

Amorpha

BRACHIARIA

A REPORT TO CIAT, COLOMBIA, ON THE SPECIES AND SPECIMENS
HELD IN THE GERMPLASM COLLECTION

Prepared by
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Kew

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1. Summary

As part of the Tropical Forage Programme at CIAT various species of the genus *Brachiaria* are receiving intensive appraisal as major components of sown and managed pasture.

1.1. The species of most interest is *Brachiaria brizantha*, currently one of the most widely used grasses in tropical pasture development. In this report the morphology of this species is described and the vegetative features analysed in detail; information on its geographical distribution and ecology is also provided.

1.2. Two closely related species, *Brachiaria decumbens* and *Brachiaria ruziziensis*, which are being used in a hybridization programme at CIAT, are described and their relationship to *Brachiaria brizantha* discussed.

1.3. Five other species, *Brachiaria humidicola*, *Brachiaria dictyoneura*, *Brachiaria jubata*, *Brachiaria bovonii* and *Brachiaria subulifolia*, are also reviewed and their morphological variation described and analysed.

1.4. Other *Brachiaria* species held at CIAT as germplasm, but which are not being used in any of the current research programmes, are listed but not discussed.

1.5. The CIAT material is compared with the data gathered from wild collected specimens.

1.6. The results indicate that representation of *B. brizantha* at CIAT covers the natural morphological range of this species.

1.7. Representation of some of the other *Brachiaria* species at CIAT is shown to be rather uneven when compared with the natural range of morphological variation.

1.8. The correct name and relevant synonymy is presented for each species.

1.9. Identification of specimens, includes other *Brachiaria* species not included in the main analysis

1.10. Key to species

2. Statement of Contract

Title:

Taxonomic revision of selected species from the genus *Brachiaria*

Terms

The terms of the contract were established in letter PSO-283 of 27 August 1992 (see Appendix 9.1.) and may be summarized as follows:-

- a) List of identifications for the plants at CIAT under study
- b) Preparation of a key to the species under study
- c) List of correct names and their principal synonyms for all the species under study
- d) Full descriptive information for the species studied

The work to be undertaken at CIAT, Colombia and the Royal Botanic Gardens, Kew, Great Britain.

Additional note (March 1993).

With the conclusion of the contract any queries, requests for further information or identifications will, within reason, be dealt with as a follow-up service.

3. Institutions and Personnel

- a) S A Renvoize, BSc. MPhil. Chief Investigator

with the assistance of Sylvia Phillips, BSc. and Nicola Biggs, BSc.

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- b) Dr Brigitte Maass, Chief Collaborator

with the assistance of Alba Marina Torres

CIAT
Cali
Colombia

4. Introduction

The genus *Brachiaria* comprises 100 annual and perennial mostly African species several of which, due to their leafiness, are of agricultural value as fodder. The most important species is *Brachiaria brizantha*, which is now the most popular grass for tropical pasture development.

Although indigenous and widespread in Africa, *Brachiaria brizantha* has been introduced throughout the tropics. It is a very variable species which provides an opportunity for the selection of clones with characteristics which fulfill a variety of agricultural requirements.

Heering (1989) evaluates 21 species of *Brachiaria* for leafiness, plot coverage, vigour, spread and height. The results identified *Brachiaria brizantha*, *B. decumbens* and *B. ruziziensis* as the most promising.

Several other *Brachiaria* species are of agricultural value. *Brachiaria mutica* (Para Grass), is widely used in the tropical zone for forage; its native country is unknown and any clues to its origins are now obscured by its pantropical distribution. *Brachiaria arrecta* (Tanner Grass), a native of tropical and southern Africa, is popular for forage, although it prefers swampy ground. *Brachiaria deflexa* is native in West Africa, where it serves as a minor cereal.

Brachiaria species range in size from small annuals 10 cm high like *Brachiaria leucacrantha* in tropical Africa to leafy perennials up to 200cm high, like *Brachiaria brizantha*. Typically, the inflorescence comprises racemes on a central axis, bearing spikelets in 1 or 2 neat files. However, spikelets may also be borne in fascicles or secondary racemelets (e.g. *Brachiaria comata*), or on well developed pedicels, so that the inflorescence resembles a panicle, (e.g. *Brachiaria deflexa* and *Brachiaria ramosa*).

CIAT holds a large collection of *Brachiaria* germplasm accessions (687 in 1991 annual report), the majority of which are *Brachiaria brizantha*. This collection provides a source of research material for various projects, in particular those of the Tropical Forage Programme.

As part of the tropical pasture programme at CIAT various genotypes of *B. brizantha* are being used in a hybridization programme with *B. decumbens* and *B. ruziziensis*, which seeks to produce a plant which is resistant to spittle bug attack, performs well on poor soils, and has a high level of productivity. The present study is designed to provide information on the natural range of morphological variation in these three species, their interspecific relationships, geographical distribution and ecological preferences. The CIAT accessions are examined in the context of this information.

In addition three other species currently of interest at CIAT for tropical pasture, *Brachiaria humidicola*, *Brachiaria dictyoneura* and *Brachiaria jubata*, are examined.

5. Resources, methods and materials, field work

5.1. Resources

The Herbarium of the Royal Botanic Gardens, Kew is the foremost scientific collection of vascular plant specimens in the world, with an international reputation for excellence in taxonomic research. The grass section contains over 300,000 specimens from all over the world and in particular is very rich in collections from tropical Africa. Research in the section over the past 30 years has centred on Africa and has resulted in a collection curated to the highest levels and a staff with unparalleled knowledge of grasses from this region. The grass collection of the Kew Herbarium is therefore considered the most appropriate source of information for this project.

B. brizantha is one of the commonest grass species of the African wooded grasslands and open grasslands. At Kew there are hundreds of collections from throughout the natural range of the species. These provide an excellent source of data for assessing the range of variation.

5.2. Methods

The morphological variation of the species listed below was assessed throughout their natural range, using the herbarium specimens at Kew. Particular attention was paid to those features relevant to forage quality:- stature of plant, growth form, and the dimensions of the culm and leaf-blade.

For frequency counts and measurements the largest number or measurement was taken from each specimen.

B. brizantha (A. Richard) Stapf

B. decumbens Stapf

B. ruziziensis Germain & Evrard

B. humidicola (Rendle) Schweickhardt

B. dictyoneura (Figari & De Notaris) Stapf

B. jubata (Figari & De Notaris) Stapf

Duplicates of CIAT herbarium specimens were received at Kew and compared with data gathered from the Kew herbarium.

5.3. Materials

The raw data collected for the statistical analyses can be made available to CIAT if required.

Histograms and scatter diagrams for *Brachiaria brizantha* were produced using GEM Graph and GEM Draw Plus (Digital).

Histograms for *Brachiaria decumbens*, *B. ruziziensis*, *B. humidicola*, *B. dictyoneura* and *B. jubata* were produced using Corel Draw level 2.00 and run on Microsoft Windows.

The text was prepared using a Compaq Deskpro 50M

5.4. Field work CIAT, Cali

In order to gain some insight into the range of representation in the CIAT collection and a better understanding of their performance under field trial conditions, the month of September 1992 was spent at CIAT, Cali, Colombia.

During this time

- a) Voucher specimens in the CIAT herbarium were examined and their identifications confirmed.
- b) The living collection at Quilichao was examined to:-
 - 1) assess changes in habit resulting from cutting
 - 2) make a detailed analysis of growth forms of *Brachiaria brizantha*, *B. jubata*, *B. humidicola* and *B. dictyoneura*.
- c) The identifications of most of the living accessions at Quilichao were confirmed, (Appendix 9.4).
- d) A map of the plots at Quilichao, with accession numbers, plot numbers and identifications of the plants was prepared with the help of Alba Marina Torres. A copy of this map was left at CIAT.
- e) A report on the visit was prepared and left at CIAT before departure at the end of September.
- f) The biologist in charge of the herbarium was given training in grass taxonomy, insofar as time and the limitations of the contract would allow.
- g) A visit was made to Carimagua, 18-22 September, to see the hybridization programme involving *Brachiaria brizantha*, *B. decumbens* and *B. ruziziensis*.

Specimens in the herbarium at CIAT were all examined and their identifications confirmed or corrected as necessary but not listed for the purposes of this study. The accession numbers and the relevant identifications are all recorded in the CIAT database. This database does however include accessions which are still in quarantine or in various stations in Africa.

Accessions which are duplicated at Kew are listed in appendices 9.5 and 9.6.

6. Results

6.1. THE BRACHIARIA BRIZANTHA COMPLEX

6.1.1. INTRODUCTION

The *Brachiaria brizantha* complex includes three species, *B. brizantha*, *B. decumbens* and *B. ruziziensis*. This group is characterized by perennial habit, elliptic spikelets borne singly on the rachis, lower glume 1/3-1/2 the length of the spikelet, clasping at the base and separated from the upper glume by an internode.

B. brizantha is very widespread in tropical Africa, (see map 1), whereas *B. decumbens* and *B. ruziziensis* are restricted to Uganda, Zaire, Rwanda, Burundi, western Tanzania and western Kenya.

6.1.2. *Brachiaria brizantha* (A. Richard) Stapf in Flora of Tropical Africa 9: 531 (1919).

Synonym: *Panicum brizanthum* A. Richard, Tent. Fl. Abyss. 2:363 (1851).

Tufted perennial with culms 30 - 200 cm high, erect or geniculately ascending. Leaf-blades linear to broadly linear, 10 - 100 cm long, 3 - 20mm wide. Inflorescence of (1-) 2-16 racemes on an axis 3 - 20 cm long; racemes 4 -20 cm long, bearing spikelets singly, these typically forming a single row; rachis crescentic in cross section, 1mm wide, ciliate on the margins. Spikelets ellipsoid, 4-6mm long, glabrous or sparsely pubescent, obtuse to subacute with a slight stipe at the base. Lower glume 1/3 the length of the spikelet, clasping, acute or obtuse, separated from the upper by a short internode; upper glume cartilaginous; lower lemma resembling the upper glume; upper lemma granulose, acute.

Illustration 1.

Brachiaria brizantha is known to be widely distributed throughout Africa, and has also long been recognised as being very variable. An attempt has been made here to explore whether regional differences exist in the variability of those characteristics which are of interest to agronomists and are amenable to examination from herbarium specimens.

- A. Distribution
- B. Variation
 - B.1 Leaves
 - B.2 Inflorescence
 - B.3 Culms
- C. Taxonomic varieties



Illustration 1. *Brachiaria brizantha*. Main illustration, habit of plant; 1, ligule; 2, segment of rachis; 3, spikelet, side view; 4, lower glume; 5, upper glume; 6, upper lemma; 7, upper palea.
From: Flora of West Tropical Africa, copyright RBG, Kew.

A. DISTRIBUTION

The natural distribution of *Brachiaria brizantha* is confined to Africa, although it has been widely introduced throughout the tropics as a useful pasture and forage grass. Its distribution within Africa, based on the herbarium specimens available at Kew, is illustrated in map 1. There are obvious limitations to the accuracy of this map, particularly with regard to comparative density of collections. In some areas a paucity of records is undoubtedly a reflection of lack of collecting, rather than true rarity. Nevertheless, the record is sufficiently complete to allow general conclusions to be drawn.

The boundaries of the phytochoria on the map have been drawn with reference to the Vegetation Map of Africa by White (1983) and the chorological studies on African grasses by Clayton et al. (1974 & 1980). It is immediately apparent that the northward extent of *Brachiaria brizantha* coincides with the southern edge of the Sahel zone, the semi-arid belt fringing the southern reaches of the Sahara. South of this belt the distribution pattern forms a broad arc closely approximating to the phytochorion termed the "Sudano-Zambezian Region", which surrounds the rainforests of the Congo basin and West Africa ("Guineo-Congolese Region"). In the south its distribution is bounded by the adverse climatic conditions of the deserts of southwestern Africa ("Karoo Namib Region") and the Mediterranean-type climate of the Cape.

The Sudano-Zambezian region is characterised by a long dry season and an equal or slightly shorter, but usually adequate, wet season; this is illustrated by the climadiagrams inserted on map 2. This regime supports a vegetation of wooded grassland commonly termed "savanna". *Brachiaria brizantha* is not able to persist in areas with an annual rainfall of less than 800mm (Bogdan, 1977).

Within its geographical range *B. brizantha* is sometimes found in tall grassland associated with other typical savanna grasses, especially species of *Hyparrhenia*. However, it more frequently appears to favour slightly shaded situations fringing woodland or thicket, clearings in woodland and openings provided by paths or streams. It is also frequently a component of areas in grassland or bush broken by rocks or associated with disturbance. The records within the Guineo-Congolese region are probably associated with scattered, small patches of grassland along rivers.

Within the arc of the Sudano-Zambezian region lies a transition zone between the savanna vegetation and the rainforest of the Guineo-Congolese region, now considerably broadened, probably by the loss of the original rainforest vegetation. The greater part of this transition zone is occupied today by secondary grassland and wooded grassland, mostly composed of Sudano-Zambezian species including *B. brizantha*. In the uplands of Ethiopia and East Africa the predominant vegetation is deciduous bushland, but *B. brizantha* is to be found here in areas of secondary grassland and grassy areas in open bush.

Over most of its range *B. brizantha* occurs at altitudes of 1000-2000m, but extends much lower where ecological conditions are suitable, particularly in West Africa. However, the upper limit of 2000m appears to be a more positive barrier, being only occasionally slightly exceeded in the uplands of Ethiopia and East Africa, where temperature is presumably the most important limiting factor.

B. VARIATION

Plants of *Brachiaria brizantha* vary greatly in vigour, actual and relative proportions of the leaf-blades, and in the number and length of the racemes which constitute the inflorescence. There is also much variation in habit, from tightly tufted plants with erect culms, to more loosely tufted plants with culms which may be geniculately ascending or shortly decumbent at the base. However, it was not found possible to score herbarium specimens for habit with any degree of confidence, as such information is seldom present on the label or clearly evident from the specimen itself. This examination of variation was therefore confined to a study of leaves, culms and inflorescence characters throughout the range in Africa, as represented in the herbarium at Kew.

The total number of specimens scored for each country or area is listed in Table 1. Neighbouring countries have sometimes been grouped where insufficient records were available for a country by country analysis. These groups, as shown in Table 1, apply to all the figures in the analysis of *Brachiaria brizantha*. The three collections from Mozambique are marked on the map, but have not been included in the analysis.

TABLE 1. Number of specimens studied

West Africa (mostly Nigeria, but including Guinea, Sierra Leone, Ivory Coast, Ghana, W. Cameroon)	3
Chad, French Cameroun, Central African Republic	1
Sudan	1
Ethiopia	2
Kenya	4
Uganda	4
Tanzania	5
Rwanda, Burundi	1
Zaire	6
Zambia	3
Malawi	2
Zimbabwe	5
Angola	9
Mozambique	3
South Africa (Namibia, Transvaal, Natal, Lesotho)	3

B.1. Leaves

The leaf-blades of *B. brizantha* vary greatly in leaf length, width and in the proportion of length to width, varying from linear to broadly linear or linear-lanceolate. There is also much variation in the nature and density of leaf pubescence.

Leaf dimensions

The variation ranges for leaf length and leaf width for each country are shown in Fig. 2, and the means and standard deviations are listed in Table 2. There is clearly a large range of variation in leaf dimensions throughout Africa, with little difference in the means for each country. Nevertheless, some regional trends are detectable. The average leaf length is 30cm or a little more, but plants from Kenya and Uganda generally have somewhat shorter leaves (Fig. 3a). The histogram for South Africa (Fig. 3c) illustrates a more typical frequency curve. In West Africa and Chad the leaves are on average longer than usual (Fig. 3b). The greatest range of variation occurs in southern tropical Africa, especially Zaire (Fig. 3d).

Variation in leaf width matches quite closely that for leaf length. Slightly wider than average leaf-blades occur from Sudan westwards to West Africa (Fig. 4b), corresponding to the somewhat longer leaves from that area. The lower than average values for Malawi (Fig. 4a) and Angola may reflect the paucity of collections at Kew from these countries. The histogram for Ethiopia (Fig. 4c) illustrates the average situation with a mean value for leaf width of about 10mm. The greatest range of variation again occurs in Zaire (Fig. 4d).

There is no real regional variation in shape of the leaf-blades, although some countries contain a wider range of the total variation than others. For example, Zimbabwe exhibits the full range from short linear-lanceolate blades under 20cm long, to blades up to 75 cm long which may be narrowly or broadly linear. In contrast, in Uganda leaf-blades over 35cm long are unusual although at the lower end of the size range, variation in Uganda matches that in Zimbabwe very closely (Fig. 5).

Leaf pubescence

The leaves, may be glabrous or thinly to densely pilose. Sometimes the leaf-sheaths may be hairy whilst the blades are glabrous, or one side only of the blade may be hairy. In the scatter graphs (Figs. 5-7) specimens are shown as "hairy" only when hairy on both sides of the leaf-blade and also on the sheath. Specimens glabrous either on the sheath or one or both sides of the blade are shown as "partially hairy".

In general, leaf pubescence varies widely from completely glabrous to densely hairy in all areas studied, and is uncorrelated with any other character. The situation in Nigeria (Fig. 6) is typical, where glabrous and variously hairy forms are found throughout the whole size range for the leaf-blades (see also Fig. 5). Leaf pubescence thus appears to be a character of negligible taxonomic value, and there is some evidence from herbarium labels that it may even vary at the population level.

Interestingly, there are no really hairy specimens from South Africa. Plants from Natal are completely glabrous, whilst those from Transvaal are either glabrous or hairy usually only on the leaf-sheaths (Fig. 7). The South African population of *B. brizantha* is relatively uniform, varying in all measurements over a fairly narrow range with low standard deviation values (Table 2). It lies at the extreme southern end of the distribution range, and it seems likely that only a limited part of the total pool of variability in the species has reached this far south.

B.2. Inflorescence

The inflorescence of *B. brizantha* is composed of 1-several racemes spaced along a central axis. Both the number and length of the racemes varies considerably. The range of variation in both these characters for each country is shown in Fig. 8, and the means and standard deviations are listed in Table 2. As with leaf dimensions, raceme length is variable within each country, and only slight regional differences are detectable. The longest racemes on average occur in West Africa (Fig. 9b), where the leaves are also longer. Otherwise, there is very little difference between the means for raceme length throughout Africa, with an average raceme length of about 9cm; the histogram for Zimbabwe (Fig. 9a) is typical. Again, as with leaf dimensions, the greatest range of variation occurs in southern tropical Africa, especially Zaire and Zambia (Fig. 9d). In contrast, the South African population is very uniform with a narrow frequency curve (Fig. 9c).

The pattern of variation for raceme number is remarkably uniform, with 2-4 racemes per inflorescence being the norm throughout virtually the whole of Africa. The number of racemes can also vary between different inflorescences of the same plant. Plants or individual inflorescences with only one raceme are found throughout, and this state just represents one end of the variation curve, so should not be regarded as exceptional or atypical. However, in nearly all countries there is a "tail" on the histogram extending towards the upper end, with a few individuals possessing markedly more racemes; the histograms for Kenya (Fig. 10a) and Zambia (Fig. 10c) are typical. In West Africa most collections have an inflorescence composed of two long racemes (Fig. 10b). Sudan also differs from the general pattern; here a higher proportion of inflorescences are made up of more than four racemes (Fig. 10d).

B.3. Culms

One of the most obvious sources of variation in *B. brizantha* is that of plant habit and vigour. Whilst these are characters of prime importance to the agronomist, they are unfortunately less easy to study in herbarium material than other vegetative characters. The culms are usually erect but may be geniculate at the base, forming a looser tuft, and vary from small plants under 1m high to tall robust forms approaching 3m in height.

The range of variation in culm height and culm diameter (used as a measure of vigour and measured near the culm base) for each country are shown in Fig. 11. Clearly, most of the variation is spread evenly across Africa, with no significant regional differences. The means are probably biased towards the lower end, as it was frequently impossible to take an accurate measurement of taller, more vigorous plants when only the upper portion of the plant is likely to have been collected. Additionally, it is likely that collectors avoid the biggest plants in favour of shorter specimens which fit more easily into a plant press.

It is impossible to assess the habit when the lower portions are missing, and often difficult even when the base is present, if only one culm has been pulled from a tuft. From this data the average height of *B. brizantha* lies in the range 100-150cm with culms about 3mm in diameter. However, it should be remembered that grazing and savanna fires will often also contribute to a plant failing to reach its maximum potential height.

C. TAXONOMIC VARIETIES

Five varieties have been recognised taxonomically in *B. brizantha*, and these are enumerated below with a brief statement of the main characters by which they are said to be distinguished.

- a) ⁶⁰ Var. **latifolium** *Oliver* in Trans. Linn. Soc. 29: 170 (1875).

Type: Uganda, Bunyoro District, *Grant* (K, holotype).

Culms decumbent, 90-120cm (3-4ft); leaves linear-lanceolate, 7.5-13cm (3-5in) long, 12-17mm ($1\frac{1}{2}$ - $2\frac{2}{3}$ in) wide, sparsely pilose or glabrous; racemes 4-5, 5-6cm ($2-2\frac{1}{2}$ in) long.

- b) ⁴ Var. **angustifolia** *Stent & Rattray* in Proc. Trans. Rhod. Sci. Ass. 32: 23 (1933).

Types: Zimbabwe, Harare [Salisbury], *Eyles* 1921 (K, syntype).

"Differs from the type in being a much more slender plant with narrower leaves".

- c) Var. **pandanifolium** *Peter* in Repert Nov. Sp. Regni Veg., Beihefte, 40, Anh.: 31 (1930).

Type: Tanzania, Tabora District, *Peter* 35122 (B, holotype, destroyed).

Culms 1.6m high; leaf-blades 15mm wide with coarsely and sharply serrate margins; inflorescence usually of 4-5(-7) racemes.

- d) ⁷ Var. **lasiochloa** *Chiovenda* in Nuov. Giorn. Bot. Ital. n.s., 26: 65 (1919).

Types: Zaire, Shaba [Katanga], *Bovone* 29 & 75 (TO, syntypes).

"Sheaths, leaves and lower part of the internodes densely and softly villous; plant much bigger".

- e) ⁸⁰ Var. **polystachyum** *De Wildeman & Th. Durand*, Pl. Thonn. Cong.: 3 (1900).

Type: Zaire, near Ndobu [$2^{\circ}13'N$ $22^{\circ}11'E$], *Thonner* 78 (BR, holotype).

Culms robust, c.2m high; leaves 60cm x 18mm, glabrous; racemes 6-9, 10-18cm long.

Var. *latifolium* and var. *angustifolia* are based mainly on leaf dimensions, and their position relative to the general pool of variation is indicated in Fig. 5. Both can be seen to be no more than rather extreme forms lying at the margin of the range of variation for *B. brizantha*. Var. *latifolium* falls within the overlap zone with *B. decumbens* (Fig. 12), having linear-lanceolate leaves and a laxly ascending habit. However, its narrow crescentic rhachis, cartilaginous spikelets and sparsely hairy leaf-blades are all good "brizantha" characters. Var. *pandanifolium* is based on a Tanzanian specimen with broader leaf-blades and reputedly more strongly serrate leaf-margins than usual. The type specimen is no longer extant, but the measurements given in the description fall comfortably within the variation range known to occur in Tanzania.

Var. *lasiochloa* is based on a big, particularly hairy collection from Zaire, but hairiness has been shown to be a character of negligible taxonomic value (see section B.1), probably controlled by very few genes and uncorrelated with plant vigour. Var. *polystachyum* is likewise based on a particularly robust form, this time with glabrous leaves and rather many, long racemes.

All these varieties are based on rather atypical specimens from the boundaries of the variation pool of *B. brizantha*, but none are in any way distinctive and the characters on which they are based merge completely into the main body of variation. As such, there is no basis on which they can be upheld as separate taxa. A taxon must be recognisable as a discrete entity, or at least be distinguished by a distinctive character before it can be accorded separate taxonomic status. In a species as variable as *B. brizantha* there will always be a few specimens which fall outside the normal range of variation (see Figs. 2,7,11).

The commercial cultivar "Marandu" is a particularly robust form with tall stout culms (CIAT 6780; Renvoize "type A"). It may correspond with var. *lasiochloa* or *polystachyum*, but there is no authentic material of either of these at Kew for comparison. Cultivar "La Libertad" (CIAT 26646) is a rather slender form of average dimensions and does not correspond to any of the taxonomic varieties.

The CIAT collection of *Brachiaria brizantha*

During the period of field work the plants of *B. brizantha* at Quilichao were sorted into 7 types according to the habit of the plants. The accessions which corresponded to each type are indicated in appendix 9.4. The types are identified as follows:-

Type A

Robust culms in dense tufts, stolons absent, culms usually erect, up to 2.5 m high. Leaf-blades broadly linear, up to 30mm wide, glabrous, subglabrous or pilose. Leaf-sheaths glabrous, pubescent or pilose. Three accessions of this type are unusual as they have decumbent culms, they are: nos. 16812, 16872 and 26389.

Type B

Plant loosely tufted, culms decumbent, slender and wiry. Leaf-blades linear, glabrous, up to 12mm wide.

Type C

Plant in very dense tufts. Leaf-blades linear, narrow, stiff and erect from the base of the plant. Rachis of racemes very narrow.

Following the assignment of accessions to this type it was later realised that the following numbers were similar to each other but different from the rest and possibly represent a separate type: nos. 16452, 16810 and 16820.

Type D

Plants loosely tufted, culms erect or ascending and rooting at the lower nodes. Leaf-blades linear, 10-20mm wide, usually glabrous, rarely pilose. Racemes (1-) 3-6; rachis 1mm wide.

Type E

Plant tufted. Leaf-blades narrowly lanceolate, 15-25mm wide.

Type F

This type is similar to type D but the leaf-blades are shorter and often at a wider angle with the culm.

Type G

Plants tufted, with erect or ascending culms. Leaf-blades linear, 10-20mm wide, vertical. This type is similar to type C but the leaf-blades are wider.

The preparation of these descriptions is very subjective; they are not strictly comparable as they were intended as rough notes to serve as a means of identifying the types during the period of field work. The task of describing what at times are very vague facies became almost impossible. The best way to understand how these types differ is to observe the living plants. Nearly all the visits made to Quilichao were in the company of Alba Marina Torres, with the express purpose of training her in the identification of these different growth forms.

Duplicates received at Kew of herbarium specimens of the Quilichao accessions were assembled in groups according to the types to which they had been assigned on the basis of habit observed in the living plants. From these groups of specimens data on culm height, leaf-blade length and width and raceme number and length, were taken and subjected to a discriminate function analysis. This analysis however failed to confirm the groups of *B. brizantha* identified at Quilichao. The type of characters which seemed to identify the groups in the field, habit, density of the tuft, angle of the leaf-blade, failed to translate to herbarium specimens.

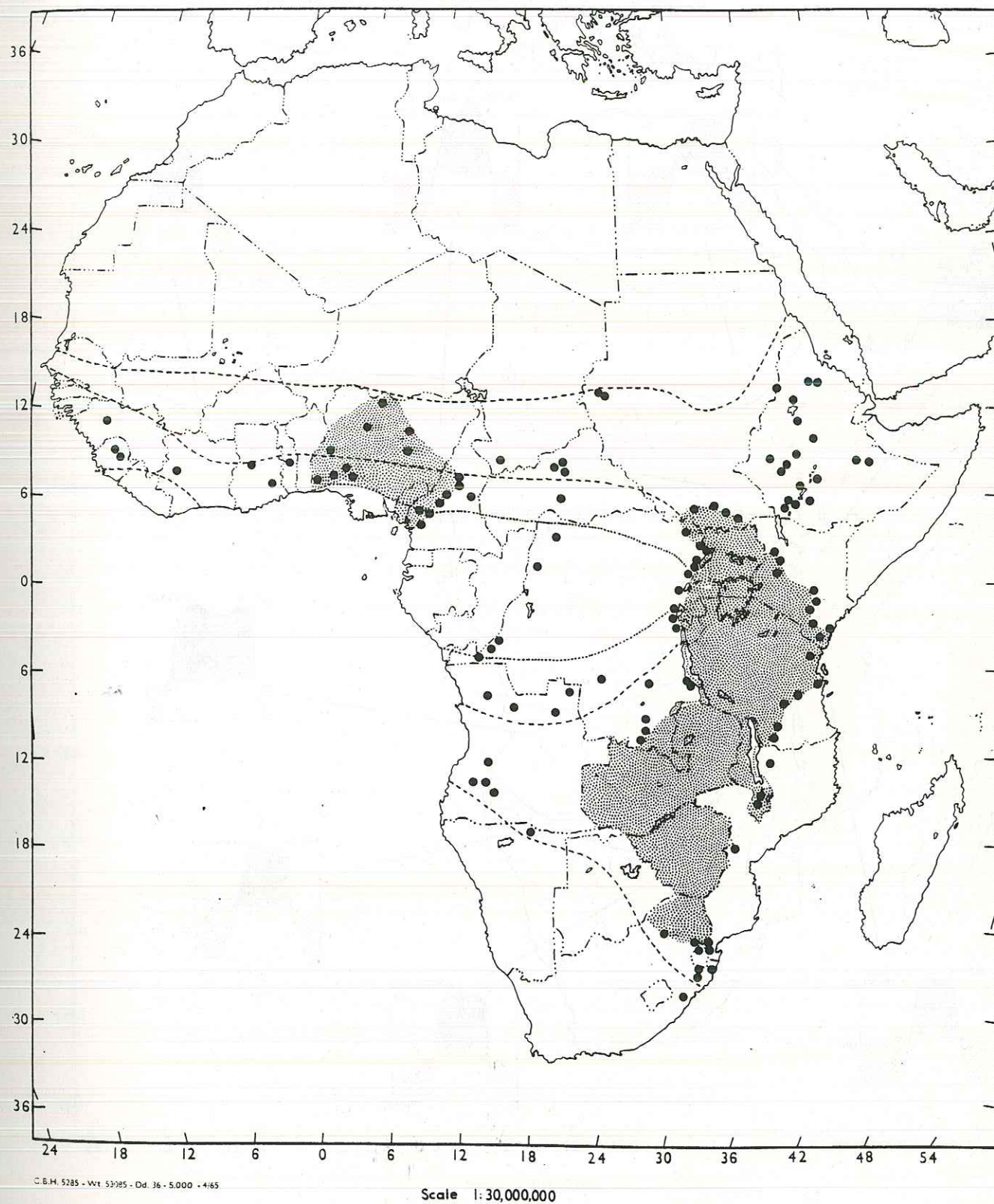
The impression gained in the field was that different genotypes vary in their response to a cutting regime. A precise cutting schedule is necessary in order that accurate comparisons can be made; see 7, General Discussion.

CARIMAGUA

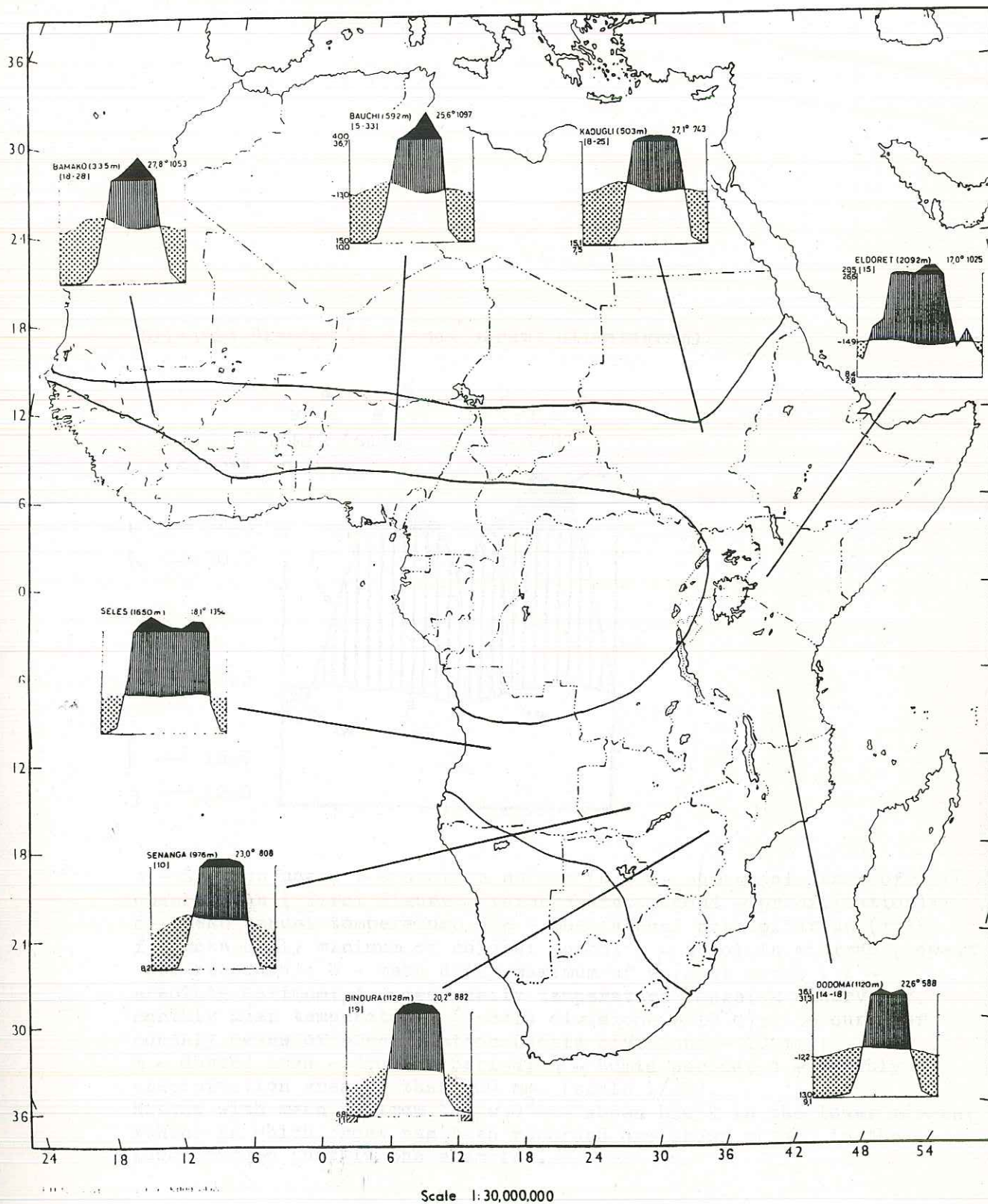
Eleven CIAT accessions are currently being utilized in the hybridization programme at Carimagua and are listed below. The accessions of *B. brizantha* have been assigned to one of the field types described on the previous page.

CIAT number

606	<i>Brachiaria brizantha</i>		see 9.4. also at Quilichao
6690	"	"	type E, " "
6780	"	" cv. Marandu,	type A, " "
16107	"	"	type D, " "
16162	"	"	type C, " "
16338	"	"	type C, " "
16829	"	"	type E, " "
26646	"	" cv. La Libertad,	type D, " "
26185	<i>Brachiaria decumbens</i>		" "
26186	"	"	" "
26303	"	"	" "

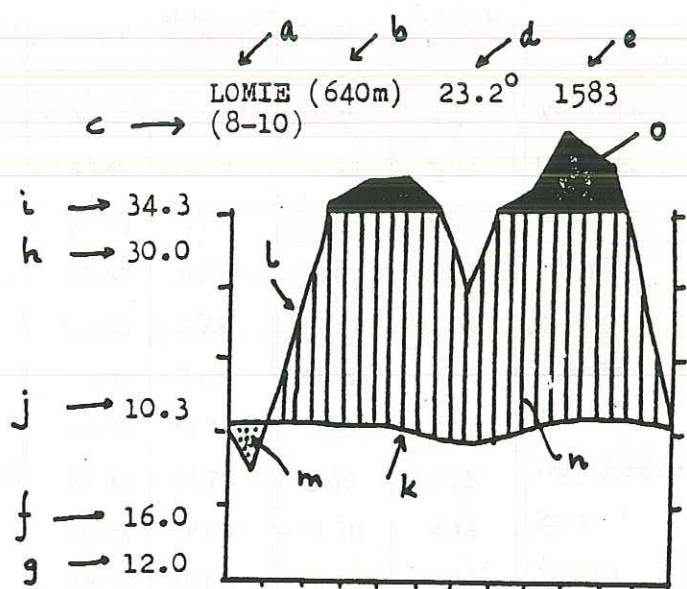


Map 1. Distribution of *Brachiaria brizantha*. Within shaded areas collections too numerous to show individually.



Map 2. Selected climatic diagrams to illustrate rainfall patterns within the Sudano-Zambezian Region. For an explanation of climatic diagram data see Fig. 1.

Climatic Diagram (Klimadiagram; Climatogram).



a - Station name; b - station height (m); c - number of years of observation (first figure - temperature, second - precipitation); d - mean annual temperature ; e - mean annual precipitation (mm); f - mean daily minimum of coldest month; g - absolute minimum (lowest ever recorded); h - mean daily maximum of warmest month ; i - absolute maximum; j - mean daily temperature range; k - curve of monthly mean temperatures (scale divisions - 10°C); l - curve of monthly means of precipitation (scale divisions - 20 mm); m - dotted area - drought period; n - humid period; o - monthly precipitation greater than 100 mm. (scale 1/10). Months with mean minimum below 0° are shown black in the lower margin; months in which frost has been recorded are shown shaded in the lower margin (not in the example).

Fig. 1. Explanation of a Climatic diagram.

	leaf length cm		leaf width mm			raceme length cm		raceme number	
	mean	standard deviation	mean	standard deviation		mean	standard deviation	mean	standard deviation
West Africa	40.50	13.91	12.42	3.54	West Africa	12.74	2.66	3.05	2.07
Chad etc.	43.44	10.19	11.22	3.03	Chad etc.	12.5	3.35	3.12	1.83
Sudan	33.15	9.75	13.06	2.15	Sudan	10.19	3.11	5.11	2.49
Ethiopia	27.37	9.88	10.07	2.01	Ethiopia	7.83	2.52	3.46	1.22
Kenya	23.99	9.78	10.31	2.62	Kenya	7.28	2.45	3.39	2.09
Uganda	24.09	7.88	11.39	2.34	Uganda	8.36	2.63	3.80	2.02
Tanzania	29.66	11.93	9.46	2.91	Tanzania	8.20	3.05	3.02	1.16
Rwanda, Burundi	31.41	14.73	9.45	2.25	Rwanda, Burundi	7.95	3.42	3.09	0.70
Zaire	36.27	18.88	11.70	4.18	Zaire	10.14	3.64	3.80	2.56
Zambia	42.59	15.95	10.26	3.19	Zambia	10.7	3.75	3.41	1.72
Malawi	29.50	9.32	8.73	2.86	Malawi	7.23	3.00	2.96	0.92
Zimbabwe	30.51	11.89	9.98	2.93	Zimbabwe	8.45	2.79	3.24	1.45
Angola	30.63	10.10	8.63	4.10	Angola	8.13	3.51	2.63	0.52
South Africa	30.38	8.59	11.19	2.48	South Africa	7.68	1.93	4.06	1.77

Table 2. Means and standard deviation of leaf and raceme characters of *Brachiaria brizantha*. Leaf-width was measured to the nearest 0.5mm.

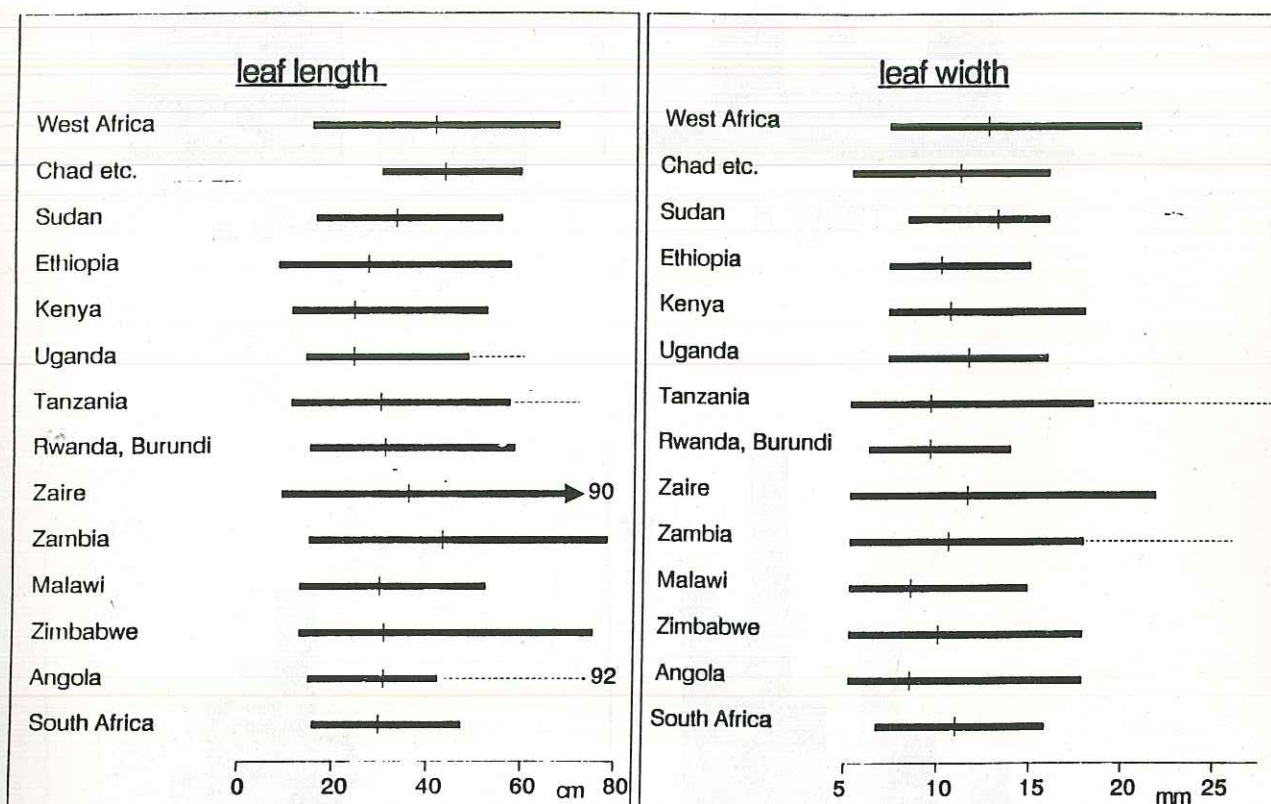


Fig.2. Variation in leaf dimensions for *Brachiaria brizantha*

Broad horizontal bar corresponds to the range of variation within each country; narrow vertical line = mean. Dashed line extends to variation range of exceptional specimens which were excluded when calculating mean.

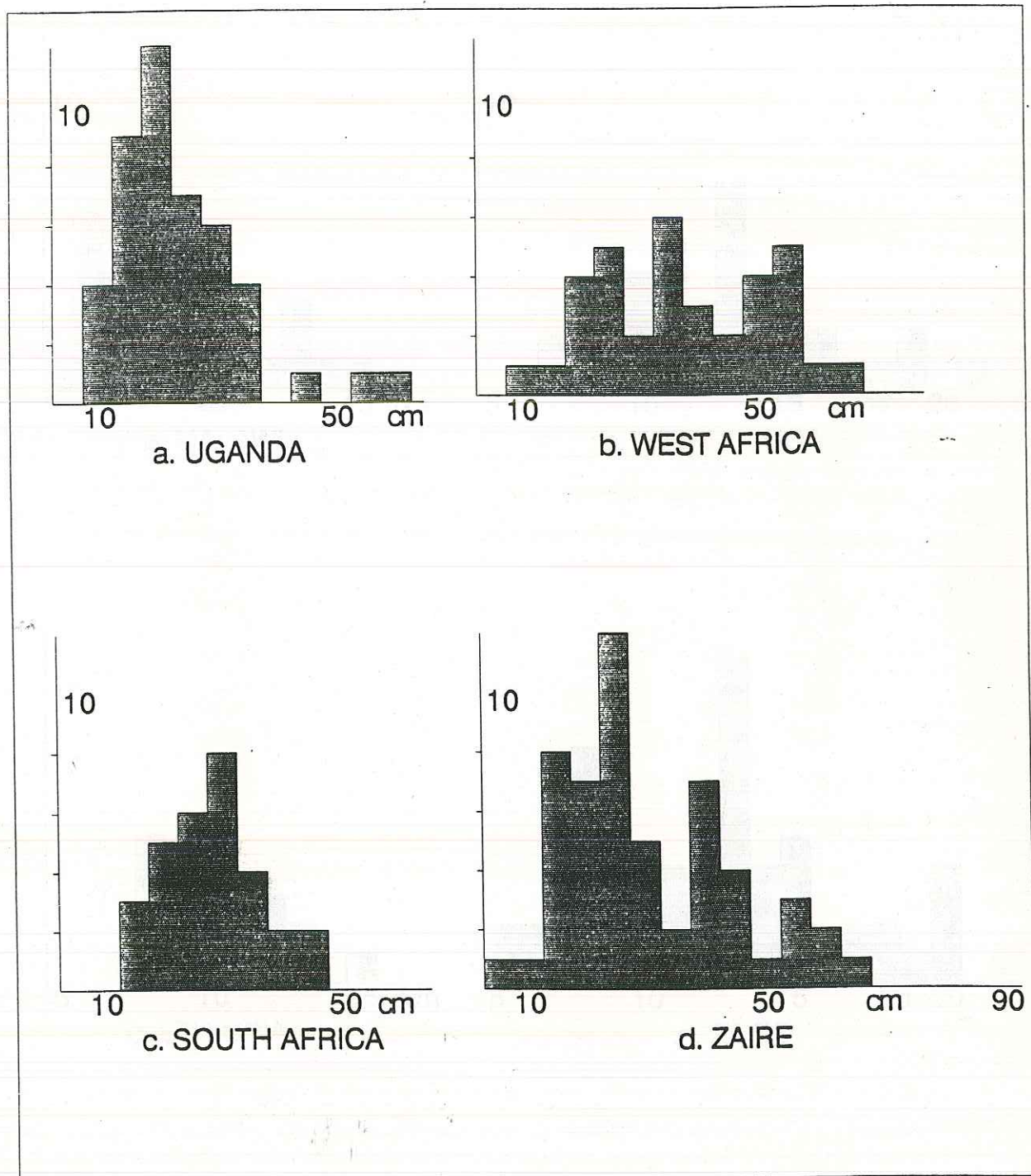


Fig. 3. Histograms of leaf length for *Brachiaria brizantha* in four areas of Africa. Horizontal scale = leaf length (bar width 5cm). Vertical scale = number of specimens.

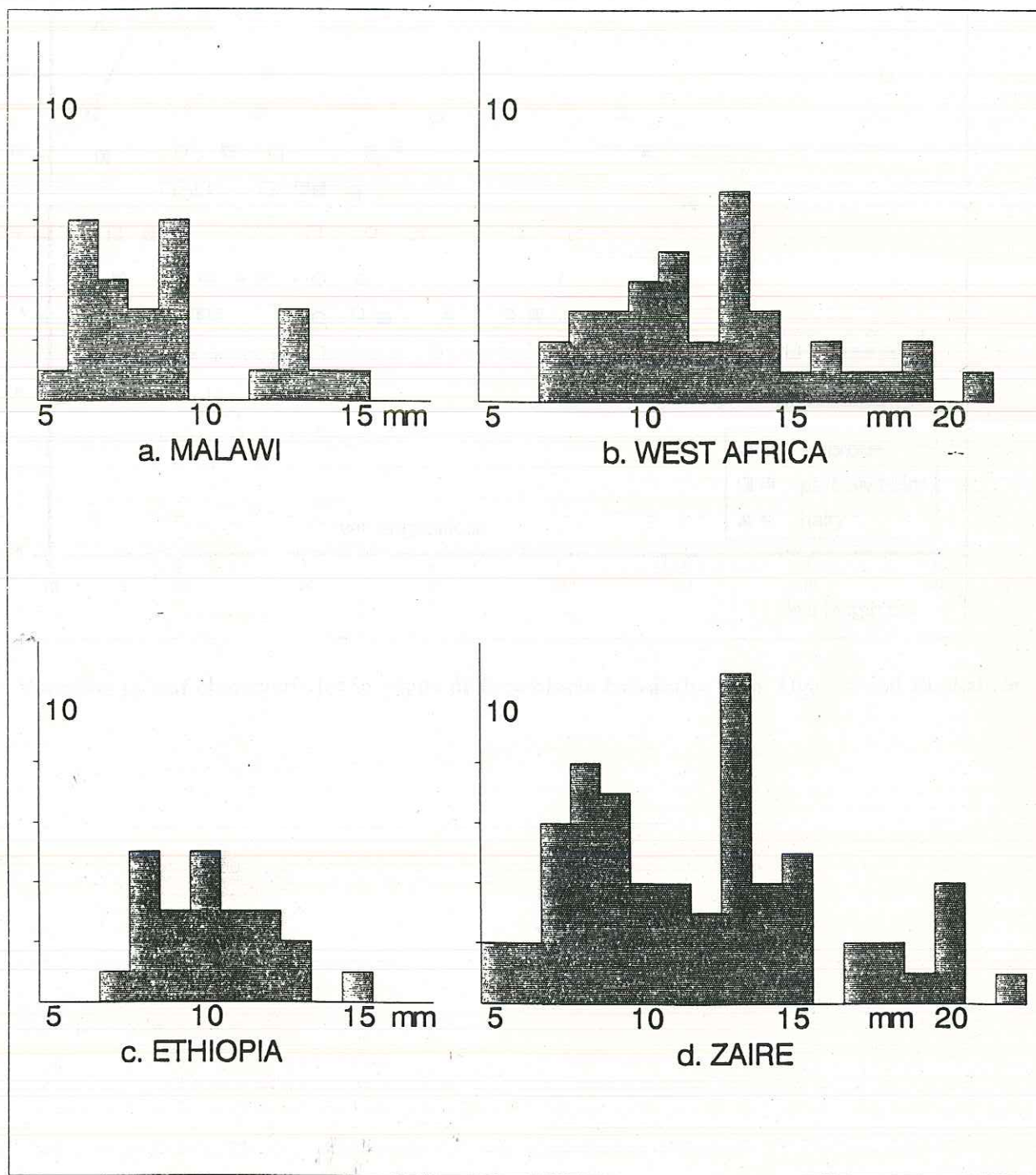


Fig. 4. Histograms of leaf width for *Brachiaria brizantha* in four areas of Africa. Horizontal scale = leaf width (bar width 1mm). Vertical scale = number of specimens.

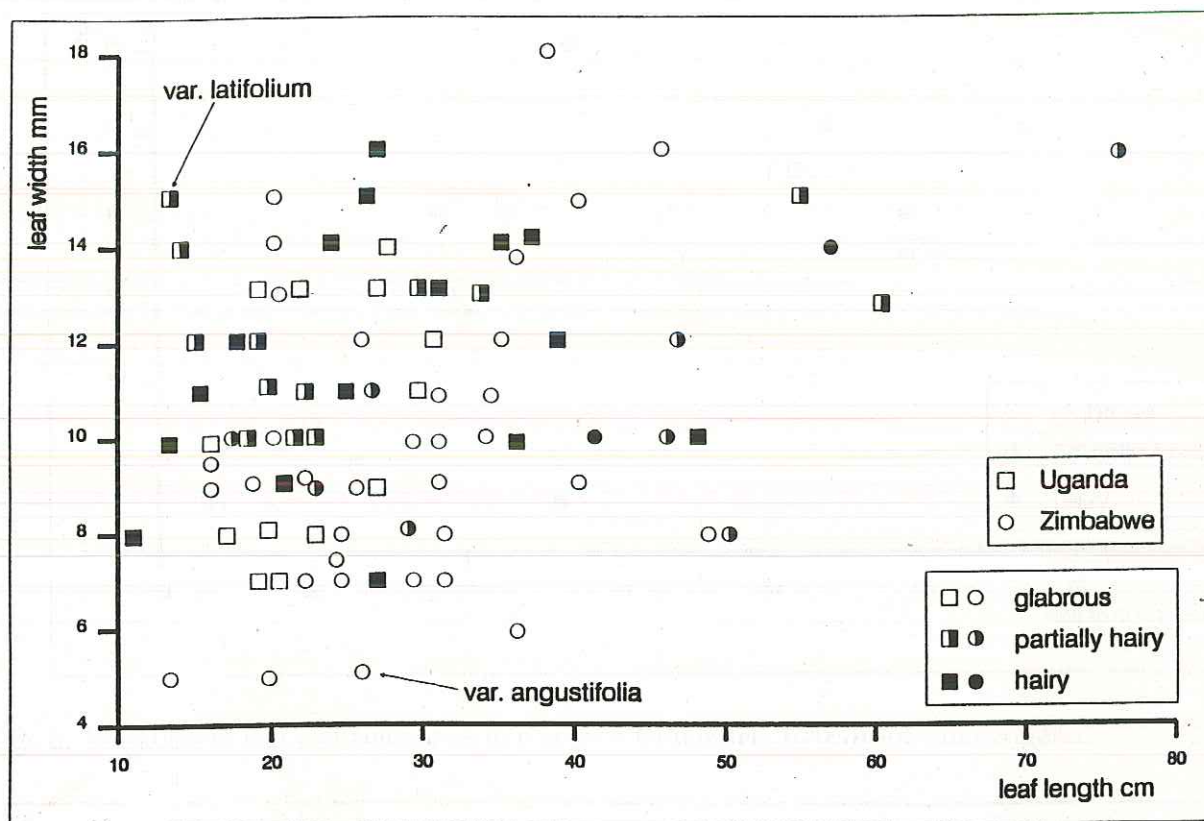


Fig. 5. Variation in leaf characteristics in plants of *Brachiaria brizantha* from Uganda and Zimbabwe.

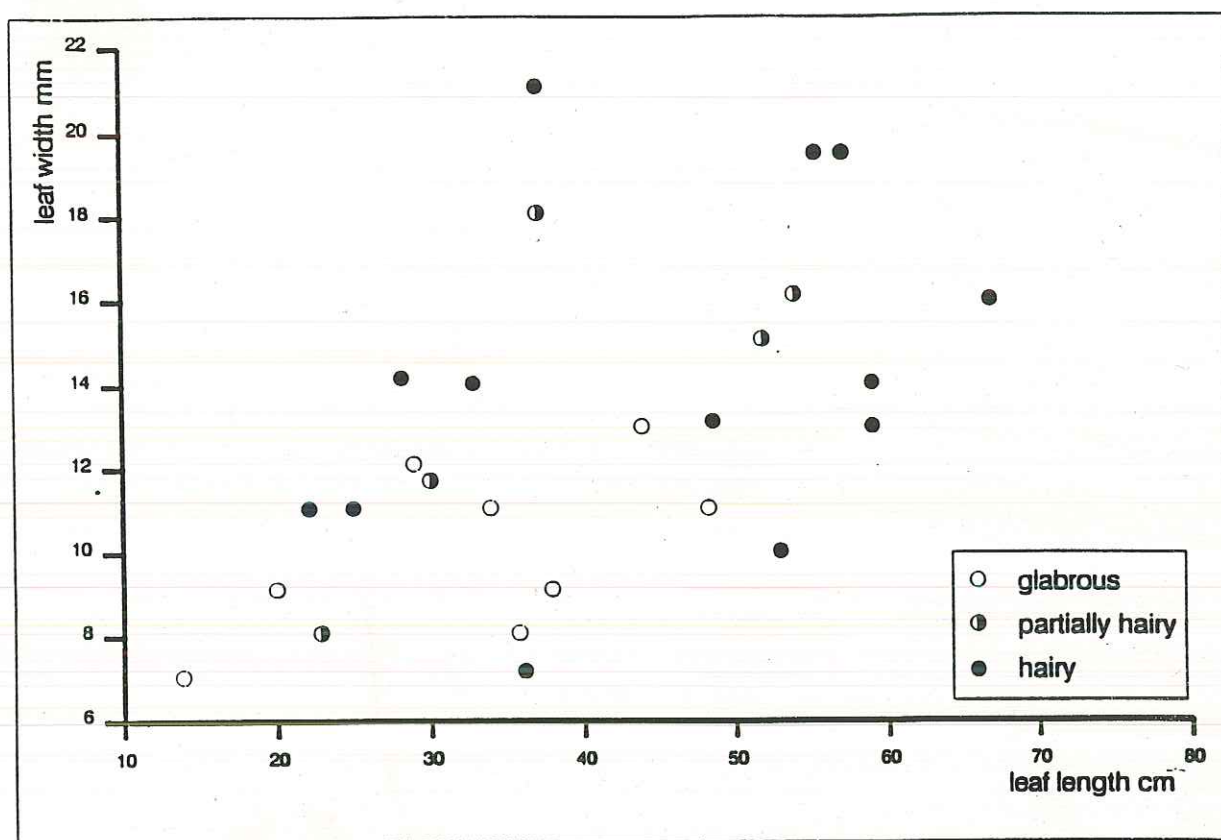


Fig. 6. Variation in leaf characteristics in plants of *Brachiaria brizantha* from Nigeria.

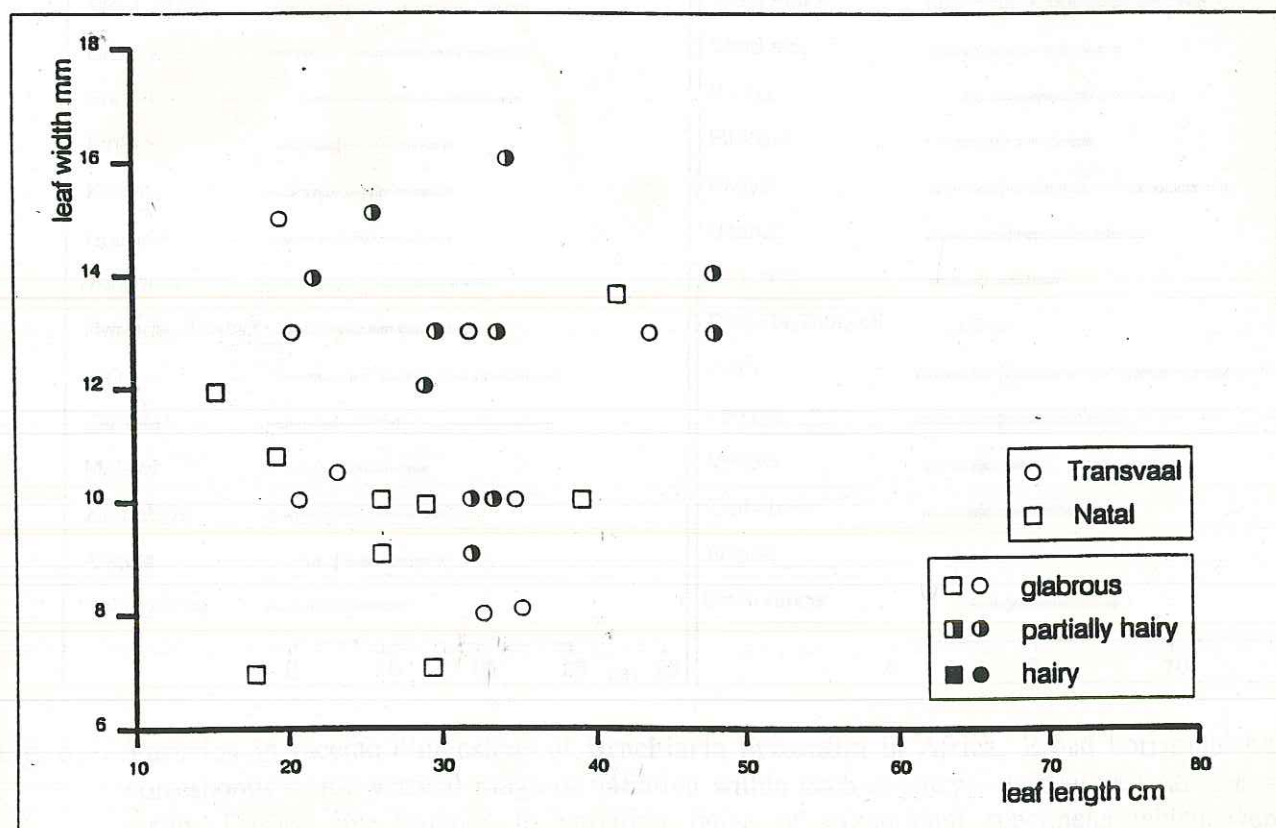


Fig. 7. Variation in leaf characteristics in plants of *Brachiaria brizantha* from South Africa.

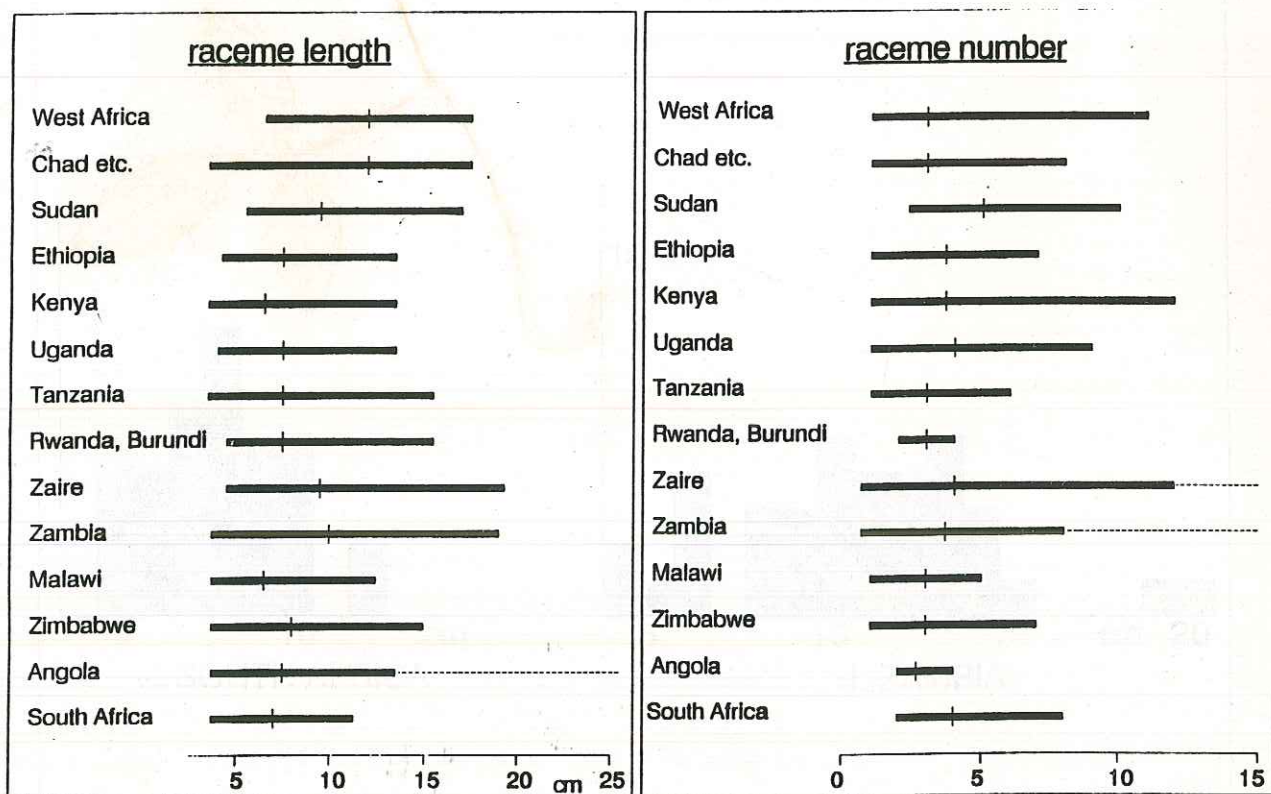


Fig. 8. Variation in raceme dimensions of *Brachiaria brizantha* in Africa. Broad horizontal bar corresponds to the vertical range of variation within each country; narrow vertical line = mean. Dashed line extends to variation range of exceptional specimens which were excluded when calculating mean.

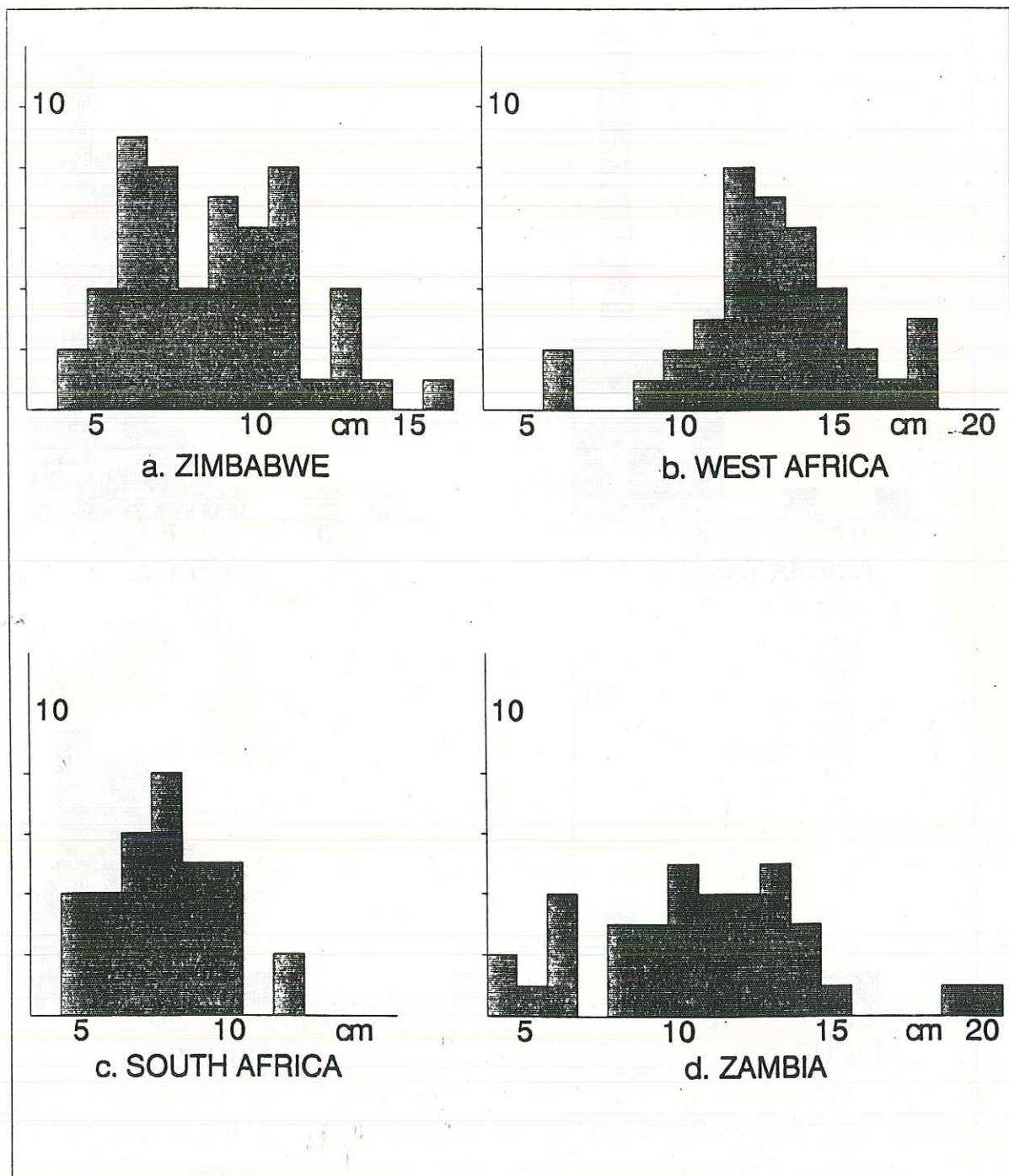


Fig. 9. Histograms of raceme length for *Brachiaria brizantha* in four areas of Africa. Horizontal scale = raceme length (bar width 1cm). Vertical scale = number of specimens.

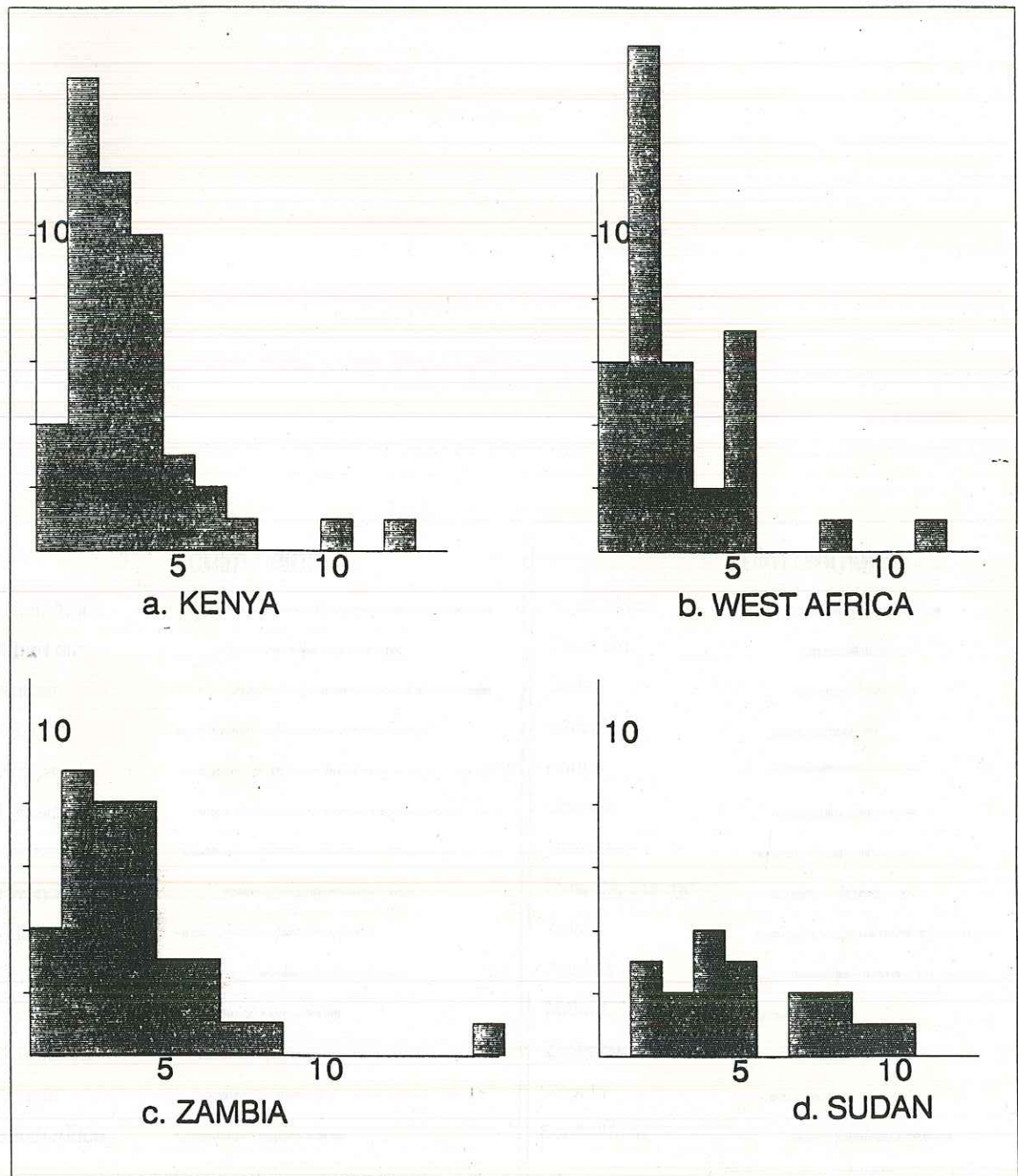


Fig. 10. Histograms of raceme number for *Brachiaria brizantha* in four areas of Africa. Horizontal scale = number of racemes. Vertical scale = number of specimens.

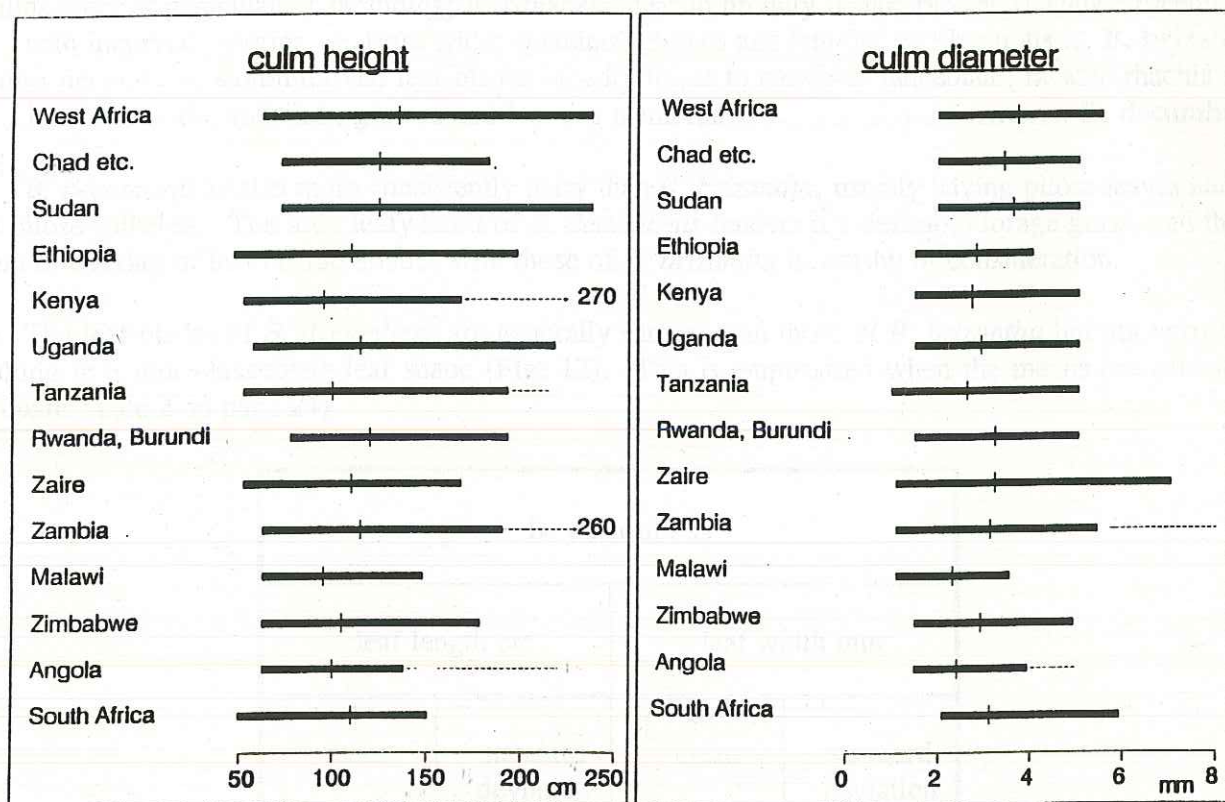


Fig. 11. Variation of culm dimensions in *Brachiaria brizantha* in Africa. Broad horizontal bar corresponds to the vertical range of variation within each country; narrow vertical line = mean. Dashed line extends to variation range of exceptional specimens which were excluded when calculating mean.

6.1.3. *B. decumbens* Stapf in Flora of Tropical Africa 9:528 (1919).

Synonym: *B. bequaertii* Robyns in Bull. Jard. Bot. Brux. 9:177 (1932) & Fl. Agrost Congo Belge 2:102 (1934).

Stoloniferous perennial with decumbent culms 50-150cm high. Leaf-blades lanceolate, 5-20cm long, 7-15mm wide. Inflorescence of 2-7 racemes 1-6cm long, on an axis 1-8cm long. Spikelets borne singly, usually in 2 rows; rachis flat or triquetrous, 1-1.8mm wide, ciliate on the margins. Spikelets elliptic, 4-5mm long, usually pubescent, with a slight stipe at the base. Lower glume 1/3-1/2 the length of the spikelet, clasping, 9-11-nerved, acute or obtuse; upper glume membranous, separated from the lower by an internode, 7-nerved; lower lemma similar to the upper glume; 5-nerved; upper lemma granulate or finely striate, acute.

DISTRIBUTION: Uganda, Tanzania, Kenya, Rwanda, Burundi, Zaire. Map 3.

ECOLOGY: Deciduous bushland and forest margins; 600-1800m.

Fig. 14 illustrates the frequency and variation of the characters of significance in this report.

B. decumbens is a segregate from *B. brizantha* occurring in East Africa. It is distinguished by a combination of vegetative and floral characters, each rather ill-defined and intergrading taken in isolation, but adding up to a recognisable facies. These differences can be summarised as follows:

Culms erect or geniculately ascending; leaf-blades linear to broadly linear; raceme rhachis crescentic with incurved margins, $\pm$ 1mm wide; spikelets, glumes and lemmas cartilaginous.... ***B. brizantha***
Culms decumbent, stoloniferous; leaf-blades broadly linear to narrowly lanceolate; raceme rhachis flat, 1-1.7mm wide; spikelets, glumes and lemmas membranous..... ***B. decumbens***

B. decumbens is also more consistently hairy than *B. brizantha*, usually having pilose leaves and also pilose spikelets. The low, leafy habit of *B. decumbens* renders it a desirable forage grass, and the extent of overlap of leaf characteristics with those of *B. brizantha* is worthy of consideration.

The leaf-blades of *B. decumbens* are generally shorter than those of *B. brizantha* but not narrower, resulting in a more lanceolate leaf shape (Fig. 12). This is emphasised when the means are calculated (compare Table 2 on page 24)

B. decumbens			
leaf length cm		leaf width mm	
mean	standard deviation	mean	standard deviation
11.52	3.68	10.84	1.93

Leaf dimensions for *B. decumbens* typically fall within the range 5-15cm long and 6-15mm wide. Whilst there is clearly considerable overlap with *B. brizantha*, the number of intermediates in the wild is actually rather low.

It is interesting to note that *B. decumbens* only occurs naturally in Uganda, neighbouring parts of Zaire, and in western Kenya and Tanzania, see Map 3. This is only a very limited part of the total distribution range of *B. brizantha*, but corresponds with that part of the range where the leaf-blades are shorter than usual but of average width, see Fig.2.

The CIAT collections

The relationship of variation in the CIAT collections of *B. decumbens* to that in the wild population is shown in Fig. 13. A high proportion of CIAT specimens fall in the intermediate range between *B. decumbens* and *B. brizantha*, with leaf-blades 15-20cm long. This is likely to be because such desirable forms, coupling a decumbent habit with big leaves, have been preferentially selected from the wild.

CIAT accessions of *B. decumbens* with leaf-blades 15-25cm long:

6691			
6701	16501	26156	26569
16498	16502	26182	
16499	26112	26187	

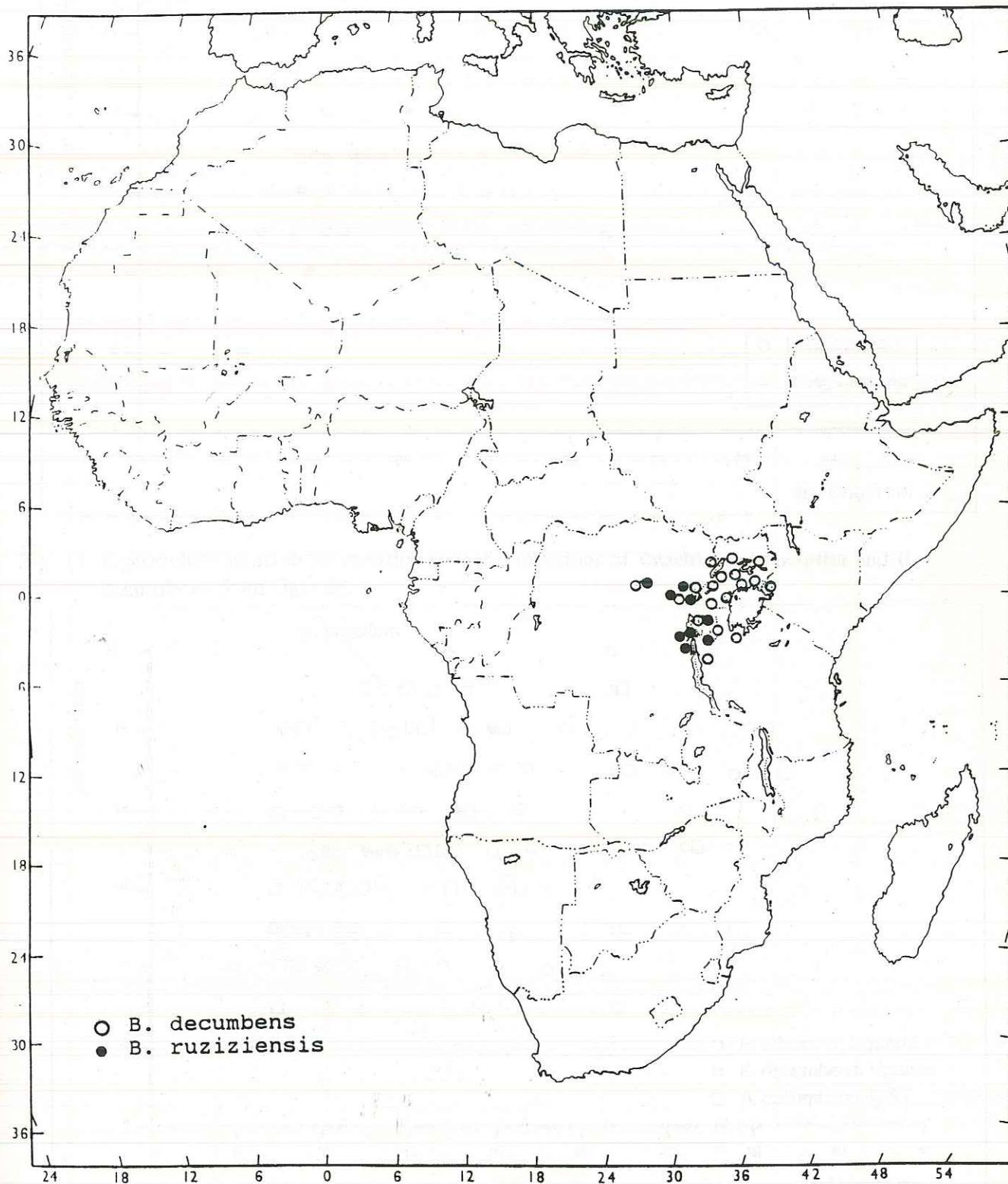
Five CIAT accessions have exceptionally long leaf-blades for *B. decumbens*, over 25cm, and fall well inside the normal range for *B. brizantha* (see Fig. 13), but nevertheless exhibit some "decumbens" characteristics as follows:

leaf-blade > 25 cm long.

6702	rhachis flat 1.5mm wide
16449	rhachis flat, 1.5mm wide
16492	stoloniferous
26183	rhachis flat, 1.2mm wide; stoloniferous
26321	stoloniferous

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Three accessions, 26185, 26186 and 26303, are being used in the hybridization programme, see 6.1.2. Only accession 26186 is duplicated at Kew.



Map 3. Distribution of *Brachiaria decumbens* and *Brachiaria ruziziensis*.

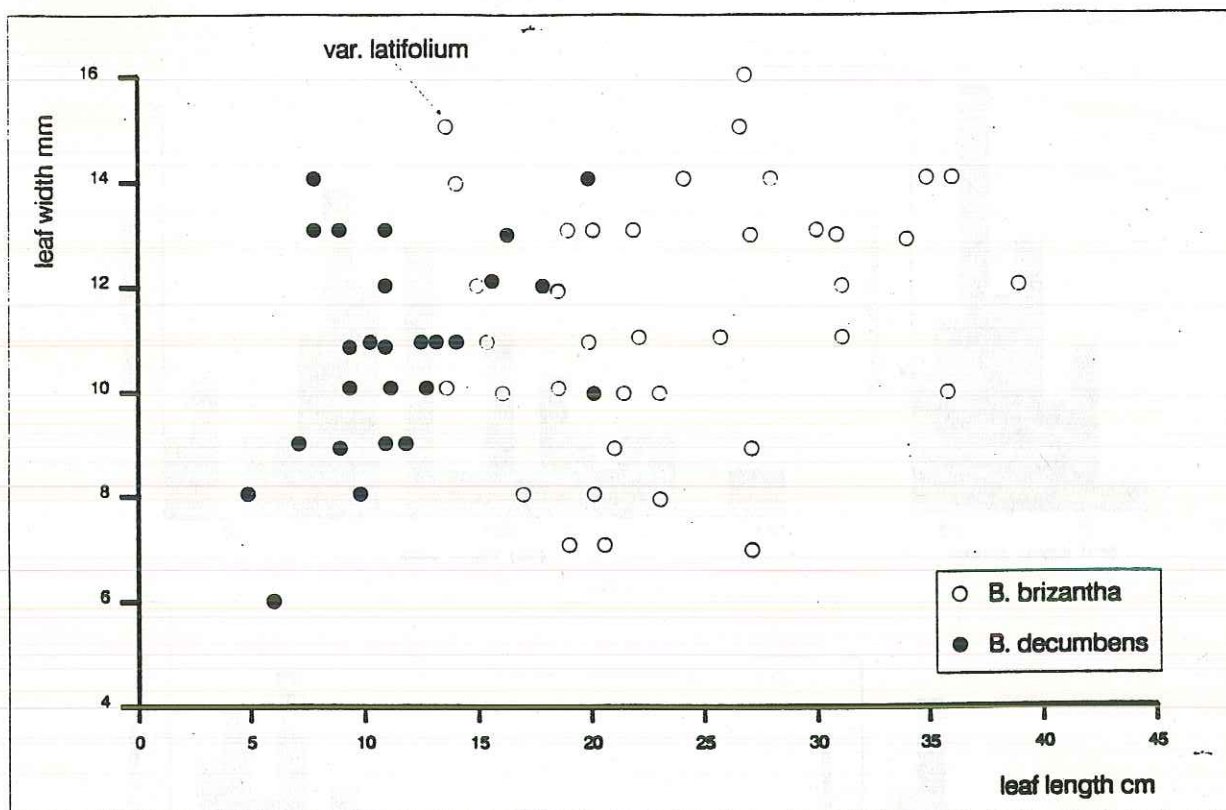


Fig. 12. Scatter diagram to show variation in leaf dimensions of *Brachiaria brizantha* and *B. decumbens* from Uganda.

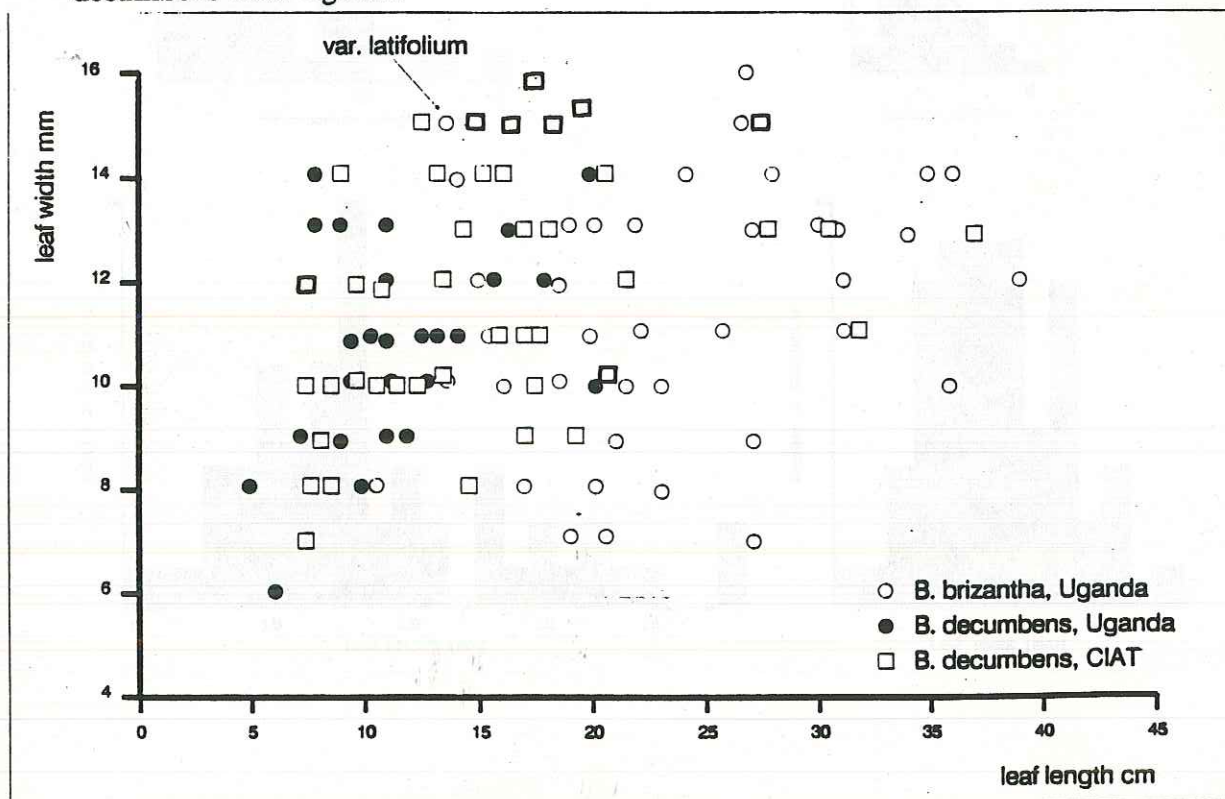


Fig. 13. Variation in leaf dimensions of CIAT accessions of *Brachiaria decumbens* superimposed on fig. 11.

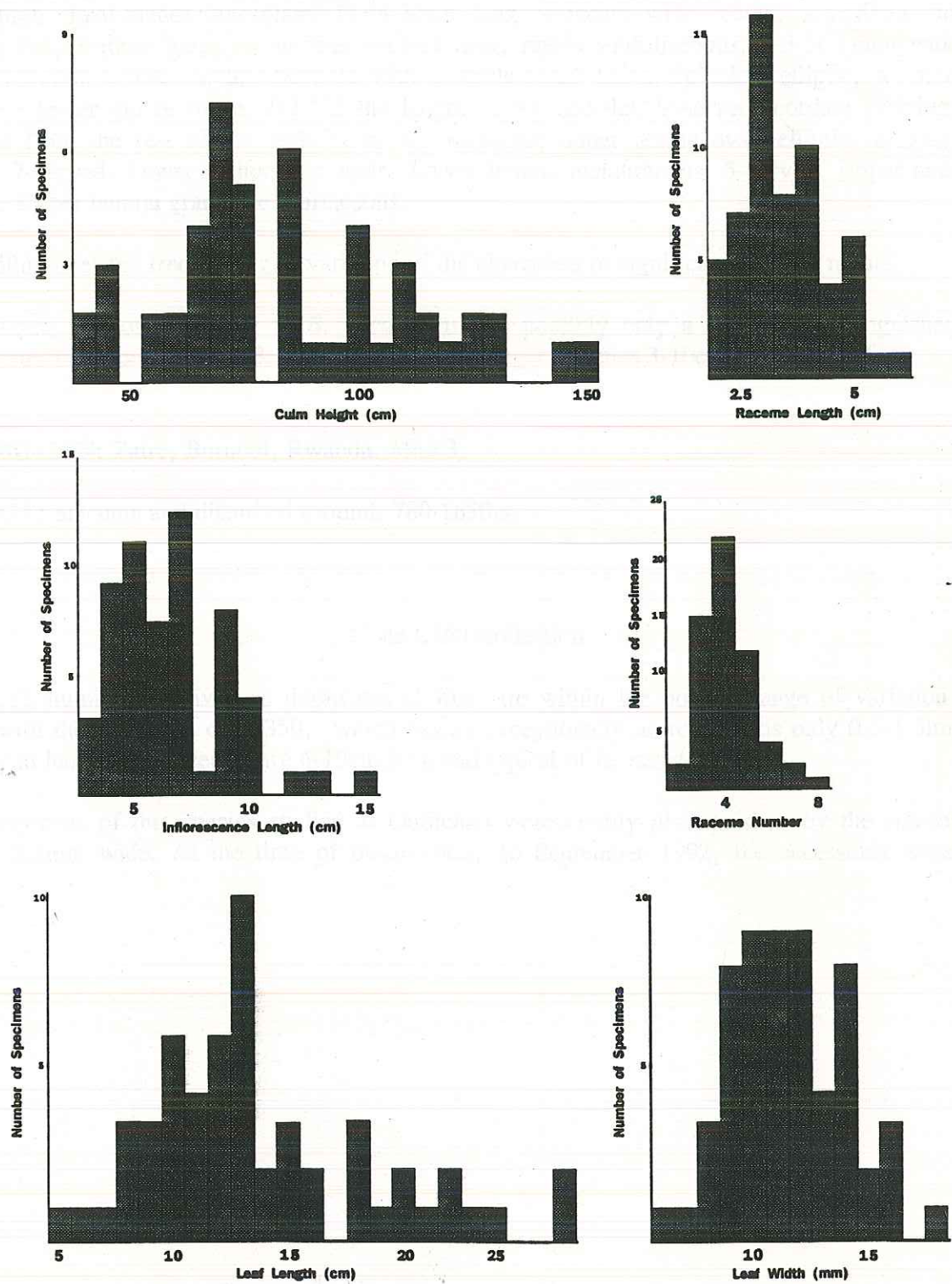


Fig. 14. Histograms of various features in *Brachiaria decumbens*.

6.1.4. *B. ruziziensis* Germain & Evrard in Bull. Jard. Bot. Brux. 23:373 (1953).

Stoloniferous, sparsely to densely pilose perennial with decumbent or geniculately ascending culms 50-175cm high. Leaf-blades lanceolate, (4-)8-30cm long, 4-16mm wide, acute, sometimes finely so. Racemes 2-8, 3-10cm long, on an axis 4-17cm long, rachis subfoliaceous, 2-3.5(-4)mm wide, often purple coloured, ciliate on the margins with tubercle-based hairs. Spikelets elliptic, 4-5mm long, pubescent; lower glume ovate, 1/3-1/2 the length of the spikelet, 9-nerved, cordate clasping, acute, separated from the rest of the spikelet by an internode; upper glume ovate-elliptic, as long as the spikelet, 7-nerved. Lower anthoecium male. Lower lemma membranous, 5-nerved. Upper anthoecium bisexual. Upper lemma granulose, coriaceous.

Fig. 15 illustrates the frequency and variation of the characters of significance in this report.

B. ruziziensis is closely related to *B. decumbens* and possibly only a segregate distinguished by its broader, subfoliaceous rachis 2-3.5(-4)mm wide and longer racemes 3-10cm long. Fig. 16.

DISTRIBUTION: Zaire, Burundi, Rwanda. Map 3.

ECOLOGY: Savanna and disturbed ground; 780-1650m.

The CIAT collection

CIAT numbers received as duplicates at Kew are within the normal range of variation for the species with the exception of 26350, which has an exceptionally narrow rachis only 0.5-1.5mm wide. However in length the racemes are 4-10cm long and typical of *B. ruziziensis*.

Specimens of this species studied at Quilichao were readily distinguished by the sub-foliaceous rachis 2-3.5mm wide. At the time of observation, 16 September 1992, the accessions were in full flower.

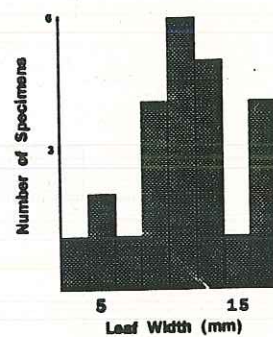
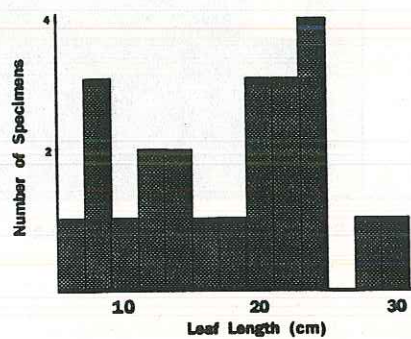
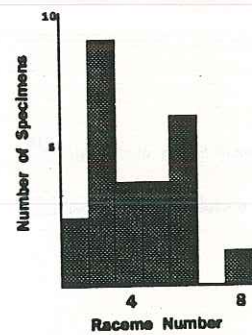
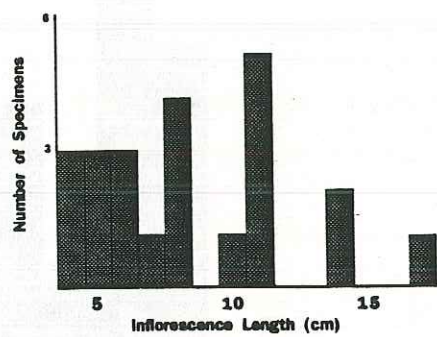
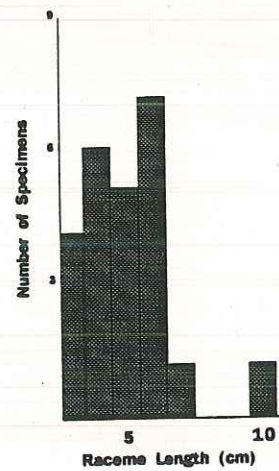
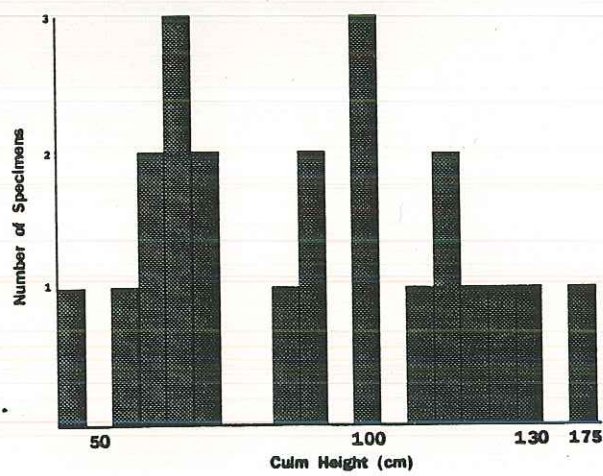


Fig. 15. Histograms of variation in *Brachiaria ruziziensis*.

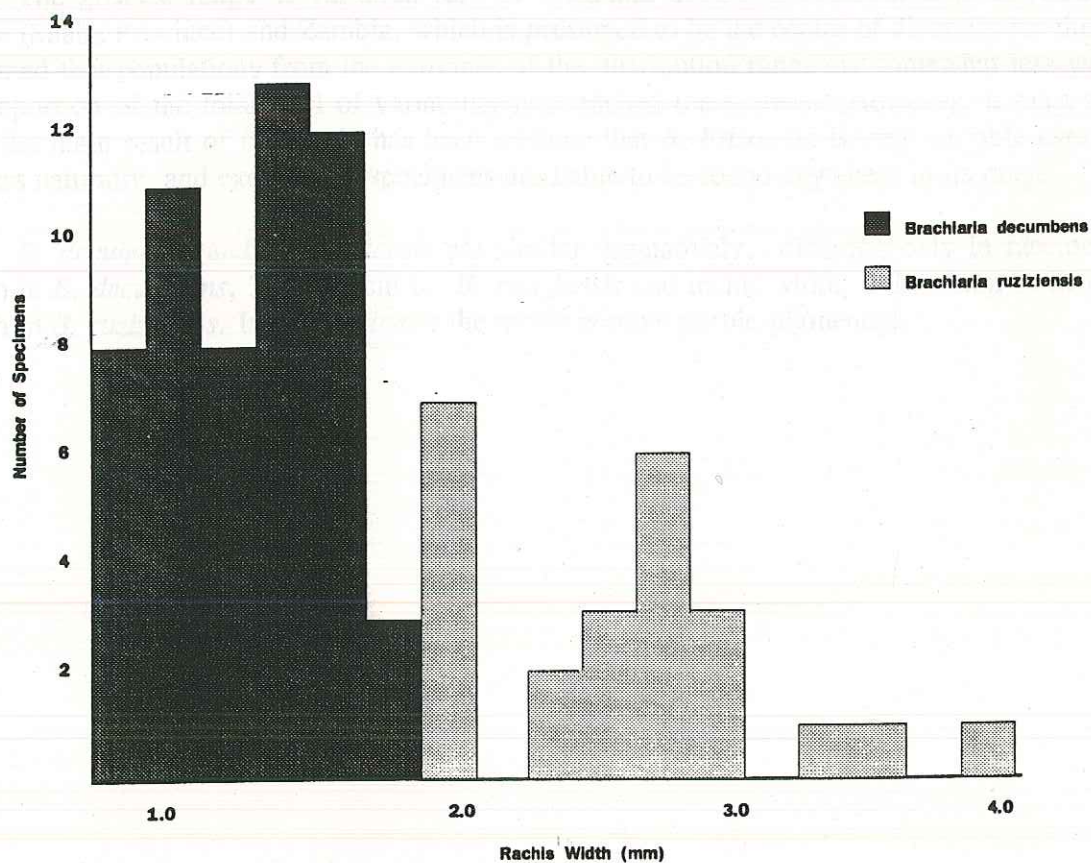


Fig. 16. Histogram to show the difference in rachis width between *Brachiaria decumbens* and *B. ruziziensis*.

6.1.5. DISCUSSION

Brachiaria brizantha is a widespread grass of the African savanna, occurring in tall open grassland, but more especially along woodland and thicket margins, pathsides or disturbed areas where there is a little shade and adequate moisture for at least some of the year.

It exhibits a high degree of variability across the whole of its range, and only very slight regional trends are detectable. Plants from West Africa tend to be slightly more vigorous on average, with long leaf-blades and typically 2 relatively long racemes. The population in South Africa is of average dimensions, but shows greater uniformity than usual with relatively little variation; additionally plants from South Africa are never very hairy, the leaves being glabrous or hairy usually only on the sheaths.

Plants from Uganda and neighbouring parts of Zaire, Kenya and Tanzania have relatively short, broad leaf-blades. This corresponds to the area of distribution of *B. decumbens*, which may have evolved from *B. brizantha* in this area from forms with lanceolate hairy leaves and a decumbent habit.

The greatest range of variation for *B. brizantha* occurs in southern tropical Africa, centred on Zaire (Shaba Province) and Zambia, which is presumed to be the centre of diversity for the species. It is assumed that populations from the extremes of the distribution range are somewhat less variable as only a proportion of the total pool of variability has reached these areas. However, it must be emphasised that the main result of this study has been to show that *B. brizantha* is very variable everywhere that it occurs naturally, and exceptional specimens are liable to be found anywhere in its range.

B. decumbens and *B. ruziziensis* are similar vegetatively, differing only in raceme length, 2-5(-6)cm in *B. decumbens*, 3-6(-10)cm in *B. ruziziensis* and rachis width, 0.8-1.8mm in *B. decumbens*, 2-4mm in *B. ruziziensis*. In *B. ruziziensis* the rachis is often purple-pigmented.

6.2. THE BRACHIARIA HUMIDICOLA / B. DICTYONEURA COMPLEX

6.2.1. INTRODUCTION

This complex comprises the two species *Brachiaria humidicola* and *B. dictyoneura* and is characterized by the perennial habit, elliptic spikelets borne singly on the rachis, a lower glume 3/4- as long as the spikelet and separated from the upper glume by a short internode and a 5-9-nerved upper glume with cross veins.

The species in the complex occur from Nigeria eastwards to Southern Ethiopia and southwards to South Africa (Transvaal and Natal).

6.2.2 *Brachiaria humidicola* (Rendle) Schweickhardt in Kew Bulletin 1936:297 (1936).

Synonyms: *Panicum humidicola* Rendle, Cat. Afr. Pl. Welwitsch 2:169 (1899).

Panicum rautanenii Hackel in Bull. Herb. Boiss., sér. 2, 2:935 (1902).

Panicum golae Chiovenda in Ann. Bot. Roma 13:43 (1914).

Brachiaria rautanenii (Hackel) Stapf in Fl. Trop. Afr. 9:513 (1919).

Panicum vexillare Peter, Fl. Deutsch Ost-Afr. 1, Anh. :22, fig. 10/2 (1930).

Stoloniferous perennial with erect or geniculately ascending wiry culms 35-120cm long; often rooting at the lower nodes. Stolons wiry, prostrate or arching. Leaf-blades of basal leaves linear 6-30cm long, (3-)4-9(-12)mm wide. Leaf-blades of the stolons narrowly lanceolate, 3-6cm long, 5-8mm wide. Inflorescence of 2-4(-5) racemes on an axis 3-10cm long, racemes 2-6cm long, bearing spikelets singly on a triquetrous rachis 0.5mm wide. Spikelets broadly elliptic, 4-6mm long, pubescent or very rarely subglabrous, subacute. Lower glume 3/4 to as long as the spikelet, 11-nerved, obtuse, separated from the upper glume by a short internode; upper glume 5-9-nerved, with cross veins. Lower lemma 5-nerved, with prominent cross veins; upper lemma slightly papillose, subobtuse to apiculate.

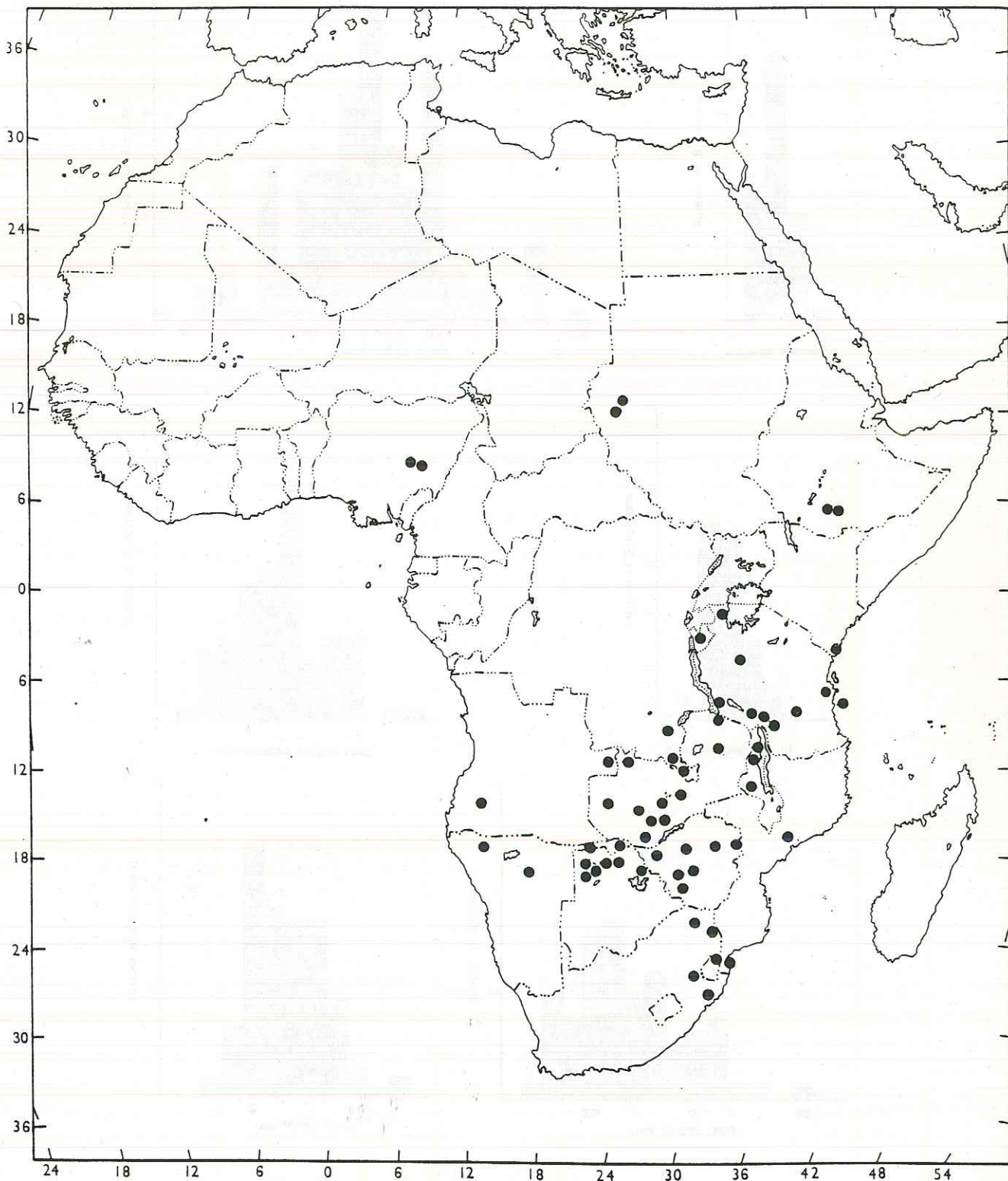
DISTRIBUTION: Nigeria, Sudan, Ethiopia, Kenya, Tanzania, Zaire, Burundi, Zambia, Zimbabwe, Botswana, Malawi, Mozambique, Angola, Transvaal, Natal and Namibia, Map 4.

ECOLOGY: Seasonally swampy grassland; 0-2100m

Fig. 17 illustrates the variation and frequency of those characters significant in this report.

The CIAT collections

All specimens of *B. humidicola* from CIAT, listed in appendix 9.4 are typical representatives of this species, firmly rooted with wiry stolons and culms and 2-4 racemes. (see note on 6133 in discussion 6.2.4).



Map 4. Distribution of *Brachiaria humidicola*.

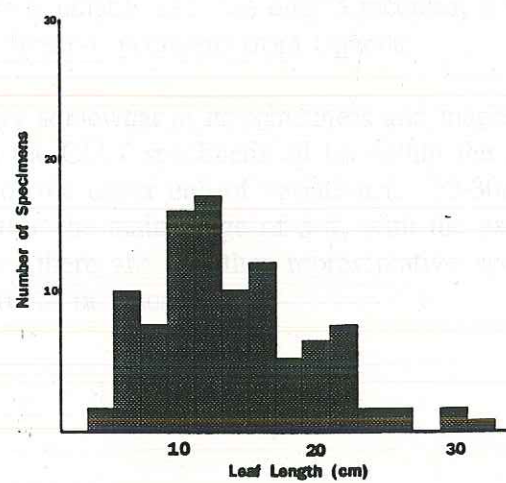
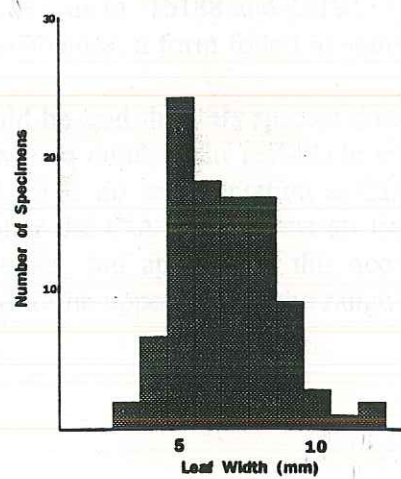
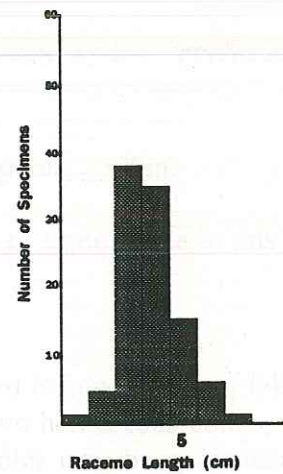
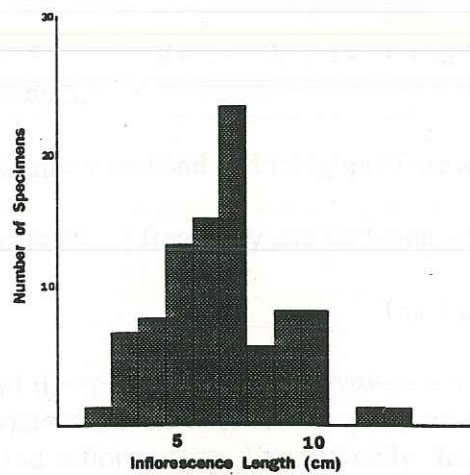
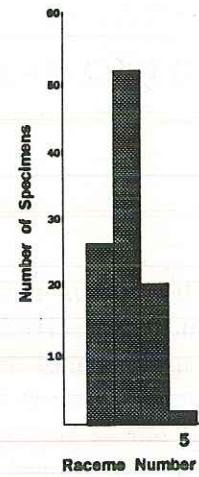
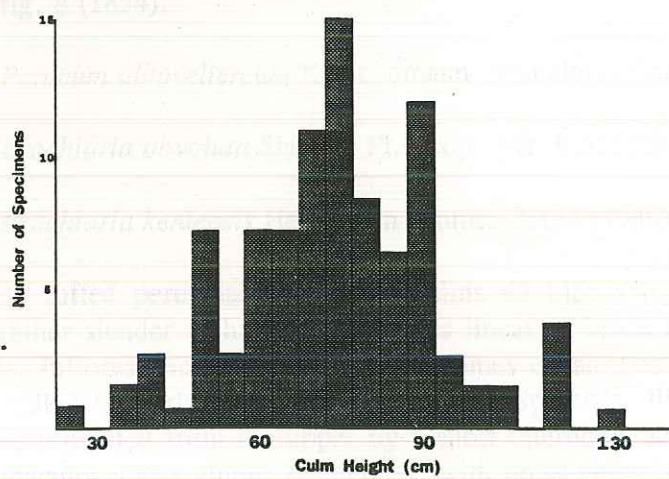


Fig. 17. Histograms to show variation in *Brachiaria humidicola*.

6.2.3. *Brachiaria dictyoneura* (Figari & De Notaris) Stapf in Flora of Tropical Africa 9: 512 (1919).

Synonyms: *Panicum dictyoneurum* Figari & De Notaris in Mem. Accad. Sci. Torino, ser. 2, 14:329, fig. 8 (1854).

Panicum albovellereum K. Schumann in Engler, Pflanz. Ost-Afr. C:101 (1895).

Brachiaria obvoluta Stapf in Fl. Trop. Afr. 9:511(1919).

Brachiaria keniensis Henrard in Blumea 3:432 (1940).

Densely tufted perennial with erect culms 45-145cm high, never rooting at the lower nodes, sometimes rather slender in habit. Leaf-blades linear to lanceolate, (6-)10-33(-45)cm long, (4-)5- 15(-30)mm wide. Inflorescence of (2-)3-8(-14) racemes on an axis 7-18cm long; racemes 3-7(-8)cm long, bearing the spikelets singly on a triquetrous rachis. Spikelets elliptic, 4-6mm long, pubescent, subacute. Lower glume separated from the upper by a short internode, $\frac{3}{4}$ to as long as the spikelet, 11-nerved, obtuse to subacute; upper glume 7-9-nerved, with cross veins. Lower lemma 5-nerved, with prominent cross veins; upper lemma slightly papillose, subobtuse to apiculate.

Sudan, Ethiopia, Kenya, Uganda, Tanzania, Zambia, South Africa (Transvaal and Natal) and Swaziland. Map 5.

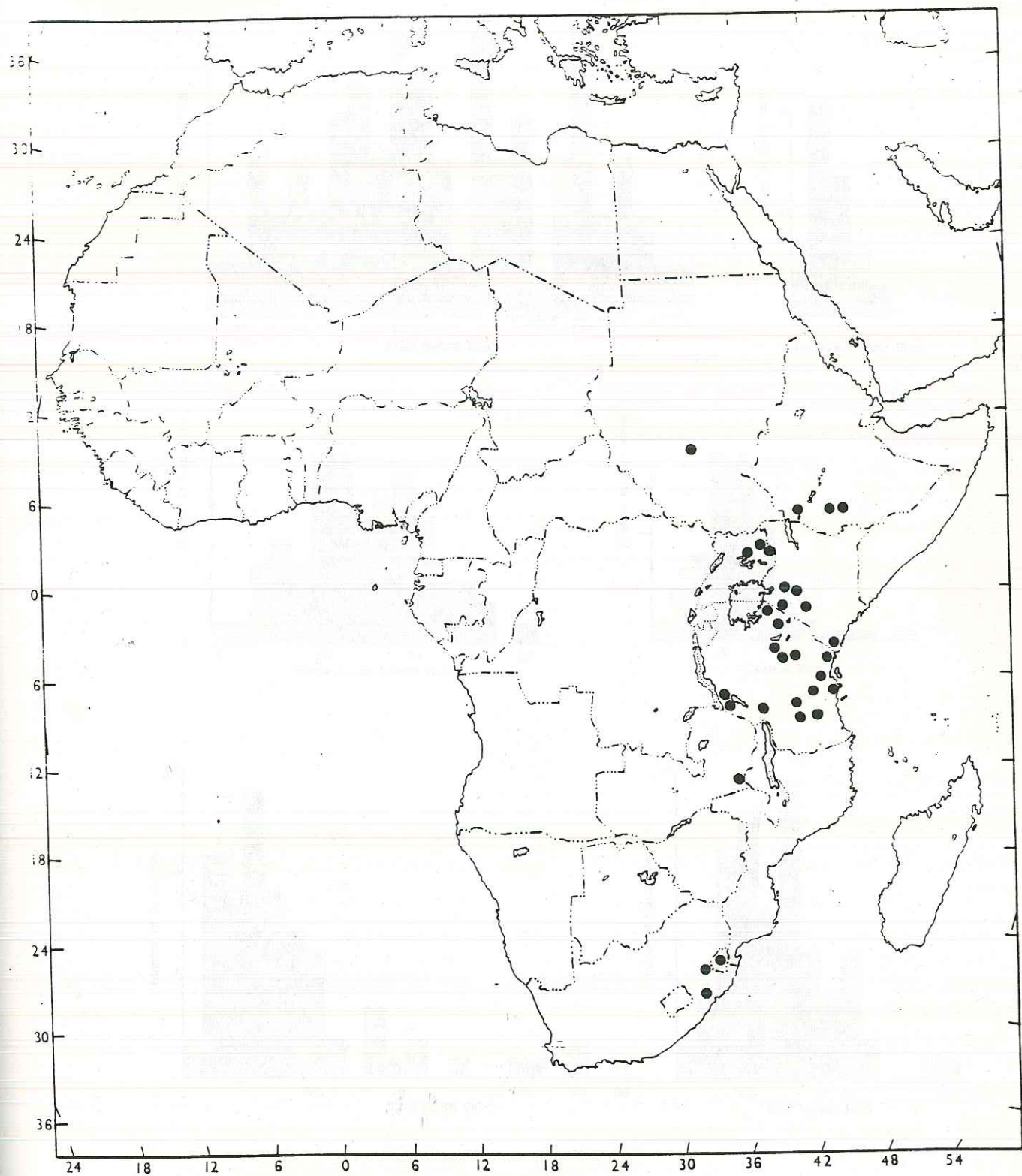
Ecology. Savanna woodland and margins of seasonally flooded pools; 1500m.

Fig. 18. illustrates the frequency and variation of the characters of significance in this report.

The CIAT collections

Most of the specimens of *B. dictyoneura* from CIAT, listed in appendix 9.4, fall within the normal range of variation for the species. They are loosely rooted, have herbaceous culms, no stolons and 3-8 racemes in the inflorescence. Exceptionally the base of the culm may be geniculately ascending with short internodes, as in 16188 and 16191. 16508 is notable as it has only 3 racemes, a very slender base and linear leaf-blades, a form found in some herbarium specimens from Uganda.

It should be said that this species does vary somewhat in its robustness and markedly in leaf-blade width and raceme number. In leaf-blade width the CIAT specimens all lie within the main range of 5-10mm, so there is no representation at CIAT of the upper end of variation ie. 10-30mm. (Fig.18). In raceme number the CIAT specimens all lie within the main range of 3-8, with the exception of 16191 with 11 racemes, but apart from this accession there are no other representative specimens at CIAT which extend to the upper part of the range of 10-14 racemes.



Map. 5. Distribution of *Brachiaria dictyoneura*

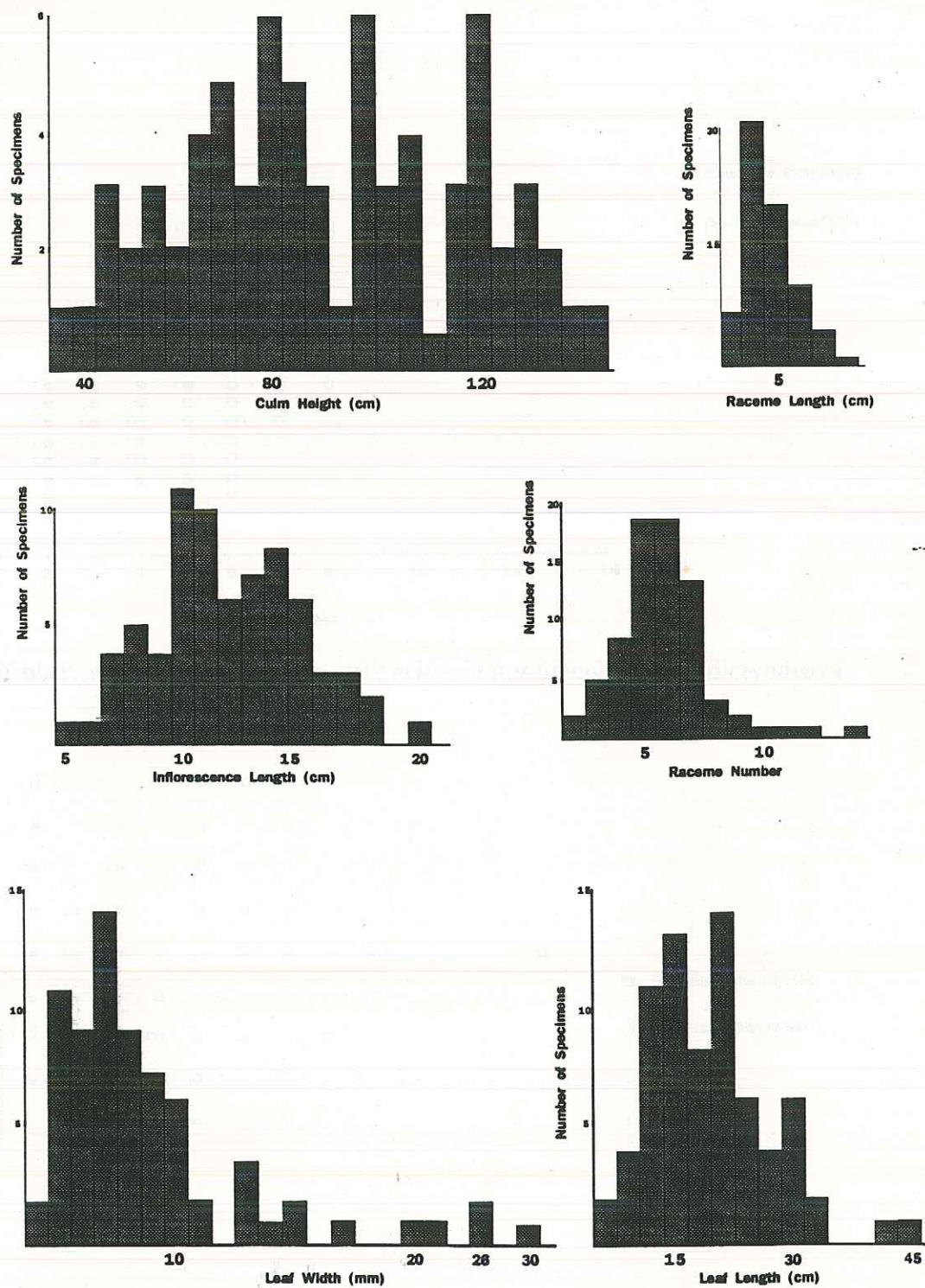


Fig. 18. Histograms to show variation in *Brachiaria dictyoneura*.

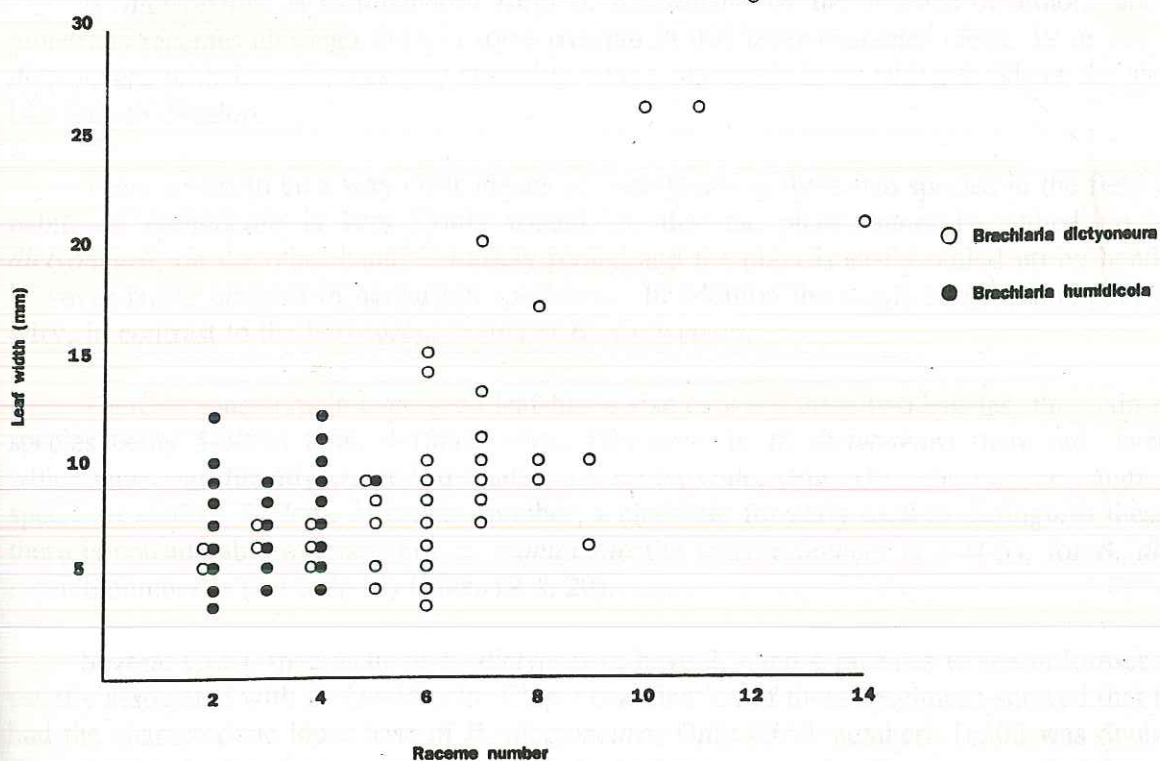


Fig. 19. Leaf-blade width/raceme number of *Bracharia humidicola* and *B. dictyoneura*.

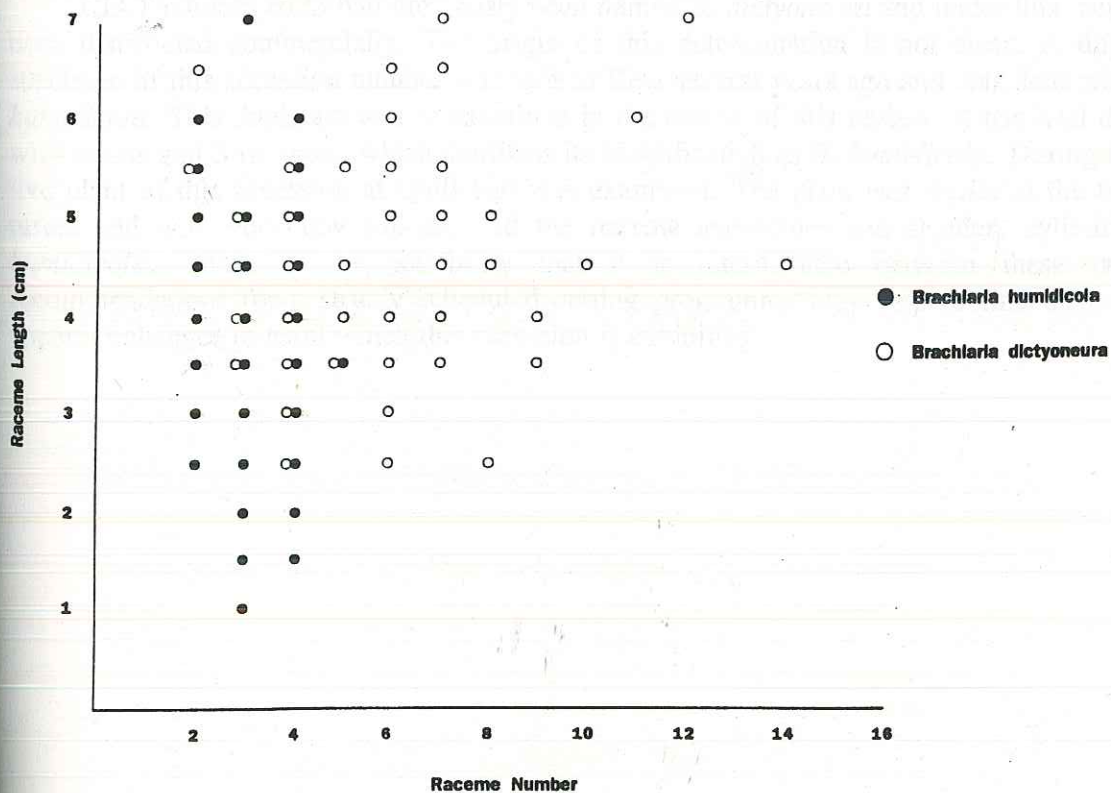


Fig. 20. Raceme length/number of *Bracharia humidicola* and *B. dictyoneura*.

6.2.4. DISCUSSION

B. dictyoneura is distinguished from *B. humidicola* by the absence of stolons and by the more numerous racemes although there is some overlap in this latter character (Figs. 19 & 20). Plants of *B. dictyoneura* with few racemes may resemble young plants of *B. humidicola* where the stolons have not had time to develop.

There seems to be a very clear means of distinguishing these two species in the field by the rooting habit; *B. humidicola* is very firmly rooted, so that the plant cannot be pulled up by hand; *B. dictyoneura*, on the other hand, is loosely rooted and the plant is easily pulled up by hand. This feature however is not obvious in herbarium specimens. In addition the culms in *B. humidicola* are noticeably wiry, in contrast to the herbaceous culms of *B. dictyoneura*.

There is considerable overlap in leaf-blade size between these two species, the main range for both species being 5-30cm long, 4-10mm wide. However, in *B. dictyoneura* there are several specimens which have significantly wider leaf-blades, 13-30mm wide, (Fig. 18). The raceme length for these two species is similar, 2-7cm. In raceme number, a character formerly used to distinguish these two species, there is considerable overlap. For *B. humidicola* the raceme number is 2-4(-5), for *B. dictyoneura* the raceme number is (2-) 3-8(-14) (Figs. 19 & 20).

Several CIAT specimens of *B. dictyoneura* have 2,3 and 4 racemes to the inflorescence, a number usually associated with *B. humidicola*. Closer examination of these specimens showed that they nearly all had the characteristic loose base of *B. dictyoneura*. Only CIAT number 16508 was doubtful, having a very slender base and very narrow, linear leaf-blades; however, the absence of stolons precluded its inclusion in *B. humidicola*.

CIAT number 6133 had previously been named *B. dictyoneura* and under this name has apparently been distributed commercially. The origin of this determination is not clear. A duplicate herbarium specimen of this accession number was sent to Kew several years ago and was determined as *Brachiaria humidicola*. This duplicate was re-examined in the course of this review. It has well developed stolons, wiry culms and 3 racemes, which confirms its identification as *B. humidicola*. During the field work the live plant of this accession at Quilichao was examined. The plant was sterile at the time but, although tufted and with very few stolons, had the narrow leaf-blades and slender, cylindrical culms of *B. humidicola*. There is the possibility that it is intermediate between these two species. The recommendations for a strictly scheduled cutting programme may help to find an explanation for the apparent changes in habit which this accession is exhibiting.

6.3. THE BRACHIARIA JUBATA COMPLEX

6.3.1. INTRODUCTION

This complex comprises four species, *Brachiaria jubata*, *B. falcifera*, *B. bovonei* and *B. subulifolia*. The group is characterized by :- perennial habit, elliptic spikelets borne singly on the rachis which is ciliate with marginal tubercle-based hairs and a lower glume $\frac{2}{3}$ - $\frac{3}{4}$ the length of the spikelet.

6.3.2. *Brachiaria jubata* (Figari & De Notaris) Stapf in Flora of Tropical Africa 9: 563 (1919).

Synonyms: *Panicum jubatum* Figari & De Notaris in Mem. Accad. Sci.Torino, ser.2, 14:331, fig.9 (1854).

Brachiaria fulva Stapf in Fl. Trop. Afr. 9:518 (1919).

Brachiaria brevis Stapf in Fl. Trop. Afr. 9:519 (1919).

Brachiaria soluta Stapf in Fl. Trop. Afr. 9:519 (1919).

Brachiaria bomaensis Vanderyst in Bull. Agric. Congo Belge 16:665 (1925).

Densely tufted perennial with erect or more often geniculately ascending, slender, branched or unbranched, often wiry culms (35-)50-135(-170)cm high from a shortly rhizomatous, dense rootstock. Leaves basal and cauline; blades linear, rarely narrowly lanceolate, (5-)8-32(-42)cm long, 3-11(-17)mm wide, flat, glabrous or pilose, finely acute. Inflorescence of 3-15 racemes, 1-6cm long, on an axis 3-20cm long. Racemes often curved, bearing spikelets singly, in two ranks, on a ribbon-like rachis 1-2mm wide, its margins ciliate with bright yellow, tubercle-based hairs 2-6mm long. Spikelets elliptic, 2.5-3.8mm long, pubescent or pilose, subacute. Glumes oblong, obtuse, lower glume $\frac{2}{3}$ - $\frac{3}{4}$ the length of the spikelet, 7-11-nerved; upper glume 5-7-nerved, cross-veins present, lower lemma 5-nerved, cross-veins present; upper lemma finely striate, granular or rugulose, shiny. Illustration 2.

DISTRIBUTION: Uganda, Kenya, Tanzania, Malawi, Zimbabwe, Zambia, Angola, Ruanda, Burundi, Chad, Central African Republic, Zaire, Cameroon, Sudan, Ethiopia, Senegal, Gambia, Mali, Guinea Bissau, Guinea, Ivory Coast, Burkina, Ghana, Togo, Benin, Nigeria. See map 6.

ECOLOGY: Grassland on alluvial soils, swamps ; 500-2900m

Figs. 21 & 22 illustrate the frequency and range of variation in those characters of significance in this report.

The CIAT collection

CIAT specimens generally conform to the typical type. They may be tufted with geniculately ascending culms or the culms may be long and straggling.

In addition to the typical type three variants were distinguished amongst the living plants at Quilichao. However, of these three only B and C could be matched to herbarium specimens at Kew.

Type A.

Weakly tufted, slender plants with long branching, often tangled, decumbent culms. This type was not matched to any herbarium material. Accessions assigned to this type:-

CIAT number 6409
16534
26327
26816

Type B.

Loosely tufted; culms stout, pilose, geniculately ascending. Racemes 11-16, 1-2(-4)cm long. This type matches material with broad leaf-blades which occurs widely in West Africa, North-east Africa and East Africa. Only one accession was assigned to this type.

CIAT number 26863

Type C,

Tufted; culms short, wiry at the base. Leaf-blades narrowly lanceolate or linear. This type is uncommon in the wild. Two accessions were assigned to this type.

CIAT number 16524
16531

6.3.3. *B. falcifera* (Trinius) Stapf in Fl. Trop. Afr. 9:517 (1919).

Synonyms: *Panicum falciferum* Trinius, Gram. Pan. :127 (1826).

Tufted, shortly rhizomatous, perennial with slender erect culms 35-100cm high. Leaf-blades linear, convolute or folded, 15-25cm long, 2-4mm wide, glaucous, glabrous or pilose, finely acute or acuminate. Racemes 2-4(-5), 1.5-4cm long, usually curved, on an axis 3-8(-10)cm long. Rhachis flat, 1-1.5mm wide, ciliate on the margins with yellow, tubercle-based hairs up to 2mm long.

DISTRIBUTION: Ghana, Accra Plains.

ECOLOGY: A dominant component of peppercorn tree savanna on black clay soils; maintained by frequent fires and an erratic bimodal rainfall pattern.

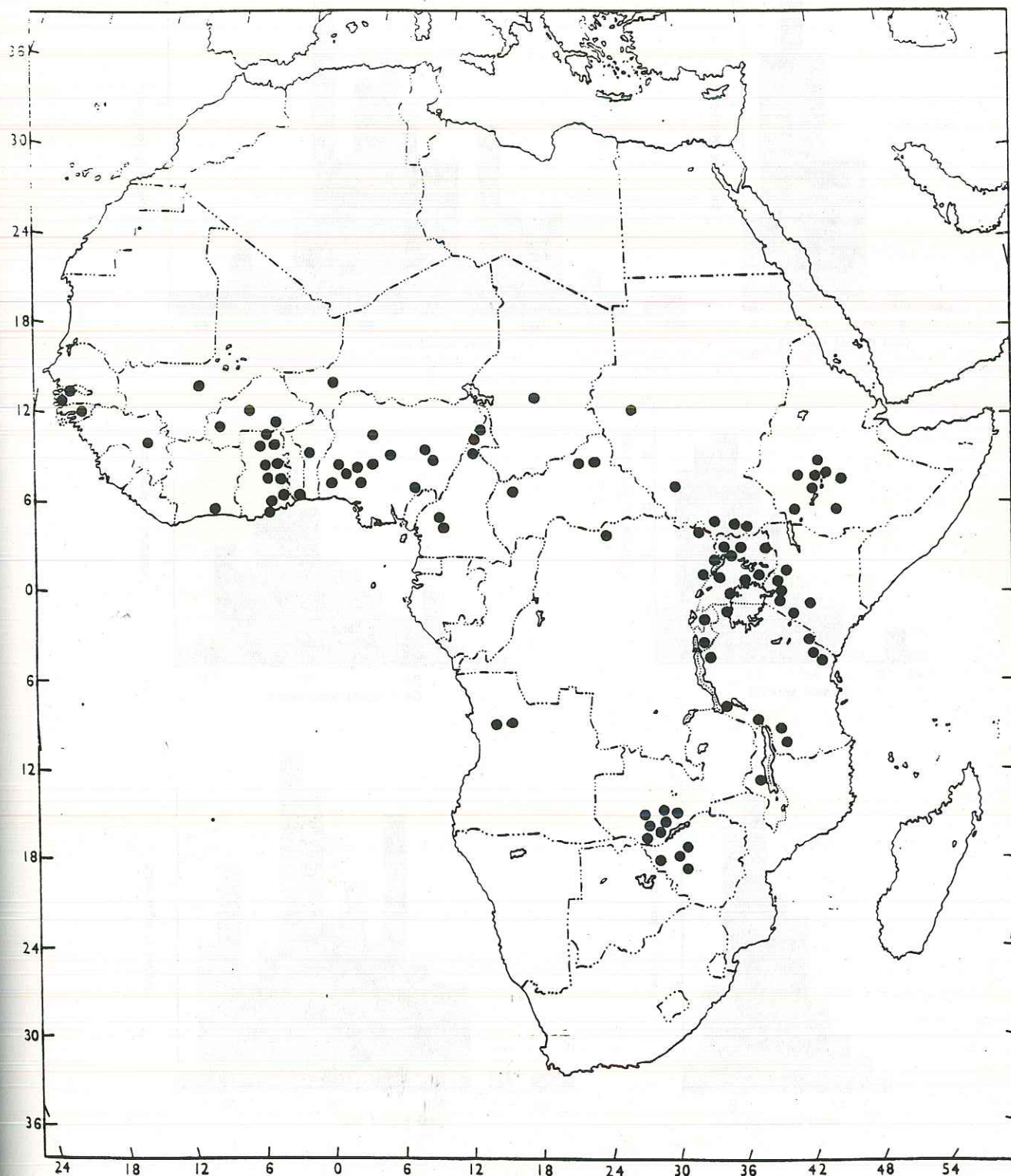
This species, although very closely related to *B. jubata*, is clearly distinguished by the caespitose habit, erect culms, convolute leaf-blades and fewer racemes. The two species occur together although *B. jubata* is uncommon. *B. falcifera* is maintained as a separate taxon by Clayton in Hepper (1972), although Scholz (1989) combines the two, sinking *B. jubata* into the earlier name *B. falcifera*.

The CIAT collection

No material of this species has been seen at CIAT.



Illustration 2. *Brachiaria jubata*. 1, habit of plant; 2, ligule; 3, segment of rachis; 4, spikelet, side view; 5, lower glume; 6, upper glume; 7, lower lemma; 8, lower palea; 9, upper lemma; 10, upper palea.



1:100,000 - 1:250,000 scale

Map 6. Distribution of *Brachiaria jubata*

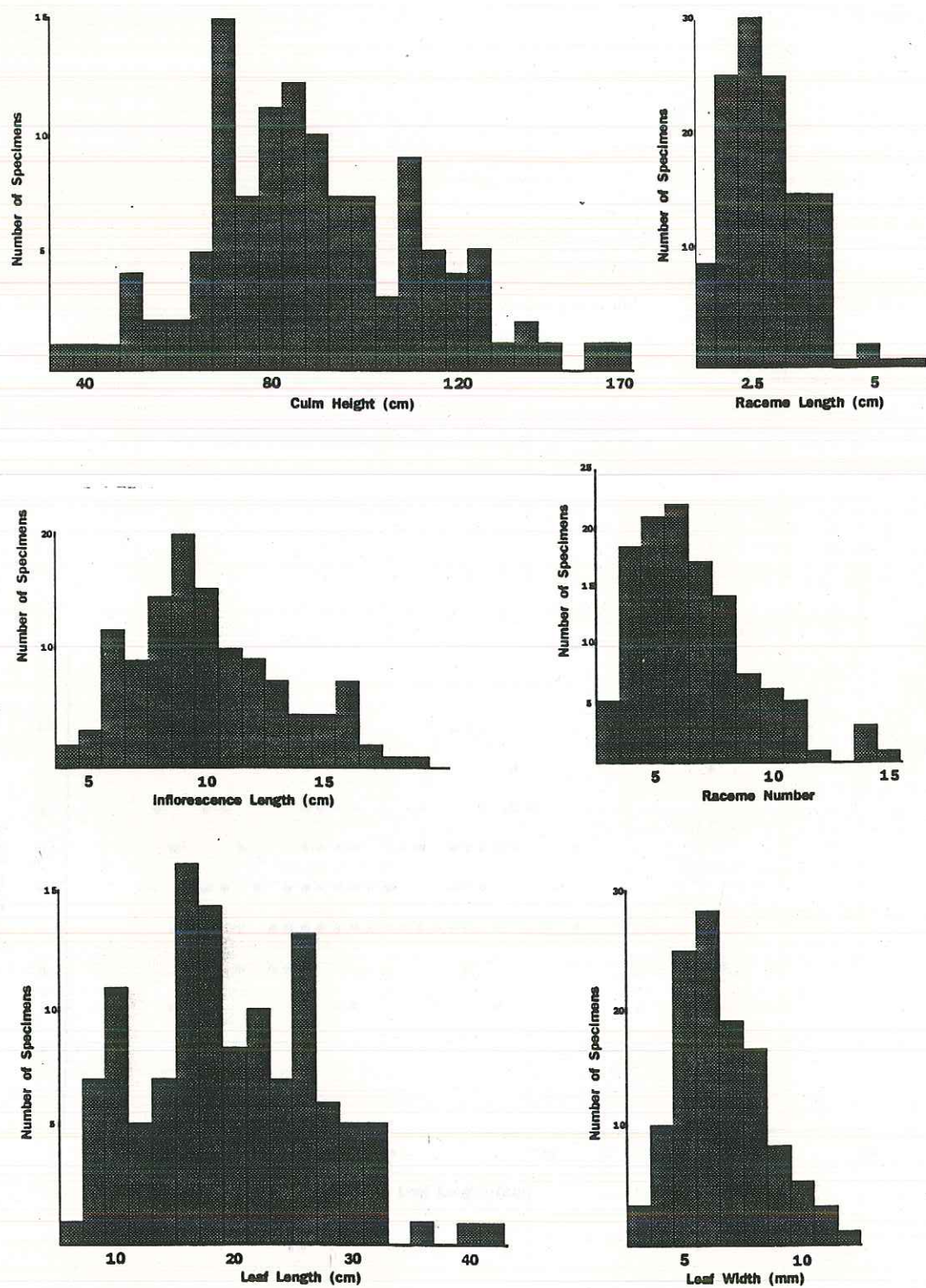


Fig. 21. Histograms to show variation in *Brachiaria jubata*.

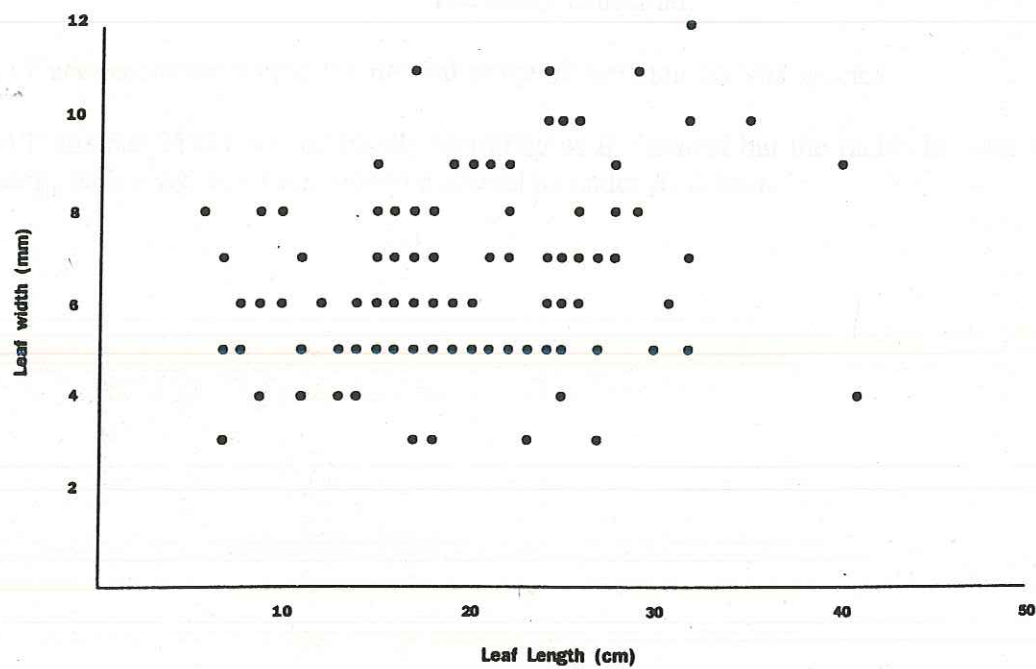


Fig. 22. Variation in leaf-blade width and length in *Brachiaria jubata*.

6.3.4. *B. bovonei*(*Chiovenda*) *Robyns* in Bull. Jard. Bot. Brux. 9:174 (1932).

Synonyms: *Panicum bovonei* Chiovenda in Ann. Bot. Roma 13:42 (1914).

Brachiaria hians Stapf in Fl. Trop. Afr. 9:514 (1919).

B. viridula Stapf in Fl. Trop. Afr. 9:515 (1919).

Densely tufted perennial with erect culms 25-100cm high. Leaves mostly basal; blades flat or convolute, 3-30cm long, 2-6mm wide, glabrous or pilose, finely acute or acuminate. Inflorescence of (1-)3-5 racemes on an axis 3-10cm long; racemes 1-5cm long, bearing spikelets singly in 2 rows; rachis 0.5mm wide, the margins ciliate with yellow tubercle-based hairs 1-2mm long. Spikelets elliptic, 3.2-4.5mm long, pubescent, subacute; lower glume 2/3 to almost as long as the spikelet, 5-11-nerved, obtuse; upper glume 5-7-nerved, with cross veins, not separated from the lower; lower lemma 5-nerved, the lateral nerves connected by cross veins; upper lemma finely stippled, subacute.

This species is distinguished from *B. jubata* by its narrow rachis with shorter marginal cilia and generally fewer racemes on the inflorescence.

DISTRIBUTION: Uganda, Kenya, Tanzania, Rwanda, Zaire, Zambia, Zimbabwe, Malawi, Mozambique, Transvaal.

ECOLOGY: Swampy or damp places; 1200-2500m.

The CIAT collection

CIAT accessions are within the normal range of variation for this species.

CIAT number 26353 was originally identified as *B. bovonei* but the rachis is 1mm wide with cilia 2.5mm long, indicating its correct position should be under *B. jubata*.

6.3.5. *B. subulifolia* (Mez) W D Clayton in Kew Bull. 34:559 (1980).

Synonyms: *Panicum subulifolium* Mez in Engler, Bot. Jahrb. 34:135 (1904).

Brachiaria filifolia Stapf in Fl. Trop. Afr. 9:516 (1919).

Densely tufted perennial with slender, erect culms 20-100cm high. Leaves mostly basal; blades filiform, subterete, 5-20cm long, up to 1mm in diameter. Inflorescence of (1-) 2-4 racemes on an axis 1-5cm long; racemes 1-3cm long, bearing the spikelets singly, in 2 rows on a narrow, triquetrous rachis 0.5mm wide, margins ciliate with tubercle-based hairs. Spikelets elliptic, 2.8-4mm long, pubescent, subacute; lower glume $2/3 - 3/4$ the length of the spikelet, 5-9-nerved, obtuse; upper glume 5-7-nerved, with a few cross-veins, not separated by an internode; lower lemma 5-nerved, the lateral nerves connected by cross veins; upper lemma finely stippled, subacute.

DISTRIBUTION: Zaire, Tanzania, Zambia, Zimbabwe, Malawi, Transvaal.

ECOLOGY: Damp ground in seasonal swamps and beside water; 1000- 1800m.

This species is similar to *B. bovonei*, being distinguished only by its filiform leaf-blades. The two species appear to intergrade on this character although typical examples of each species are not difficult to distinguish.

The CIAT collection

CIAT accessions are within the main range of variation for this species, with the exception of 16964, which has a single raceme.

6.3.6. DISCUSSION

Brachiaria jubata is the principle species of interest in this group. It is a common species, widely distributed in West and East Africa, which, with its long leafy culms, has obvious forage value. Although CIAT has a substantial number of accessions of *B. jubata*, they are all in the lower or middle range of leaf-blade width, CIAT number 26863 has the broadest leaf-blades with a maximum of 8mm; in the wild the range extends up to 17mm, Fig. 22. There is scope for further selections, with greater forage potential, to be made from the wild should they be desired.

Brachiaria subulifolia and *B. bovonii*, distributed in East Africa, are plants of slender habit with very narrow leaf-blades and appear to be of little forage value.

7. GENERAL DISCUSSION AND CONCLUDING REMARKS.

1. Herbarium taxonomists are used to working on what is often considered to be a typical selection of specimens. Data on morphology, distribution and ecology, gathered from herbarium specimens, has been combined to produce an overall picture of the species. By comparing the data from similar species an idea of their interrelationships can be gained. As a general rule a species will vary within certain limits - it is the limits which define a species and indicate the boundary between one species and another.
2. The Kew herbarium was used as a source of data for assessing the range of natural variation in eight species of *Brachiaria* currently of interest to CIAT for the Tropical Forage Programme. *Brachiaria brizantha*, which is the commonest and most widespread species, has been analysed in greater detail than the others.
3. The CIAT *Brachiaria* collection comprises in excess of 600 accessions, the majority being *B. brizantha*.
4. These accessions have been studied as live plants and as herbarium specimens and compared with data from wild-source specimens.
5. The information obtained from studying the Kew material is presented in the form of descriptions, scatter diagrams, histograms, bar diagrams and maps.
6. The inter-relationships of the species within each group are discussed.
7. The work on living plants at Quilichao revealed that many of the accessions of *B. brizantha* could be grouped together into recognizable types according to habit. These types appeared to be the result of different responses to periodic cutting back of the stems.
8. It was found that differences of habit relating to stature and angle and size of the leaf-blade were not translated to herbarium specimens. When statistical methods were applied to pressed specimens it failed to confirm the groups observed in the field.
9. The accessions studied as duplicate herbarium specimens at Kew are listed in appendix 9.5 and 9.6. Some accessions seen at Quilichao were not available as duplicates for study at Kew.
10. All specimens of *Brachiaria* in the herbarium at CIAT were examined and the identifications confirmed or corrected as necessary but they were not listed for the purposes of this study, except where they occur as live plants at Quilichao, appendix 9.4, or were received as duplicates, appendices 9.5 and 9.6. The CIAT herbarium specimens are all listed in the CIAT database.
11. All accessions at Quilichao were examined, with the exception of a few *B. brizantha* and *B. decumbens*, which are listed at the end of 9.4.
12. *Brachiaria jubata* plants at Quilichao were divided into groups according to differences in habit.

13. Plants at Quilichao are subjected to cutting. This cutting is apparently done at irregular intervals. In view of the different responses which the plants appear to have to the cutting it is suggested that a more formal programme is initiated with a strict timetable. In this way comparisons can be made between different clones of the same species and the responses monitored more accurately. It is also suggested that only half of each plot is cut, the other half being left to achieve its natural stature and habit, thus providing a comparison both within the same accession and between different accessions.

14. The collection of further germplasm from wild sources would usefully broaden the representation in some species, eg. *Brachiaria dictyoneura* and *Brachiaria jubata*.

15. During the field work it became clear that the flowering periods of the species were often clearly defined. Some species were in full flower while others showed no sign of flowering, others were just coming into flower and others were at the end of their flowering period.

16. The data presented in this report:-

- a) Provides identifications for current *Brachiaria* accessions.
- b) Assesses the status of individual accessions.
- c) Provides a source of parameters for performance evaluation.
- d) Provides a guide for future selection of useful clones.
- e) Provides a source of basic information for staff at CIAT to refine further the data on *Brachiaria* held in the germplasm collection.

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Appendix 9.1.

Terms of Contract

Appendix 9.2.

Key to 8 species of *Brachiaria* under review in this report.

1. Lower glume over 2/3 as long as the spikelet, many-nerved; lower lemma reticulately veined:
 2. Glumes separated by a short internode:
 3. Plant firmly tufted, shortly rhizomatous and stoloniferous; inflorescence of 2 - 3 racemes; leaf-blades of the basal tuft linear but of the stolons lanceolate*B. humidicola*
 3. Plant loosely tufted; inflorescence of 3 - 8 racemes; leaf-blades linear to lanceolate*B. dictyoneura*
 2. Glumes not separated by a short internode:
 4. Leaf-blades flat or convolute:
 5. Rachis 1-2mm wide; leaf-blades 3-17mm wide*B. jubata*
 5. Rachis 0.5mm wide; leaf-blades 2-6mm wide*B. bovonei*
 4. Leaf-blades filiform, subterete*B. subulifolia*
1. Lower glume up to 1/2 the length of the spikelet:
 6. Rachis of racemes crescentic in section, narrow, 1mm wide; plant loosely or densely tufted*B. brizantha*
 6. Rachis of racemes ribbon-like, 1-3.5mm wide; plant stoloniferous:
 7. Rachis 1-1.7mm wide*B. decumbens*
 7. Rachis 2-3.5mm wide*B. ruziziensis*

Appendix 9.3

Key to all species of *Brachiaria* represented in the germplasm collection at CIAT.

1. Lower glume over 2/3 the length of the spikelet, many-nerved; lower lemma reticulately veined:
 2. Glumes separated by a short internode:
 3. Plant firmly tufted, shortly rhizomatous and stoloniferous; inflorescence of 2-3 racemes; leaf-blades of the basal tuft linear, blades of the stolons lanceolate*B. humidicola*
 3. Plant loosely tufted; inflorescence of 3-8 racemes; leaf-blades linear to lanceolate*B. dictyoneura*
 2. Glumes not separated by an internode:
 4. Margins of rachis ciliate with yellow or white tubercle-based hairs:
 5. Leaf-blades flat or convolute:
 6. Rachis 1-2mm wide; leaf-blades 3-17mm wide*B. jubata*
 6. Rachis 0.5mm wide; leaf-blades 2-6mm wide*B. bovonei*
 5. Leaf-blades filiform, subterete*B. subulifolia*
 4. Margins of rachis glabrous or scaberulous*B. platynota*
- Lower glume up to 2/3 as long as the spikelet:
 7. Rachis of racemes flat, ribbon-like, narrowly or broadly winged:
 8. Margins of rachis ciliate with tubercle-based hairs:
 9. Rachis 1-1.7mm wide*B. decumbens*
 9. Rachis 2-3.5mm wide*B. ruziziensis*
 8. Margins of rachis glabrous:
 10. Plants annual*B. subquadripara*
 10. Plants perennial*B. arrecta*
 7. Rachis of racemes triquetrous or crescentic:
 11. Plants perennial:

12. Spikelets supported on a conspicuous black stipe*B. nigropedata*

12. Spikelets on a short, inconspicuous green stipe:

13. Upper glume and lower lemma with a transverse fringe of hairs near the tip*B. serrata*

13. Upper glume and lower lemma not transversely fringed:

14. Racemes 2-5cm long, rachis pubescent to villous*B. lachnantha*

14. Racemes 4-20cm long, ciliate on the margins:

15. Leaf-blades flat*B. brizantha*

15. Leaf-blades convolute*B. dura*

11. Plants annual:

16. Upper lemma smooth, shining *B. eruciformis*

16. Upper lemma granulose to rugose:

17. Spikelets 1.5-2mm long*B. scalaris*

17. Spikelets 2.5-4mm long:

18. Spikelets single, in two neat rows*B. xantholeuca*

18. Spikelets paired, the pedicels often long, the racemes loose:

19. Pedicels, or some of them longer than the spikelet*B. deflexa*

19. Pedicels shorter than the spikelet*B. ramosa*

9.4. CIAT accessions seen at Quilichao of the eight *Brachiaria* species featured in this review.

Note: Due to lack of time a small number of accessions at Quilichao of *B. brizantha* and *B. decumbens* were not appraised in September 1992; see separate list at the end of 9.4.

Accessions arranged in three groups according to species associations. Accession numbers taken from map produced in September 1992.

Group 1 *B. brizantha*, *B. decumbens*, *B. ruziziensis*

Group 2 *B. humidicola*, *B. dictyoneura*

Group 3 *B. jubata*, *B. subulifolia*, *B. bovonei*.

Within the accessions of *B. brizantha* observed at Quilichao several infraspecific groups were identified, they are indicated here by the suffixes A-G. For an explanation of these groups see 6.1.2. Numbers without letter suffixes represent accessions which were not appraised in the field but were examined as herbarium specimens after return from Cali in September 1992, consequently no infraspecific group identification was possible.

Group 1.

B. brizantha

606 Previously identified from herb. specimen as *B. decumbens*.

6016

6294 A

6297 A

6384 F

6385 B

6387

6399

6413 B

6421 F

6424 B

6426

6433 B

6674

6675 F

6681

6682

6683 B

6684 G

6686

6687 B

6688

6690 E

6693 F 6735

6780 A

16077 A

16094

16095

16096 B
16097 B
16098 B
16099 A
16106 D
16107 D
16110 D leaf-blades pilose
16111 C
16113 D
16114 C
16116 C
16118 D
16119 D leaf-blades pilose
16121 D
16122 D
16123 G
16124 G
16125 G
16126 C
16128 D
16130 C
16131 D
16132 C
16133 A
16134 G
16135 D
16136 C
16138 D
16139 C
16141 C
16142 D
16143 D
16144 D
16145 D
16146 G
16149 D
16150 D
16151 B
16152 D
16153 D
16154 G
16155 D
16156 C
16157 F
16158 C
16160 F
16161 D
16162 C
16163 G
16164 D
16166 D
16168 D

16169 D
16170 F
16173 D
16189 B
16197 C
16212 F
16288 A
16289 D
16290 B
16292 A
16294 G
16295 D
16296 B
16297 D
16298 B
16299 B
16300 D
16301 D
16302 D
16303 C
16304 C
16305 D
16306 E
16307 A
16308 D
16309 A
16310 A
16311 D
16312 C
16313 A
16315 D
16316 E
16317 D
16318 D
16319 D
16320 A
16322 D
16324 C
16325 A
16327 D
16328 D leaf-blades pilose
16329 B
16331 C
16332 D
16333 C
16334 E
16335 F
16336 E
16337 D
16338 C
16339 D
16340 C

16341 C
16342 F
16348 F
16431 D
16435 B
16436 D
16437 B
16438 D
16439 D
16440 C
16441 F
16442 F
16443 F
16444 F
16447 F
16448 F
16449 F
16450 F leaf-blades pilose
16451 F
16452 C
16453 F
16455 F leaf-blades pilose
16456 D
16457 D
16458 D
16460 F
16461 F
16462 F
16463 F
16464 F leaf-blades pilose
16466 D
16467 D
16469 G
16470 D racemes 1-2, leaf-blades 10mm wide
16471 D
16472 F
16473 D
16474 D
16476 D
16478 F
16481 B
16482 F
16483 B
16484 B
16485 B
16486 D
16487 D
16488 D
16505 F
16549 D
16766 C
16767 C

16770 C
16771 C
16775 C
16776 G
16779 E
16783 C
16797 C
16801 C
16807 C
16809 G
16810 C
16811 G
16812 A
16814 C
16817 C
16820 C
16823 C
16826 G
16827 E
16828 G
16829 E
16830 E
16832 C
16833 D
16834 G
16835 A
16837 C
16838 G
16840 G
16872 A
16961 A
26032 A
26102 D
26104 F leaf-blades pilose
26110 E
26111 D
26124 D
26129 D
26179 F
26297 F
26314 D
26315 D
26316 C
26318 D
26366 D
26370 B
26389 A
26393 D
26554 D
26555 D
26556 F
26557 D

26560 F
26562 D leaf-blades pilose
26563 G
26564 (-P) F
26564 (-G) F
26565 D
26566 E
26568 D
26641 D
26642 G
26646 D
26647 B
26746 F

B. decumbens

The identification of some of the accessions is based upon herbarium specimens examined at Kew after returning from Cali, September 1992.

664
665
6009
6012
6021
6058
6131
6132
6298
6370
6392
6670
6677
6698
6699
6700
6701
6702
16100

16493
16494
16502
16519
16532
26180
26182
26185 not duplicated at Kew
26186
26287
26288 43

26290
26291
26292
26293
26295
26298
26299
26300
26302
26303 not duplicated at Kew
26304
26305
26307
26308

B. ruzizensis

641
654
655
6019
6130
6134
6241
6291
6419
6692
6711
6713
6778
16075
16101
16102
16103
16551
16552
26164
26166
26175
26178
26162
26167
26168
26170
26174
26347
26350
26433

Group 2.

B. humidicola

675
679
682
6013
6133
6369
6705
6707
6709
6738
16146-A
16180
16181
16182
16183
16350
16517
16774
16777
16793
16866
16867
16868
16870
16871
16873
16874
16876
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16878
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16880
16882
16883
16884
16885
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16887
16888
16889
16890
16891
16892
16894
26085
26096
26130
26145

48

26146
26149
26154
26155
26159
26160
26181
26312
26371
26375
26407
26411
26413
26414
26415
26416
26425
26427
26430
26438
26570
26573
26575

B. dictyoneura

16186
16187
16188
16191
16506
16508
16509
16511

Group 3.

B. jubata

6409
16176
16194
16195
16202
16204
16205
16459
16468
16512
16514

16516
16522
16524
16526
16527
16530
16531
16534
16536
16538
16539
16542
16710
26122
26127
26189
26190
26198
26327
26353
26863
26816

B. subulifolia

16962
16964
16966

B. bovonei

16847
16849
16896

28
Quilichao accessions recorded as *Brachiaria brizantha* and *B. decumbens* but identification not confirmed; no duplicate of these numbers received at Kew.

Arranged according to species, names assigned by CIAT, not confirmed by S.A.R. in September 1992.

B. brizantha

664
665
667
6009
6012

6021
6298
6370
6392
6408
6687 (no plant in plot)
16104
16117
16120
16127
16148
16171
16177
16314
16445 (no plant in plot)
16477
16479
16480
16799
16804
16819
16842
26101
26184
26551
26553
26556
26559
26561
26821

B. decumbens

16475
16489
16490
16491
16492
16495
16497
16498
16499
16500
16501
16503
16504
16515
26112
26177
26183
26187

26188 97. (LAT accession: exsiccated as herbarium duplicates at Kew; arranged numerically Grechides
 26294 accessions which may or may not be kept as living plants at Quibouac).
 26306
 26569 = *brizantha* excluded, see 9.1.

611. *indensis*
 612. *humidicola*
 613. *pendulata*
 614. *racemosa*
 615. *drumstick*
 616. *humidicola*
 617. *argentea*
 618. *argentea*
 619. *humidicola*
 620. *humidicola*
 621. *humidicola*
 622. *humidicola*
 623. *humidicola*
 624. *humidicola*
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 796. *humidicola*
 797. *humidicola*
 798. *humidicola*
 799. *humidicola*
 800. *humidicola*

9.5. CIAT accessions received as herbarium duplicates at Kew; arranged numerically (includes accessions which may or may not be represented as living plants at Quilichao).

B. brizantha excluded, see 9.4.

641 ruziziensis
675 humidicola
679 humidicola
6019 ruziziensis
6020 decumbens
6369 humidicola
6386 nigropedata
6698 decumbens
6701 decumbens
6709 humidicola
6713 ruziziensis
6738 humidicola
6778 ruziziensis
16075 ruziziensis
16100 decumbens
16101 ruziziensis
16103 ruziziensis
16176 jubata
16179 jubata
16182 humidicola
16183 humidicola
16186 dictyoneura
16187 dictyoneura
16188 dictyoneura
16191 dictyoneura
16194 jubata
16195 jubata
16202 jubata
16203 jubata
16204 jubata
16205 jubata
16208 jubata
16215 lachnantha
16358 jubata
16359 jubata
16449 decumbens
16475 decumbens
16490 decumbens
16491 decumbens
16492 decumbens
16493 decumbens
16494 decumbens
16495 decumbens
16496 decumbens
16498 decumbens
16499 decumbens
16500 decumbens
16501 decumbens
16502 decumbens
16503 decumbens
16504 decumbens
16508 dictyoneura

16509 dictyoneura
16511 dictyoneura
16512 jubata
16514 jubata
16516 jubata
16518 jubata
16519 decumbens
16522 jubata
16523 jubata
16524 jubata
16525 jubata
16526 jubata
16527 jubata
16529 jubata
16530 jubata
16531 jubata
16532 decumbens
16534 jubata
16536 jubata
16538 jubata
16539 jubata
16540 jubata
16542 jubata
16551 ruzizensis
16552 ruzizensis
16710 jubata
16740 subquadripa
16774 humidicola
16794 nigropedata
16845 arrecta
16846 arrecta
16847 bovonei
16849 bovonei
16856 deflexa
16865 deflexa
16867 humidicola (originally numbered incorrectly, 16827)
16874 humidicola
16878 humidicola
16886 humidicola
16887 humidicola
16896 bovonei
16898 nigropedata
16900 nigropedata
16902 nigropedata
16903 nigropedata
16911 nigropedata
16915 nigropedata
16918 nigropedata
16921 nigropedata (base looks strange)
16924 nigropedata
16927 nigropedata
16931 nigropedata
16939 deflexa
16943 eruciformis (intermediate with B.malacodes)
16949 serrata
16952 serrata
16960 subulifolia

16962 subulifolia
16964 subulifolia
26033 nigropedata
26112 decumbens
26122 jubata
26127 jubata
26130 humidicola
26154 humidicola
26156 decumbens
26160 humidicola
26162 ruzizensis
26164 ruzizensis
26166 ruzizensis
26168 ruzizensis
26171 ruzizensis
26174 ruzizensis
26175 ruzizensis
26177 decumbens
26178 ruzizensis
26179 decumbens
26180 decumbens
26182 decumbens
26183 decumbens
26186 decumbens
26187 decumbens
26188 jubata
26189 jubata
26190 jubata
26196 scalaris
26198 jubata
26199 platynota
26287 decumbens
26288 decumbens
26297 decumbens
26298 decumbens
26304 decumbens
26305 decumbens
26306 decumbens
26321 decumbens
26327 jubata
26331 platynota
26332 platynota
26339 platynota
26340 platynota
26343 platynota
26347 ruzizensis
26350 ruzizensis
26353 jubata
26371 humidicola
26411 humidicola
26548 ramosa
26549 ramosa
26550 ramosa
26569 decumbens
26570 humidicola
26575 humidicola
26638 dura

Falta
↓

26741 arrecta
26816 jubata
26853 xantholeuca (labelled *Setaria barbata*)
26863 jubata
26871 ruziziensis
26883 eruciformis
26884 eruciformis
26885 (eruciformis ? no name but looks like 26884 NB)
26887 eruciformis
26888 eruciformis
26893 subquadripa
26894 subquadripa

9.6. CIAT accessions received as herbarium duplicates at Kew; arranged alphabetically according to species.

B. brizantha excluded, see 9.4.

arrecta

16845
16846
26741

bovonei

16847
16849
16896

decumbens

6020
6698
6701
16100
16449
16475
16490
16491
16492
16493
16494
16495
16496
16498
16499
16500
16501
16502
16503
16504
16519
16532
26112
26156
26177
26179
26180
26182
26183
26186
26187
26287
26288
26297
26298
26304
26305
26306

26321
26569

deflexa

16856
16865
16939

dictyoneura

16186
16187
16188
16191
16508
16509
16511

dura

26638

eruciformis

16943
26883
26884
26885
26887
26888

humidicola

675
679
6369
6709
6738
16182
16183
16774
16867
16874
16878
16886
16887
26130
26154
26160
26371
26411
26570
26575

jubata

16176
16179
16194
16195
16202
16203
16204
16205
16208
16358
16359
16512
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16516
16518
16522
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16539
16540
16542
16710
26122
26127
26188
26189
26190
26198
26327
26353
26816
26887

lachnantha

16215

nigropedata

6386
16794
16898
16900
16902
16903
16911

16915
16918
16921
16924
16927
16931
26033

platynota

26199
26331
26332
26339
26340
26343

ramosa

26548
26549
26550

ruzizensis

641
6019
6713
6778
16075
16101
16103
16551
16552
26162
26164
26166
26167
26168
26171
26174
26175
26178
26347
26350
26871

scalaris

26196

serrata

16949
16952

subquadripara

16740
26893
26894

subulifolia

16960
16962
16964

xantholeuca

26853