakhapatnam, Anantgiri—*Subbarao* 19465 (MH). Warangal, Pakhal, 2 Mar. 1963—*Henry* 15976 (MH). Sind Circle, 10 Feb. 1905—*Herb. R.E.P.* 24141 (BSIS). MYSORE: Belgaum, *s.l.* s.n. (CAL). Bellary, Bellary Farm, Dec. 1904—*Barber* 6578 (MH); Kottur, 12 Oct. 1919—*s.l.* 15965 (MH); Hampi, 14 Oct. 1919—*s.l.* 15992 (MH); Paramadravanahallu,

26 Nov. 1902—*Burkill* 17667 (BSIS). Bijapur, 27 July 1957—*Jain* 20604 (BSI). Dharwar, 2 Jan. 18...? —*Talbot* 2237 (BSI); Dharwar—*Sedgwick* A 176 (BLAT). Goa, Valpoi, 2 May 1963—*Kanodia* 88371 (BSI). North Kanara, Sirsi, 9 Nov. 1950—*Fernandez* J. F. 1740 (BLAT); Yellapur, 27 Apr. 1956—*Mahajan* 1470 (BSI). Shimoga, Gersoppa Falls, 17 May 1911—*Chibber*, s.n. (BSI). Mysore & Karnatic, loc.?—*G. Thomson* s.n. (CAL). MADRAS: Chittoor, 9 Oct. 1902—*Barber* 4898 (MH); Chittoor, Vayalpad, 7 May 1918—*s.l.* 15486 (MH). Coimbatore, 9 Aug. 1902—*Barber* 4450 (MH); Hassanur, 10 Mar. 1931—*Jacob* 242 (MH); Udumalpet, 20 Nov. 1931—*Narayan & Naganath* 6156 (MH); on way to Varapalayam, 666 m, 13 July 1956—*Subramanyam* 251 (CAL); Coimbatore, 22 June 1957—*Subramanyam* 3517 (MH). Nilgiri, loc.?—*Schmidt* s.n. (CAL); Nilgiris—*Perrottet* s.n. (DD 136870). Pulneys, Kodaikanal Ghat, 11 July 1898—*Bourne* 1048 (CAL); Tandigudi, 24 May 1899—*Bourne* 3151 (CAL). Tanjore, Point Calimere, 23 Jan. 1961—*Ellis* 11846 (MH). Tinnevely, Mundanthurai, 13 July 1959—*Sebastine* 8542 (MH). Vijayawada, Aug. 1954—*s.l.* 51 (CAL). Peninsular Indiae Orientalis, loc.?—*Wight* 3311 (CAL). ANDAMANS: Nop Island—*Kurz* s.n. (CAL).

Cynodon barberi Rangachari et Tadulingam, *J. Bomb. nat. Hist. Soc.* 24: 846, 1916; Achariyar & Mudaliyar, *S. Indian Grass*. 255, 1921; Fischer in *Fl. Mad.* 1835, 1934; Senaratna, *Grass. Ceylon* 91, 1956; Sakharan Rao, *J. Bomb. nat. Hist. Soc.* 54: 687, 1957; Bor, *Grass. Burma, Ceylon, India & Pak.* 469, 1960; Chase & Niles, *Index Grass Spp.* 1: 516, 1962; Jain, *Indian For.* 92: 201 and 699, 1966; Jain, *Kheti* 19: 39, 1966; Jain, *Bull. bot. Surv. India* 8: 204, 1966.

Etymology: The specific epithet is given in honour of Dr. C. A. Barber.

Vernacular name: Uttar Pradesh: *Khati Dobb*.

A perennial grass. Culms radiately creeping close to the ground, 30-60 cm long, rooting at the nodes, producing several branches from each node; flowering branches erect or ascending, 2.5-1.5 (20) cm high; internodes 2.5-6.5 cm, slightly flattened, pale green or purplish. Leaf sheaths short, strongly compressed, almost keeled, smooth, hairy at mouth. Ligule a narrow membrane with lacinate edge. Leaf-blades flat, narrowly oblong to lanceolate, 1-3.5 cm long, 3-4 mm broad, obtuse or subacute, scaberrulous above, more so along the margins; primary nerves on leaves usually 7. Inflorescence of 3-5,

slender, digitate, 2-4 cm long, erect or spreading spikes borne on the ends of their peduncles; rhachis slightly angular. Spikelets 1.5-2 mm long, 1-flowered, awnless, laterally compressed, sessile or obscurely pedicelled, imbricate, alternately 2-seriate on ventral side of the rhachis and appressed to it; rhachilla disarticulating above the glumes and produced into a bristle behind the palea, about $\frac{1}{4}$ to $\frac{3}{4}$ the size of spikelet, with or without a minute pale membranous lemma. Glumes distinctly unequal, lanceolate, narrow, keeled with a strong keen nerve, keel shortly scabrid; lower glume 1.25-1.5 mm long, acute; upper glume 2 mm long, acuminate, slightly longer than or equal to the lemma. Lemma with a complete flower, pale, subchartaceous, boat-shaped, obliquely oblong to ovate, subacute, truncate or 2-toothed with a minute mucro in between, 3-nerved, nerves pale (not green as in *C. dactylon*), one median and two marginal, not prominent, keel and margins densely pilose with distinctly and characteristically clavellate hairs. Palea firmly membranous, equal to or slightly smaller than lemma, linear oblong, 2-nerved, 2-keeled, densely hairy with clavellate hairs along keel; margins glabrous. Lodicules 2, small. Stamens 3, anthers 4-5 mm long, filaments about same length or shorter. Ovary glabrous, style distinct, stigmas feathery. Grain oblong, free within the glumes, smooth, pale, transparent, obscurely trigonous; the embryo sac $\frac{1}{4}$ to $\frac{1}{2}$ of the grain.

Illustrations: Figs. 13-25.

Rangachari & Tadulingam 1916, t. 1 (habit), t. 2 (raceme, spikelet, androeceum, gynaeceum, clavellate hairs, grain, lodicules); Achariyar & Mudaliyar 1921, t. 194 (habit, ligule), t. 195 (raceme, spikelet, glumes, hairs, androeceum, gynaeceum); Jain 1966c t. 3 (habit, spikelet, leaf, hairs).

Type locality: South India.

Type specimen: Lectotype—South India Flora No. 13715, loc. Agricultural College, Central Farm, Coimbatore, Aug. 1916 (CAL), (Jain, 1966d).

Distribution: *C. barberi* occurs in Rajasthan, Uttar Pradesh, Bihar, Orissa, Bengal, Andhra Pradesh, Madras, Kerala, Mysore and Laccadive group of Islands; it has also been found to occur in Burma (Jain 1966a).

Economic use: It is a good pasture grass (Sakharan Rao 1957).

Herbarium specimens examined: RAJASTHAN: Mandheera, 5 Aug. 1959—*Khisti* 59909 (BSI 29369); Nakakota, 12 Aug. 1963—*Verma* 435 (BSA 4304-5). UTTAR PRADESH: Pilibhit, Mahofe, 590 ft., 27 Aug.

1916—*Gulabrai* 20 (DD 19405). MADHYA PRADESH: Raipur, Sep. 1959—*Bot. Dept. Sci. Coll. Raipur* No. 11 (DD 131936); Sidhi, Paharadam, 13 Nov. 1962—*Panigrahi* 5837 (BSA 1555), BIHAR: Dumka, Baidyanath, 10 Oct. 1894—*Nusker* 1279 (CAL). WEST BENGAL: Burdwan, Bagila, 14 July 1964—*Dutt* 462; Midnapore, Araberi, 28 July 1955—*Ganguly's collector* 30 (CAL); Gopedanga—*Ganguly's collector* s.n. (CAL 1797); Raniganj, 11 Oct. 1894—*Nusker* 1159 (BSI). ANDHRA PRADESH: Cuddapah, *Naidu* G 18. Godavari, Samalkota, 24 Aug. 1902—*Barber* 4469 (Syntype MH 57730); Samalkota, 9 Jan. 1917—*s.l. S. Indian Flora* 14169 (MH 57701). Kistna, Bezwada, 28 July 1907—*Barber* 7965 (MH 84313); Mylavaram, 4 Aug. 1907—*Barber* 8145 (MH 84319). MADRAS: Chingleput, Vandulur, 25 Oct. 1914—*Rangachariar* 11119 (Syntype MH 95731); Sithampur, 28 Oct. 1914—*Rangachariar* 11203 (Syntype MH 57702); Uragam, 19 Dec. 1916—*s.l. S. Indian Flora* 14075 (MH 57723); Sembarampakam, 17 Sep. 1917—*s.l. S. Indian Flora* 14842 (MH 57725). Coimbatore, Aug. 1916—*Tadulingam* s.n. (Syntype, BSI); Coimbatore, Agric. Coll. Central Farm, Aug. 1916—*Tadulingam* 13715 (Lectotype and Isolectotype, CAL); Hassanur, 20 June 1929—*Jacob* 18540 (MH 82574). Salem, Krishnagiri, 27 Dec. 1916—*s.l. S. Indian Flora* 13870 (MH 57708). Tinnevely, Palamcottah, 11 May 1901—*Barber* 2726 (Syntype MH 57705); Mahendragiri hills, Tirukarangudi, 18 Sep. 1916—*s.l. S. Indian Flora* 13256 (MH 57718); Nilgiri, 1818-1835—*Schmidt* s.n. (CAL). MYSORE: North Kanara, Hulial, Aug. 1888—*Talbot* s.n. (BSI). LACCADIVE, MINICOY & AMINDIVI ISLANDS: Kalpeni Island, Nov. 1889—*Dr. Alcock* s.n. (CAL).

Cynodon barberi Rangachari et Tadulingam f. ***longifolius*** Jain, *Indian For.* 92: 699, 1966.

Etymology: The epithet *longifolius* refers to long leaves.

It differs from *Cynodon barberi* Rang. et Tad. f. *barberi* in having slender, pointed, much longer and narrower acute leaves, and longer (15-30 cm long) flowering branches.

Type locality: Orissa.

Type specimen: Holotype—Orissa, near Puri, 1889—*Dr. J. H. J. Walsh* s.n. (CAL).

Distribution: Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh and Madras in India.

Herbarium specimens examined: UTTAR PRADESH: Lucknow, Arjunanj, 1 Aug. 1950—*Ram Singh* 1111 (LWG); Kanpur, Botanic Garden, 20 Aug. 1951—*Janki Prasad* 2728 (LWG). BIHAR: Chai-

basa, rains 1898—*s.l. s.n. (CAL)*. ORISSA: Puri, 1889—*J.H.J. Walsh*, s.n. (CAL); Chatrapur, Parlakimedi, Sep. 1903—*Grant, Candler & Burkill* 20584 (BSIS). WEST BENGAL: Bankura, Adhkata, 20 July 1955—*Ganguly* s.n. (CAL 1798). ANDHRA PRADESH: Nagarjunakonda valley, 15 July 1961—*Thothathri* 9683 (CAL); Chittoor, Panappakkam, 25 Dec. 1918—*S. India Flora* 15789 (MH 57695). MADRAS: Tinnevely, Mahendragiri, 17 Sep. 1916—*S. India Flora* 13197 (MH 57714); Mudaliarutta, Srivilliputtur, 19 Sep. 1917—*S. India Flora* 15037 (MH 57697); Madras Presidency, precise loc.? *Ramaswami* 541 (CAL); Madras Central Leather Research Institute—*G. Saran & party* 39042 (LWG).

Cynodon arcuatus J. S. Presl ex C. B. Presl Rel. Haenk. 1: 290, 1830; Bor, Grass, Burma, Ceylon, India & Pak. 469, 1960; Chase & Niles, Index Grass Spp. 1: 516, 1962; Jain, *Indian For.* 92: 201, 1966; Jain, *Kheti* 19: 39, 1966; Jain, *Bull. bot. Surv. India* 8: 204, 1966.

Cynodon intermedius Rang. et Tad. in *J. Bomb. nat. Hist. Soc.* 26: 304, 1918; Achariyar & Mudaliyar, *S. Indian Grass* 252, 1921; Chase & Niles, Index Grass Spp. 1: 518, 1962.

C. dactylon (L.) Pers. var. *suberectus* Haines, Bot. Bih. & Ori. 967, 1925; Chase and Niles, Index Grass Spp. 1: 517, 1962.

C. dactylon (L.) Pers. var. *intermedius* (Rang. et Tad.) Fischer in Fl. Mad. 1835, 1934; Rhind Grass. Burma 36, 1945; Senaratna, Grass. Ceyl. 90, 1956; Chase and Niles, Index Grass Spp. 1: 517, 1962.

Etymology: The specific epithet *intermedius* was given by Rangachari and Tadulingam as these authors considered the characters of this grass to be intermediate between *C. dactylon* and *C. barberi*; *C. arcuatus* refers to flexuous bow-like spikes.

Haines assigned the name *suberectus* to his variety due to the nearly erect habit of the grass.

Vernacular name: Hindi-Siuri.

A widely creeping perennial. Culms slender, glabrous, often stoloniferous, not rhizomatous, leafy, with slender or geniculately ascending flowering branches, 30-45 cm high; nodes slightly swollen, glabrous or purplish. Leaf-sheath slightly compressed, smooth, glabrous, scarcely bearded at mouth. Ligule membranous, sometimes shortly ciliate. Leaf-blade linear, flat, 2-10 cm long, 4-6 mm broad, acuminate, smooth, except on midrib below, scaberrulous on margins; primary nerves usually 7 (3 on each side of the midrib), rarely 5 or 9. Inflorescence of (4) 5-6 (8) thin, slender, 5-10 cm long, slightly

drooping and flexuous digitate spikes; peduncle smooth, rhachis tumid and pubescent at base, somewhat compressed, scaberulous. *Spikelets* 1.5-2 mm long, 1-flowered, awnless, narrow, sessile in two rows on the side of the rhachis and appressed to it; rhachilla produced to about half the length of the spikelet as a slender naked bristle behind the palea. *Glumes* unequal, about 1 mm long, shorter than lemma, lower glume lanceolate, acute or acuminate, 1-nerved, its keel obscurely scabrid; upper glume longer, similar in shape. *Lemma* firm, longer than glumes, obliquely ovate oblong, chartaceous, obtuse or subacute, 3-nerved; margins and keel with close-set hairs. *Hairs* swollen towards tips and again pointed at apex, or gradually thickened from middle to the tip, or faintly clavellate (not as distinctly globular or capitate at tips as in *C. barberi*). *Palea* chartaceous, linear oblong, 2-nerved, 2-keeled, keels scaberulous, without hairs. *Lodicules* 2. *Stamens* 3, anthers .5 mm long. *Ovary* with purple stigmas. *Grain* oblong, reddish brown, with a faint dorsal groove.

Illustrations: Figs. 26-36.

Rangachari and Tadulingam 1918 t. 1 (habit), t. 2 (racemes, spikelet, glumes, lemma, palea, hairs, lodicules, androecium, gynaeceum, grain); Achariyar and Mudaliyar 1921 t. 192 (habit) t. 193 (raceme, spikelets, glumes, hairs, androecium, gynaeceum); Jain 1966, c t. 2 (habit, spikelet, leaf, hairs).

Type locality: Luzon in Philippine islands.

Two taxa under the genus *Cynodon* described from India, and now considered synonymous with *C. arcuatus* Presl namely, *C. intermedius* Rang. et Tad., and *C. dactylon* var. *suberectus* Haines have their type locality in Madras and Bihar respectively.

Type specimens: Lectotype for *C. intermedius* Rang. et Tad. has been selected by Jain (1966d); it is *S. India Flora* No. 13259, loc. Mahendragiri Hills, Tinnevely Dt., 18 Sep. 1916, (MH 57732). Syntypes of *C. intermedius* are also deposited in Coimbatore herbarium (MH 57734, 58704 and 84322).

Distribution: India, in the States of Uttar Pradesh, Bihar, Orissa, Bengal, Assam, Madhya Pradesh, Maharashtra, Andhra Pradesh, Madras, Kerala, Mysore and Nicobar islands and in Nepal, Burma and other parts of south-east Asia.

Economic uses: Cattle are very fond of this grass; it is readily eaten by them.

Herbarium specimens examined: UTTAR PRADESH: Gonda, Jarawa—Chandra & party s.n., (LWG 13033); Bankalva Range, Aug. 1939—Balesh-

war Prasad 17 (DD 82804); Birpur & Marni block, Bhambhar Range, 18 Sep. 1911—D. F. O. Gonda 19 (DD 3531); Nainital, Ramnagar, 21 May 1956—Kapur & Jhamman 27526 (LWG); Pilibhit, by side of river—Hiralal 2040 (LWG). BIHAR: Dumka, Baidyanath, 7 Oct. 1894—Nusker 1171 (CAL); Rajmahal Hills, South of Sahibganj, Oct. 1870—Kurz s.n. (CAL); * Parasnath Hills, 25 Sep. 1954—Srivastava 20762 (LWG). ORISSA: Khurda, 1889—Walsh s.n. (CAL); S. Kalahandi, Gunpur, 2400 ft., 19 July 1949—Mooney 3541 (DD 104403). Rampur State, 22 Aug. 1946—Mooney 2695 (CAL); Mahendragiri, 1000 ft.—Saran & party 38323 (LWG). BENGAL: Burdwan, 24 Oct. 1894—Nusker 1180 (CAL); Howrah, Sibpur, Oct. 1864—Kurz s.n. (CAL); Howrah, 2 Oct. 1894—Nusker 1285 (CAL); Bamunara, 22 Aug. 1955—J. Ganguly's Collector s.n. (CAL 1795). ASSAM: loc.? s.l.—Herb. Wight (CAL); Khaseah, 1899, s.l. (CAL). NEPAL: Mayangdi Khola, 5 Sep. 1954—Stainton, Sykes & Williams 4179 (CAL 7412). MADHYA PRADESH: Bastar, Bailadilla, 5 Oct. 1940—Mooney 1435 (DD 87362); Bailadilla, 17 Feb. 1963—Panigrahi & Arora 1066 (BSA 6596 and 8059); Hoshangabad, Central Farms, 22 Sep. 1956—Hiralal & party 32812 (LWG). ANDHRA PRADESH: Godavary Gorge, 5 Jan. 1902—Bourne 3484 (CAL); Gokhavaram, 4 Sep. 1907—Barber 8262 (MH 84322); Rampa, Devarapalli, 2 Oct. 1920—Narayanaswami 395 (CAL); Warangal, Pakhal, 28 Feb. 1963—Henry 15960 (MH 31416). MAHARASHTRA: Bhandara, 2 Dec. 1957—Nanda 1330 (DD). Chanda 1 Feb. 1890—Duthie 9926 (CAL); S. Chanda, Allapadi, 8 Dec. 1957—Sethi & Negi 25666 (DD 125328). MADRAS: Coimbatore, Anamalais, 24 Feb. 1942—S. R. Raju 20283 (MH 86363); Nilgiris, Kallar, Dec. 1917—*S. India Flora* 13988 (MH 58704). Tinnevely, Mahendragiri Hills—(MH 57732 & 57734). Vellore (N. Arcot), Kuttathur to Puliur, 10 Sep. 1958—Subramanyam 6529 (MH 12774). MYSORE: Bisle, 5 Jan. 1957—Mahajan 19831 (BSI). KERALA: Travancore, Naduvathumuzhi, 25 Aug. 1913—Rama Rao 1439 (CAL); Travancore, Aug.-Sep. 1913—Caldar & Narayanaswami 175 (CAL). NICOBAR ISLANDS: Kamorta—Kurz s.n. (CAL); loc.? Kurz s.n. (CAL).

Cynodon plectostachyus (K. Schum.) Pilger in Engler's Bot. Jahrb. 40: 82, 1907; Stent, *Bothalia* 2:

*This in all probability, is the collection cited by Haines for his new variety *Cynodon dactylon* (L.) Pers. var. *suberectus* Haines.

281, 1927; Wealth of India 2: 421, 1950; Senaratna, Grass. Ceylon 91, 1956; Whyte, Grassl. Fodd. Res. India 357, 1957; Bor, Grass. Burma, Ceylon, India and Pak. 471, 1960; Chase & Niles, Index Grass Spp. 1: 518, 1962.

Leptochloa plectostachya K. Schum. ex Pilger Pflanzenr. Ost.-Afr. C. 112, 1895.

Etymology: The specific name seems to refer to the whorled spikes.

Common names: Stargrass, Giant stargrass.

A perennial grass with long, prostrate running stems, forming dense matted tufts. *Flowering culms* generally about 50 cm high, but often over 1 metre high, generally branched, terete, glabrous smooth, striate, 2 to many-noded; internodes included or shortly exserted. *Leaf-sheaths* finely striate, sparsely tubercular and hairy, more densely so towards the margins. *Ligule* membranous, upto about 4 mm long. *Leaf-blades* linear, tapering to a fine setaceous point, flaccid, flat, 3-6 mm wide by about 18 cm long, finely tubercular hairy on both sides, midrib fine and prominent, keeled in the lower part of the blade and with three primary and 16-18 secondary nerves on either side of the midrib. *Inflorescence* of 5-12 spikes; spikes whorled, binate or scattered on an elongated axis, often with one spike some distance below the first whorl; rhachis narrow, keeled, scabrid, minutely spinously ciliate along the margins, bearing spikelets from the base. *Spikelets* 2.5-3 mm long; 1-flowered, awnless, laterally compressed, sessile, in two rows on one side of the rhachis and appressed to it, rhachilla not produced beyond the palea. *Glumes* very small, with coarsely scabrid stout keels and minutely but rigidly ciliate margins, lower about 0.3 mm long, upper 0.6 mm long. *Lemma* stoutly keeled, not winged, keel rigidly ciliate and produced into a short mucro, minutely pubescent on the back towards the margins. *Palea* equalling or slightly exceeding the lemma, 2-keeled, minutely pubescent between the minutely pectinate scabrid keels. *Lodicules* small, cuncate. *Stamens** 3, anthers 1.5 mm long. *Stigmas* plumose from middle. *Grain* linear oblong.

Illustrations: Figs. 37-46. Stent 1927, 281, t. 6 (T. S. leaf); Pole-Evans 1939, 34 (habit); Sena 1942, 421 (habit); Jain 1966 c, t. 4 (habit, spikelet, leaf hairs).

Type locality: East Africa.

Distribution. Kenya and Tanganyika; now introduced into several parts of the world including India.

Fodder: *Cynodon plectostachyus* has been introduced into India for fodder. The property of very fast growth of this grass was first observed by Pole-Evans (1939), who chose to call it a 'leviathan' (monster). The first growth trials on this grass in India were done in 1940 (Sen 1942).

It establishes well under irrigated and rain-fed conditions and thrives well in plains or hilly regions with a rainfall between 600-2500 mm. Usually it is not manured. It is generally propagated by cuttings and root stock or slips, but can be raised from seed also. Slips are planted on a well-prepared seed-bed and 40-45 cm apart on either side, either at the start of the rainy season, or with irrigation facilities at any time of the year.

The first cut is ready after about three and a half months and subsequent cuttings are taken every two months. Under average (rather dry) conditions the yield is 15,000-30,000 kg of green fodder per acre in 3-4 cuts.

The grass is mainly used as pasture but may also be cut and fed as green fodder or made into hay. The grass contains 10% protein and is also rich in CaO and P₂O₅ (0.8 and 0.5% respectively). The values for digestible nutrients per 100 pounds of hay of this grass are: crude protein 2.39; carbohydrates 43.08; ether extract 0.51; nutritive ratio 18.00; starch equivalent 21.9. The results of digestibility trials show that mature grass hay by itself could maintain cattle. Cattle relish this grass.

The grass has been reported to contain hydrocyanic acid at all stages of its growth, (Senaratna 1956) but the HCN content remains well below toxic limits; toxicity does not increase even in its wilted state (Shiva Rau & Chandrasekaran 1947).

Soil conservation: The grass is useful also for controlling soil erosion; its growth is very rapid and vigorous.

In one experiment, 8 seedlings of this grass covered, in four months, an area of over 20 sq. m. It is used on railway embankments and on earthen dams.

Ecology: The grass is well adapted to dry as well as irrigated conditions and grows well at all altitudes upto about 1700 m; it does well on alluvial soils.

*Not seen in our specimen.

INTERSPECIFIC RELATIONSHIP

Only three species of the genus *Cynodon* are indigenous to India; and it is a small number for making any phylogenetic interpretations. However, basing our observations on some obvious morphological characters, certain tentative suggestions can be made. The following morphological characters have been taken into account in the discussion of phylogenetic relationship: these are the characters (in addition to several others) utilised also by Bews (1927) and Rominger (1962) in the interpretation of phylogeny in Gramineae.

Primitive	Advanced
Perennials with rhizomes	Annuals
Leaf-sheath not conspicuously compressed	Leaf-sheath compressed and keeled
Ligule leafy	Ligule ciliate
Leaf-blade large, broad	Leaf-blade narrow and reduced in size
Inflorescence an open branching panicle; branches of panicle long and spreading	Inflorescence narrow spicate; spikes short, appressed
Glumes shorter than lemma	Glumes equal to or longer than lemma
Flowers in each spikelet many	Flowers in each spikelet fewer.

Rhizomes: All the three Indian species are perennials; but only *C. dactylon* is rhizomatous; *C. arcuatus* and *C. barberi* are not rhizomatous.

Leaf-sheath: Leaf-sheaths are rounded in *C. dactylon*, slightly compressed in *C. arcuatus* and tightly compressed or keeled in *C. barberi*, suggesting that *C. arcuatus* and *C. barberi* may be placed higher than *C. dactylon*.

Leaf-blade: The leaf-blade is very reduced in *C. barberi*; in *C. barberi* f. *barberi* its size is usually only about .5-2 cm long. *C. barberi* f. *longifolius* with comparatively longer leaves, seems to hold phylogenetically an intermediate position between *C. arcuatus* and *C. barberi* f. *barberi*.

Inflorescence: The inflorescence in all the Indian species is digitate. The length of racemes varies considerably in *C. dactylon* and *C. arcuatus*; but it is generally very short in *C. barberi*.

Glumes: The size of the involucrel glumes in relation to the size of the lemma shows a distinct range from a condition where both glumes are much shorter than the lemma (*C. dactylon*), through a stage where the upper involucrel glume is only slightly shorter than lemma (*C. arcuatus*), to the condition where the upper involucrel glume is equal to or longer than lemma (*C. barberi*). Again, within the species *C. barberi*, the form *longifolius* sometimes does have the upper involucrel glume

slightly shorter than lemma; the form *barberi* rarely has that condition. The length of upper involucrel glume (and the length of leaves) suggest that form *barberi* is to be placed higher than f. *longifolius*.

Florets in spikelets: As a rule, there is only one fertile floret in each spikelet in the genus *Cynodon*. Exceptions to this rule have, however, been noticed in some specimens of *C. dactylon*. The occurrence of more than one fertile floret in a spikelet is a throw back to the condition prevailing in other genera of Chlorideae. Such exception has not so far been encountered in the other two species.

In addition to the above characters, it may be mentioned that the size of spikelet is 2-3 mm in *C. dactylon* and 1.5-2 mm in *C. arcuatus* and *C. barberi*; the size of anthers is 1-1.5 mm in *C. dactylon* and .5 mm in *C. arcuatus* and *C. barberi*. Reduction in these sizes is believed to be an advanced character.

The above discussion suggests the following positions for the different taxa.

Phylogenetic scale { *Cynodon barberi* f. *barberi*
Cynodon barberi f. *longifolius*
Cynodon arcuatus
Cynodon dactylon

The introduced species *Cynodon plectostachyus* is rhizomatous; has longer and broader leaves, long ligule; its spikes are scattered on a long axis and the involucrel glumes are very small, almost minute. These characters would suggest its position at a level lower than all the Indian species listed above.

DOUBTFUL SPECIMENS

It has not been possible to determine with certainty the identity of the following specimens:

1. *Coldstream, W.*, s.n., Hissar (BSIS)
2. *Nair, N. C.*, 27730, Dabwali, Punjab, 11 May 1963 (BSD 34238)
3. *Nair, N. C.*, 27810, Bhatinda, Punjab, 12 May 1963 (BSD 34231)
4. *Nair, V. J.*, 23245, Rohtak, Punjab, 14 August 1962 (BSD 34283)

The above specimens seem to belong to one and same taxon.

They are non-rhizomatous, have 7-nerved leaves, comparatively larger membranous ligule, large (3-3.5 mm) spikelets, upper involucrel glume subequal to lemma, clavellate hairs on lemma and palea and large (1 mm) anthers.

Thus, they differ from *C. dactylon* (L.) Pers. in

absence of rhizomes, nervation of leaves, membranous ligule, larger upper involucre glume, and clavellate hairs on palea.

They differ from *C. barberi* Rang. et Tad. in longer ligule, much larger spikelets, presence of mixed types of hairs on lemma and palea and larger anthers.

They differ from *C. arcuatus* J. S. Presl ex C. B. Presl in size of upper involucre glume, size of spikelets, presence of hairs on palea and size of anthers.

One of the above mentioned specimens was sent to Dr. N. L. Bor for opinion. He remarked "it has a membranous ligule, ciliate on the margins. I should call it *Cynodon arcuatus* Presl". As I have not seen any other *C. arcuatus* with such large spikelets and anthers, I hesitate to assign these to

Synonyms

Agrostis bermudiana Tussac ex Kunth
Agrostis filiformis Koen. ex Kunth
Capriola dactylon (L.) O. Ktze.
Chloris cynodon Trin.
Cynodon ciliaris (L.) Rasp.
Cynodon curtispindula Rasp.
Cynodon dactylon var. *intermedius*
 (Rang. et Tad.) Fischer
Cynodon dactylon var. *suberectus* Haines
Cynodon donax (L.) Rasp.
Cynodon erectus Presl
Cynodon filiformis (Koen.) Voigt
Cynodon gracilis Nees ex Steud.
Cynodon intermedius Rang. et Tad.
Cynodon maritimus H.B.K.
Cynodon melicoides (P. Beauv.) Rasp.
Cynodon neesii Thw.
Cynodon occidentalis Willd. ex Steud.
Cynodon phragmites (L.) Rasp.
Cynodon pilosa (Retz.) Roem. et Schult.
Cynodon portoricensis Willd. ex Steud.
Cynodon tenuis Trin.
Cynodon ternatus A. Rich.
Cynodon virgatus Willd.
Dactylon officinale Vill.
Digitaria dactylon (L.) Scop.
Digitaria littoralis Salisb.
Digitaria maritima H.B.K.
Digitaria stolonifera Schrad.
Fibichia umbellata Koel.
Leptochloa plectostachya K. Schum.
Milium dactylon (L.) Moench.
Panicum dactylon L.
Paspalum dactylon (L.) Lamk.

that species. It is of further significance that all the specimens noted above, though collected at such long interval of time (about 75 years), are from a restricted geographical area, namely Punjab in north-west India. Efforts are being made to collect live material and grow it; until this is done, the specimens are placed under *C. dactylon*, which name they have been given by their collectors.

CONSPECTUS OF SYNONYMOUS NAMES

The synonyms appearing in the foregoing taxonomic treatment of the genus *Cynodon* are listed below. Many binomials published under the genus *Cynodon* refer to grasses which are not *Cynodon* at all, but belong to other genera; several such names relate to grasses occurring in India and are included in the following table.

Correct names

Cynodon dactylon (L.) Pers.
 " "
 " "
 " "
Eragrostis ciliaris (L.) R. Br.
Bouteloua curtispindula (Michx.) Torr.
Cynodon arcuatus J. S. Presl ex C. B. Presl
 " "
Arundo donax L.
Cynodon dactylon (L.) Pers.
Chloris dolichostachya Lagasca.
Leptochloa uniflora Hochst. ex A. Rich.
Cynodon arcuatus J. S. Presl ex C. B. Presl
Cynodon dactylon (L.) Pers.
Bouteloua curtispindula (Michx.) Torr.
Leptochloa neesii (Thw.) Benth.
Cynodon dactylon (L.) Pers.
Phragmites communis Trin.
Digitaria stricta Roth ex Roem. & Schult.
Cynodon dactylon (L.) Pers.
 " "
Digitaria ternatea (Rich.) Stapf ex Dyer
Leptochloa chinensis (L.) Nees
Cynodon dactylon (L.) Pers.
 " "
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 " "
Cynodon plectostachyus (K. Schum.) Pilger
Cynodon dactylon (L.) Pers.
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 " "

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INDEX OF NUMBERED EXSICCATA

Explanation of citations below: Name of the collector, collection number, (number of the taxon as it appears in the work, viz. 1 *Cynodon dactylon*, 2. *C. barberi*, 3. *C. barberi* f. *longifolius*, 4. *C. arcuatus*). Sheets without collector's number but bearing accession numbers of their herbaria are also included.

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