

New Taxa in *Brachiaria* Griseb. (Poaceae)

G P BASAPPA* and M MUNIYAMMA

Department of Post-Graduate Studies and Research in Botany, University of Mysore,
Manasagangotri, Mysore 570006

(Received 14 December 1982; after revision 26 May 1983)

Based on biosystematic investigations in Indian species of the genus *Brachiaria*—one of the important fodder grasses of the tropics—3 new species and 8 new varieties are recognized and described in this paper. For each taxon, the nature of breeding system and the gametic chromosome number are provided. This work has led to the recognition of 32 taxa including 23 species and 9 varieties for India. A key to the Indian species is also presented.

Key Words: *Brachiaria* Griseb., Biosystematics, Fodder grasses, Breeding

Introduction

The name *Brachiaria* was first introduced by Trinius (1826) as a section of the genus *Panicum* L. in which he included various taxa currently recognized as *Panicum* L., *Echinochloa* P. Beauv., *Paspalum* L., *Thrasya* Kunth...Trinius (1826) also proposed the status of sub-genus for *Brachiaria*. However, in his later work (Trinius 1834), he continued to treat it as a section of *Panicum* in which a somewhat different group of species was included from those included in his first treatment of the section. Amongst several characters attributed to diagnose the section, the reversed position of the spikelet was not mentioned, which is now recognized as one of the

most important characters to diagnose the genus *Brachiaria*. His efforts to segregate the species of *Brachiaria*, and to elevate the section as a genus were not successful, since there is nothing in either of his works to indicate which species should be considered as the type.

Grisebach (1853) subsequently elevated the section to a genus, describing a single species *Brachiaria eruciformis* (Smith) Griseb. based on *Panicum eruciforme* Smith. The uncertain status of *Brachiaria*, continued to be confusing when Grisebach (1864) got back and used *Brachiaria* Trin. as a section of *Panicum*. Bentham (Bentham & Hooker 1883), Hackel (1887) and Hooker (1896) have used the name

*Present address: Department of Botany, D V S College of Arts and Science, Shimoga 577201, Karnataka.

Brachiaria for a section of *Panicum*.

Nash (1901) recognized *Brachiaria* as a genus (giving Ledebour as the author), diagnosing it by the racemose inflorescence and awnless spikelets of 3-glumes. But he further increased the confusion by transferring *Panicum digitarioides* and *P. obtusum*, in both of which the spikelets are in the position normal to *Panicum*, not the reversed position of *B. eruciformis*. However, Nash (1903) modified his diagnosis of the genus *Brachiaria* by adding 'flowering scale with its opening toward the rachis'—which certainly limits the genus to Grisebach's type species and its allies. Here he has retained *P. digitarioides* and *P. obtusum* in *Panicum*, the act of which is a clear indication of importance of the reversed position of the spikelets to delimit the genus *Brachiaria*. Hitchcock (1908) accepted *Brachiaria* in this amended sense, separating it from *Panicum* chiefly on account of its 'having spikelets so placed that the fertile floret stands with its palea toward the axis'. The major contribution to this genus comes from Stapf (1919), who recognized the genus *Brachiaria* Griseb. and described some 52 species.

From hereafter, more or less every worker has recognized *Brachiaria* Griseb. as a distinct genus. Although the problematic status of *Brachiaria* appears to be resolved, there are still a number of perpetuating problems as to a set of characters determining the generic delimitation. Nevertheless, a number of species complexes and erroneous identifications existing in the genus, have led many workers in various fields to arrive at a wrong conclusion. No systematic coverage of this genus as a whole has ever been attempted, and the taxonomy has consisted mainly of the new species

descriptions, and species transfers.

In view of the above stated reasons, a biosystematic study in the genus was felt more important and contemplate to revise the genus for India. During this investigation we have had to describe a few new species and new varieties, and propose a new infrageneric classification. This study is mainly concerned with the delimitation and relationships of the taxa in the genus *Brachiaria*. Morphological, cytological, embryological, anatomical, biochemical, and distribution data obtained from population samples and herbarium material are used to delimit the taxa. Morphological variation within and among populations is assessed and analyzed by studies of the breeding systems and reproductive biology, and by the responses of population transplants grown under uniform conditions.

As it is realized that there is an unavoidable delay in the publication of the full revision, only the diagnoses of all the new taxa are presented in this paper. Detailed descriptions and specimens' citation together with illustrations of all the new species and varieties will be presented in the revision of the genus *Brachiaria*, which will be published in due course.

Results and Discussion

Brachiaria chennaveeraiana Basappa et Muniyamma, sp. nov.

Brachiaria ramosae var. *ramosae* (L.) Stapf, in aspectu similis, sed differt habitu nana, culmis erectis, racemis saepe ramosis, spiculis majoribus et persistentibusque, pedicellis longioribus sine setis longis.

Type: India, Rajasthan, Mount Abu, near Gomukh, 15 Oct. 1980, Basappa & Muniyamma 2195 (CAL holotype; MH, BSI, BSJo, MGM isotypes)

B. chennaveeraiana is similar to *B. ramosa* var. *ramosa*, but it is characterized by erect and short culms, long secondary branches of racemes, absence of tuft of bristles on the pedicels, the larger and persistent spikelets.

This annual species reproduces sexually and its n chromosome number is 16.

This taxon is named in honour of Dr M S Chennaveeraiah, a leading Indian agrostologist.

Brachiaria hybrida Basappa et Muniyamma, *sp. nov.*

Brachiaria miliiformis (Presl) A. Chase similis, sed differt foliorum laminis basibus inaequalibus, paniculis saepe racemum singularem efferentibus, pedicellis cum 1 vel 2 pilis albis longis, spiculis majoribus, flosculus inferior sine palea.

Type: India, Karnataka, Shimoga District, Gajanur, near Tunga Dam, 10 Sept. 1979, *Basappa & Muniyamma* 2851 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

B. hybrida is similar to *B. miliiformis*, but differs in having leaf blades with unequal bases, panicle often producing single raceme, pedicels with 1 or 2 long white hairs, larger spikelets, and the absence of palea in the lower floret.

This perennial taxon is an apomict, and its n chromosome number is 27.

The rarity of this taxon and its erratic meiotic behaviour suggest that this might be a recent and an uncommon natural hybrid between *B. distachya* (L.) Stapf. (n=18) and *B. subquadripara* (Trin.) Hitchc. (n=36) (*Basappa* 1982).

The specific epithet refers to the hybrid nature of the species.

Brachiaria stapfiana Basappa et Muniyamma, *sp. nov.*

B. ramosa sensu Stapf. in Prain, Fl. Trop. Afr. 9: 542. 1919 (*pro parte*).

Brachiaria deflexae (Schumach.) C.E. Hubb. ex Robyns similis in mor-

phologia, sed differt racemis brevibus rectisque, spiculis majoribus et minus distantibus, pedicellis brevioribus.

Type: India, Karnataka, Bellary District, Hampi, near Ugra Narasimha Temple, 20 Sept. 1979, *Basappa & Muniyamma* 2100 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

B. stapfiana is similar to *B. deflexa* in gross morphology, but differs in having short and straight racemes, larger and densely arranged spikelets, and shorter pedicels.

This short-lived annual reproduces sexually and its n chromosome number is 18.

This species is named in honour of O. Stapf, who had contributed much to the knowledge of the genus *Brachiaria*.

Brachiaria brizantha (Hochst. ex A. Rich.) Stapf. var. *ciliata* Basappa et Muniyamma, *var. nov.*

Varietati *brizanthae* similis, sed differt foliorum laminis brevibus, racemis brevibus rectisque, apicibus spicularum longe ciliatis.

Type: India, Karnataka, Mysore, cultivated in departmental garden, Manasagangotri (Fiji origin, introduced through USDA, U.S.A.: 355712), 11 Sept. 1980, *Basappa & Muniyamma* 1004 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *ciliata* is similar to the typical var. *brizantha*, but differs in having short leaf blades, short and straight racemes, and long-ciliated spikelet tips.

This perennial taxon is an apomict, and its n chromosome number is 18.

The name refers to the long hairs present at the tip of spikelets.

Brachiaria eruciformis (J.E. Smith) Griseb. var. *divaricata* Basappa et Muniyamma, *var. nov.*

Varietati *eruciformi* similis, sed differt racemis manifeste divaricatis, basibus manifeste pulvinatis.

Type: India, Karnataka, Mysore,

3 km west of Mysore, along the edge of tank-bund, 12 Aug. 1979, *Basappa & Muniyamma* 1451 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *divaricata* is similar to var. *eruciformis*, but differs in having distinctly patent racemes and the prominent pulvinus base of racemes.

This is an annual and sexually reproducing taxon. Its n chromosome number is 9.

The name *divaricata* refers to the widely divergent racemes.

Brachiaria ramosa (L.) Stapf. var. *pubescens* Basappa et Muniyamma, var. nov.

Varietati *ramosae* similis, sed differt spiculis puberulis.

Type: India, Karnataka, Shimoga District, Benakanahalli, on the top of the Fort, 20 Aug. 1980, *Basappa & Muniyamma* 2171 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *pubescens* is similar to the var. *ramosa*, but differs in having finely pubescent spikelets.

This long-lived annual reproduces sexually, and its n chromosome number is 16.

The name refers to the pubescent nature of the spikelets.

Brachiaria reptans (L.) Gard. et C.E. Hubb. var. *hispida* Basappa et Muniyamma, var. nov.

Varietati *reptanti* similis, sed differt spiculis hirsutis.

Type: India, Karnataka, Shimoga District, Govinakovi, 10 Oct. 1980, *Basappa & Muniyamma* 2302 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *hispida* is similar to var. *reptans*, but differs in having hirsute spikelets.

This annual taxon reproduces sexually and its n chromosome number is 7.

The name *hispida* refers to the nature

of indumentum of the spikelets.

Brachiaria semiundulata (Hochst.) Stapf. var. *intermedia* Basappa et Muniyamma, var. nov.

Varietati *semiundulatae* similis, sed differt spiculis pubescentibus.

Type: India, Karnataka, Mysore District, Bedaguli, near Doopada Bore, 1500 m, 8 Aug. 1979, *Basappa & Muniyamma* 2602 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *intermedia* is more similar to var. *semiundulata*, but differs in having pubescent spikelets.

This taxon is an annual and high altitude grass. It reproduces sexually and its n chromosome number is 18.

The epithet *intermedia* refers to the resemblance of the new taxon to both var. *semiundulata* and var. *lanata*.

Brachiaria semiundulata (Hochst.) Stapf. var. *lanata* Basappa et Muniyamma, var. nov.

Varietati *intermediae* Basappa et Muniyamma similis, sed differt spiculis apice barbatis pilis argenteis.

Type: India, Karnataka, Mysore District, Bedaguli, near Doopada Bore, 1500 m, 8 Aug. 1979, *Basappa & Muniyamma* 2603 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *lanata* is similar to var. *intermedia*, but differs in having spikelets with an apical beard of silvery hairs.

This variety is also an annual and high altitude grass reproducing sexually. Its n chromosome number is 18+1B.

The epithet *lanata* refers to the dense woolly hairs present near the tip of the spikelets.

Brachiaria setigera (Retz.) C.E. Hubb. var. *albistyla* Basappa et Muniyamma, var. nov.

Varietati *setigerae* similis, sed differt habitu parviore, vaginis laminisque pubescentibus, pedicellis non setiferis, stylis stigmatibusque albis.

Type: India, Tamil Nadu, Coimba-

tore, near Agriculture College Campus, along waysides toward Sugarcane Breeding Research Centre, 25 Oct. 1980, *Basappa & Muniyamma* 2716 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *albistyla* is similar to var. *setigera*, but differs in having dwarf habit, pubescent leaf sheaths and blades, absence of bristles on the pedicels, and white styles and stigmas.

It is a perennial and an apomictic taxon, and its n chromosome number is 14.

The epithet *albistyla* designates the white colour of styles and stigmas.

Brachiaria villosa (Lamk.) A. Camus var. *glaberrima* Basappa et Muniyamma var. *nov.*

Varietati *villosae* similis, sed differt spiculis perfecte glabris.

Type: India, Chandigarh, Siwalik Hills, Kasauli, near Monkey point, 26 Nov. 1981, *Basappa & Muniyamma* 2911 (CAL holotype; MH, BSI, BSJo, MGM isotypes).

Variety *glaberrima* is similar to the typical variety, but differs in having completely glabrous spikelets.

This is an annual and sexually reproducing taxon. Its n chromosome number is 18.

The name refers to the glabrous nature of spikelets.

Brachiaria villosa (Lamk.) A. Camus var. *barbata* Bor, The Grasses of Burma, Ceylon, India and Pakistan 286. 1960.

We take this opportunity to refer to a probable error crept in the taxonomic key given by Bor (1960). He described this variety on a specimen collected from Nepal (*Stainton* 1374). In the key to the species (page 279), he distinguishes this variety from the typical variety *villosa* as follows: 'Lower glume and upper lemma with an apical beard of silvery hairs'. This is incorrect. Because the specimens collected by *Stainton*, *Sykes* and *Williams* (Acc. No. 7121, CAL) from the type locality show the different characters: while the lower glume is pubescent as in the var. *villosa*, the upper lemma remains perfectly indurate and glabrous. On the contrary, upper glume and lower lemma have an apical beard of long silvery hairs as meant by Bor (1960) in the diagnosis (page 286). This is the condition in all the specimens we have examined. Therefore, we presume, that the character given in the key might be an oversight.

To facilitate identification of Indian species, including the new taxa, a dichotomous key is given below:

1A. Spikelets lanceolate:

- 2A. Lower glume more than two-thirds the spikelet length, lower floret epaleate. . . . *B. paspaloides*
- 2B. Lower glume less than one-fourth the spikelet length, lower floret paleate (*B. setigera*):
 - 3A. Pedicels with a tuft of bristles; sheaths and blades glabrous; styles and stigmas purple. . . .
B. setigera var. *setigera*
 - 3B. Pedicels devoid of bristles; sheaths and blades pubescent; styles and stigmas white. . . .
B. setigera var. *albistyla*

1B. Spikelets oblong-ovate or elliptic-oblong:

- 4A. Spikelets imbricate or approximate:
 - 5A. Rachis flat, sometimes crescentic, herbaceous:
 - 6A. Spikelets crowded in more than 2 rows; basal racemes branched; spikelets 3.33–3.79 mm long. . . . *B. mutica*
 - 6B. Spikelets not crowded; always in 1 or 2 rows; racemes unbranched; spikelets more than 5.0 mm long:

- 7A. Rachis flat, winged, more than 2.0 mm wide; sheaths and blades heavily villous:
 - 8A. Rachis more than 4.0 mm wide. . . . *B. ruzizensis*
 - 8B. Rachis ca. 2.0 mm wide. . . . *B. decumbens*
- 7B. Rachis crescentic, less than 1.5 mm wide; sheaths and blades glabrous or puberulent (*B. brizantha*):
 - 9A. Upper glume and lower lemma tips with long hairs. . . . *B. brizantha* var. *ciliata*
 - 9B. Upper glume and lower lemma entirely glabrous. . . . *B. brizantha* var. *brizantha*
- 5B. Rachis triquetrous, sometimes filiform, not herbaceous:
- 10A. Spikelets more than 3.0 mm long:
- 11A. Spikelets strictly solitary and always in 2 rows; racemes always unbrached, alternate, distant; inflorescence open type; perennials:
 - 12A. Spikelets widest above the middle, tapering to the base, rounded at the apex to an apiculate tip:
 - 13A. Spikelets 3.0–3.48 mm long, peduncle softly hairy. . . . *B. distachya*
 - 13B. Spikelets more than 3.5 mm long, peduncle glabrous or puberulous:
 - 14A. Spikelets 4.05–4.39 mm long, 1.58–1.71 mm wide; peduncle glabrous; lower floret epaleate. . . . *B. hybrida*
 - 14B. Spikelets 3.59–4.15 mm long, 1.26–1.58 mm wide; peduncle puberulous; lower floret paleate. . . . *B. subquadripara*
 - 12B. Spikelets almost elliptic-oblong, gradually tapering to both ends, tip finely acuminate (3.88–4.18 mm long). . . . *B. miliiformis*
- 11B. Spikelets paired or fascicled on small secondary racemes, crowded in more than 2 rows; racemes approximate; inflorescence subpyramidal; annuals:
 - 15A. Spikelets turgid, widest near the middle, finely beaked, lower glume nearly acuminate, clasping, rachilla internode between lower and upper glumes elongated and swollen:
 - 16A. Spikelets 3.59–4.0 mm long; inflorescence long-exserted; lower and upper glumes 7-nerved, and lower lemma 5-nerved; plants geniculately ascending; blades 6.0–16.0 cm long. . . . *B. stapfiana*
 - 16B. Spikelets 4.29–4.84 mm long; inflorescence partly hidden within the flag leaf; lower and upper glume 11–13 nerved, and lower lemma 9-nerved; plants prostrate; blades 2.0–5.0 cm long. . . . *B. muna*
 - 15B. Spikelets not turgid, widest above the middle, with an apiculate tip, lower glume obtuse or acute, not clasping, rachilla internode not elongated or swollen between lower and upper glume:
 - 17A. Pedicels with a tuft of bristles, primary pedicels ca. 2.0 mm long:
 - 18A. Sheaths and blades puberulent, blades wavy, with amplexicaul base, the longest blade 18.0–25.5 cm long, 3.0–3.9 cm wide; spikelets 3.23–3.65 mm long.
B. lata
 - 18B. Sheaths and blades glabrous, blades entire, with cordate base, the longest blade 16.0–19.6 cm long, 2.6–3.2 cm wide; spikelets 3.0–3.56 mm long (*B. ramosa*):
 - 19A. Spikelets glabrous. . . . *B. ramosa* var. *ramosa*
 - 19B. Spikelets pubescent. . . . *B. ramosa* var. *pubescens*
 - 17B. Pedicels without bristles, primary pedicels 3.0–5.0 mm long. . . . *B. chennaveeraiana*
- 10B. Spikelets less than 3.0 mm long:
 - 20A. Lower glume less than one-fourth of the spikelet, truncate:
 - 21A. Plants geniculately ascending; blades linear, with rounded base, the longest blade 5.52–11.4 cm long, 0.5–0.8 cm wide; spikelets solitary, in 2 rows, fertile floret smooth and shining, with a blunt end (*B. eruciformis*):
 - 22A. Panicle linear; racemes appressed to the inflorescence axis, without pulvinus base. . . . *B. eruciformis* var. *eruciformis*
 - 22B. Panicle broadly oblong; racemes widely spreading, with a pulvinus base.
B. eruciformis var. *divaricata*

- 21B. Plants prostrate (only flowering branches ascend); blades lanceolate, with amplexicaul base, the longest blade 6.0—8.3 cm long, 0.8—1.5 cm wide; spikelets in pairs; fertile floret indurate, with an apiculate tip (*B. reptans*):
 23A. Spikelets glabrous...*B. reptans* var. *reptans*
 23B. Spikelets hispid...*B. reptans* var. *hispidula*
- 20B. Lower glume up to half as long as the spikelet, obtuse or acute:
 24A. Spikelets obovate-elliptic, gibbous, beaked; lower glume obtuse or subacute, upper glume shorter than spikelet; plants confined to Western Ghats (*B. semiundulata*):
 25A. Spikelets with an apical beard of silvery hairs...*B. semiundulata* var. *lanata*
 25B. Spikelets devoid of such hairs:
 26A. Spikelets woolly...*B. semiundulata* var. *intermedia*
 26B. Spikelets glabrous...*B. semiundulata* var. *semiundulata*
- 24B. Spikelets elliptic, not gibbous; lower glume finely acute or subacuminate, upper glume equal to spikelet; plants confined to Himalaya (*B. villosa*):
 27A. Spikelets with an apical beard of long silvery hairs...*B. villosa* var. *barbata*
 27B. Spikelets without such hairs:
 28A. Spikelets villous...*B. villosa* var. *villosa*
 28B. Spikelets glabrous...*B. villosa* var. *glaberrima*
- 4B. Spikelets distant:
 29A. Spikelets less than 3.25 mm long, distant by 10.0—20.0 mm; primary pedicels 6.0—10.0 mm or more long; racemes reflexed; annuals...*B. deflexa*
 29B. Spikelets more than 3.25 mm long, distant by 5.0—10.0 mm; primary pedicels 3.0-5.0 mm long; racemes spreading, not reflexed; perennials:
 30A. Culms robust, erect, to 3.0 m tall; racemes 10-28, to 16.0 cm long, whorled or semiwhorled; inflorescence pyramidal...*B. semiverticillata*
 30B. Culms weak, decumbent, less than 2.0 m tall; racemes less than 10, less than 8.0 cm long, alternate, distant, not whorled; inflorescence open type:
 31A. Plants entirely glabrous including nodes and overlapping sheath margins; blades linear, the longest blade 9.0—14.5 cm long, 0.8—1.3 cm wide; spikelets puberulent...*B. remota*
 31B. Plants minutely pubescent; blades broader at the base, lanceolate, the longest blade 6.2—15.5 cm long, 1.4—2.3 cm wide; spikelets glabrous...*B. kurzii*

Acknowledgements

We wish to express our sincere thanks to Dr T A Cope of the Royal Botanic Gardens, Kew and Miss M E Young of the Linnean Society of London, for comparing the specimens with the types and for their expert opinion, and also to the authorities of CAL, MH, BSI, BSJo, BSD, DD, LWG and ASSAM for permitting to consult the Indian collections of

Brachiaria. We thank Dr R S Mallikarjunappa, for his assistance in the preparation of this paper; Dr Sanjappa, for his help during the consultation of herbarium specimens at Calcutta Herbarium (CAL); and Dr N C Majumdar of the Botanical Survey of India, Howrah, for the Latin translation. Award of a Teacher Fellowship to G P Basappa by the University Grants Commission, New Delhi, is gratefully acknowledged.

References

- Basappa G P 1982 *Biosystematic Studies in the Genus Brachiaria Griseb. Poaceae*; Ph.D. Thesis, University of Mysore, Mysore
- Bentham G 1983 in *Genera Plantarum* vol. 3 part 2 pp 11-12 eds G Bentham and J D Hooker Lovell (London: Reeve and Co.)

- Bor N L 1960 in *The Grasses of Burma, Ceylon, India and Pakistan (Excluding Bambuseae)* (London: Pergamon Press)
- Grisebach A H R 1853 *Brachiaria* Griseb.; in *Flora Rossica, Sive Enumeratio Plantarum in Totius Imperii Rossici Provinciis Europaeis, Asiaticis, et Americanis Hucusque Observatarum* vol. 4 469: ed. C F Ledebour (Stuttgart)
- 1864 in *Flora of the British West Indian Islands* (London: Lovell Reeve and Co.)
- Hackel E 1887 Gramineae, Teil II, Abteilung 2; in *Die natürlichen pflanzenfamilien* ed. H.G.A. Engler and K.A.E. Prantle, (Berlin)
- Hitchcock A S 1908 Types of American grasses: A study of the American species of grasses described by Linnaeus, Gronovius, Sloane, Swartz, and Michaux; *Contr. U S natn Herb* **12** 113-158
- Hooker J D 1896 in *The Flora of British India* vol. 7 27 (London)
- Nash G B 1901 in *Manual of the Flora of the Northern States and Canada* ed. N L Britton (New York: Henry Holt and Co.)
- 1903 in *Flora of the Southeastern United States* ed. J K Small (New York)
- Stapf O 1919 *Brachiaria* Griseb.; in *Flora Tropical Africa* Vol 9 part 3 505-565 ed. D Prain (London: Lovell Reeve and Co.)
- Trinius C B 1826 *De Graminibus Paniceis* (Petropolis: Impensis Academiae Imperialis Scientiarum) p 289
- 1834 *Panicearum Genera. Speciebusque compluribus illustravit; Mem. Acad. St. Petersb.* ser. 6, *Sci. Nat.* **3** 194