TAXONOMIC RELATIONSHIP OF THE GENUS
DIGITARIA IN PAKISTAN

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Abstract

Numerical techniques were used to show the taxonomic relationship between the *Digitaria species* in Pakistan. A correlation phenogram showed a distinct dissimilarity between the species.

Digitaria sanguinalis possesses a distinct morphological character of having silicious spines on lateral nerves of lower lemma. New additions of subspecies to *D. sanguinalis* in Pakistan are reported as *D. sanguinalis* ssp. *pectiniformis, D. sanguinalis* ssp. *aegyptiaca, D. sanguinalis* ssp. *vulgaris* (varieties *glabra, rottleriana* and *pubescens*) and a new subspecies *D. sanguinalis* ssp. *pakistanica* with two new varieties such as *D. sanguinalis* ssp. *pakistanica* Gilani, Khan and Shinwari var. *pakistanica* Gilani, Khan and Shinwari and *D. sanguinalis* ssp. *pakistanica* var. *stewartii* Gilani, Khan and Shinwari, which gave same results by numerical analysis. They were clustered together confirming the current findings.

The independent status of *D. denudata* Henr., from the *D. stricta* which was considered by most of the taxonomists as *D. stricta* var. *denudata* was confirmed. Similarly, the controversial taxa viz., *D. ciliaris* (Retz.) Koel., and *D. bicornis* Roem. & Schult., have to be considered distinct species which is supported by the minute morphological characters i.e., ciliated frill around the margins of the lower lemma of the spikelets, shorter distance to the first lateral nerve on the lower lemma, a longer upper glume and a shorter lower glume as compared to *D. ciliaris*.

D. cruciata (Nees) A. Camus was also a new addition to the flora of Pakistan. It may have differed from all other related species by its broad and turgid spikelet and the large ovate upper glume, with three nerves that never reach to its apex. This character was neglected and the species was not added to the Flora of Pakistan. Cluster analysis also confirmed the morphological findings that it was not the variant of *D. ciliaris* but a distinct species.

D. stewartiana Bor, an endemic to Azad Kashmir, was not classified at section level by any of the taxonomists. It differs from its related species, *D. ischaemum* (Schreb.) Schreb. ex Muhl. and *D. violascens* Link, was more closely related to the *D. ischaemum* than *D. violascens*. It clustered with *D. ischaemum*. Thus it is suggested that it may be transferred to section *Clavipilae* and placed with *D. ischaemum*.

Introduction

The genus *Digitaria* belongs to the tribe Panicoideae, family Poaceae (Gramineae). *Digitaria* Haller was reported for the first time from Pakistan by Ahmad & Stewart in 1958. It is a widely growing genus in different parts of Pakistan. The most commonly growing species in Pakistan are *D. bicornis* (Lamk.) Roem. & Schult. Ex Loud., *D. ciliaris* (Retz.) Koel. and *D. nodosa* Parl. (Ahmad & Stewart, 1958; Stewart, 1972; Cope, 1982). Haller was the first author, who gave a full and correct description of the genus *Digitaria* in 1768 and Stapf (1919) used this name, crediting it to Haller, although Haller and all other writers, took up the name from Heister (1748) (Henrard, 1950).

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Table 1. Names of the authors of classification of the genus *Digitaria* and the categories which they presented.

Author of classification	Name of categories
Hackel (1901)	Series: *Solitaria, Binata, Ternata.*
Stapf (1919)	Sections: *Setariopsis, Eu-Digitaria.*
Henrard (1950)	Sub-genera: *Solitaria, Setariopsis, Leptoloma, Eu-Digitaria.*
Bor (1955)	Followed Henrard's classification.
Goethebeur and Van der Veken (1975)	Followed Henrard's classification.

Most of the taxonomists have treated *Digitaria* as *Paspalum* or *Panicum*. Robert Brown (1810) included 10 names that were later transferred to *Digitaria*. Mueller (1874) treated *Digitaria* as a section of *Panicum* and named one new species. Bentham (1878) also placed these species in *Panicum*, grouping them into the series *Digitarieae* and *Trichachne*. These groups contained 13 species and included four new names. Hughes (1923), following the excellent generic concepts of Stapf (1919), placed 21 species in the genus *Digitaria* and one species in the genus *Leptoloma* (Chase, 1906).

The first attempt to subdivide *Digitaria* above species level was made by Hackel (1901) who used the number of spikelets per grouplet to recognize the series *Solitaria, Binata* and *Ternata* (Table 1). Stapf (1919) recognized the sections *Setariopsis* and *Eu-Digitaria* (Table 1) then used a variety of characters to sub-divide the latter into nine sub-sections.

Stapf's treatment served as the basis of Henrard's (1950) in-depth infrageneric classification of *Digitaria*. Henrard recognized four subgenera including the *Solitaria* (8 sp.), *Setariopsis* (9 sp.), *Leptoloma* (2 sp.) and *Eu-Digitaria* (310 sp.) (Table 1). The latter was subdivided into 32 sections (Webster, 1983).

The presence or absence of a first (lower) glume is considered as an important character due to which a member of this group is placed in *Panicum* or *Paspalum*; but now it is proved to be of no taxonomic value by the contemporary systematists. *Digitaria* without the lower glume was formerly placed in the genus *Paspalum* and *Digitaria* with a distinct lower glume was placed in the genus *Panicum* (Henrard, 1950).

The lower lemma of *Digitaria* is highly diagnostic, and can be used to identify most, if not all the species. For many species, the length of the lower lemma is analogous to spikelet length. Relative length of the lower lemma and upper lemma is of taxonomic importance, but precise measurement must be made (Webster, 1983).

Webster & Hatch (1981) used techniques to clarify the taxonomic relationships between two closely related grasses, *Digitaria ciliaris* and *D. bicornis*. Principal Component Analysis (PCA) illustrated distinct specimen clusters, whereas a correlation phenogram showed a distinct dissimilarity between the species and high degree of similarity among populations within the species. A multiple discriminant analysis procedure showed that there were no misclassifications of the specimens. *Digitaria bicornis* was found to have a shorter distance to the first lateral nerve on the lemma of the lower floret, a longer second glume, and a shorter first glume. Minor characters included a shorter main axis and a longer average rachis length. The lengths of the second glume, main axis, and rachis were characters previously not considered as taxonomically important. A nested analysis of variance showed these characters to have more than 70% of the measured morphological variation due to differences between species.

Webster & Shaw (1982) analysed phenetically and statistically to show the taxonomic relationship between the perennial *Digitaria milanjiana* and the annual species

of *Digitaria* section *Digitaria* (*D. bicornis, D. ciliaris, D. horizontalis, D. nuda, D. sanguinalis* and *D. setigera*). A phenetic analysis showed populations of *D. milanjiana* form a distinct cluster separate from the most closely related annual (*D. bicornis*), and a statistical analysis showed these species differed significantly on 16 of the 20 characters measured. It was concluded that a measurable and definable difference exists between *D. milanjiana* and the annual members of the section *Digitaria*.

Materials and Methods

Pakistan has 15 species of *Digitaria*. All the specimens of National Herbarium, Quaid–e–Azam University Herbarium, Pakistan Museum of Natural History (PMNH) Herbarium were examined besides living collections and available literature. Forty-four characters were identified to show variation among Operational Taxonomic Units (OTUs) including vegetative and floral characters. Though anther length and fruit (length, breadth, color and shape) characters are important but were not considered during analysis due to the non-availability of these characters in few species.

The method of coding of the characters follows that of Boratynski & Davis (1971). For most of the quantitative characters, there was a considerable range, not only on a single individual but also between individuals of one OTU. Since, one has to decide on a single value for each cell of a data matrix, the mean of the values measured was adopted as the most satisfactory.

A data matrix or spreadsheet was prepared in Microsoft Excel, so that each row represented one taxon and each column represented one character. Each cell of the spreadsheet contained the character states for the character represented by the column the cell is in, and the taxon represented by the row. Then the final matrix was subjected for taximetric analysis. Cluster Analysis was employed to workout relationship among these taxa. Similarly, matrix was measured using Euclidean distance and a dendrogram was constructed using average linkage method. The data matrix is analysed using the following packages SPSS 10.0 (Statistical Procedure for Social Sciences).

Clustering by average linkage

These groups are a class of clustering techniques proposed by Sokal & Michener in 1958 (Sokal & Sneath 1963). These authors suggested their techniques for the analysis of correlation coefficient matrices, but with some minor exceptions, the group methods can be applied to all types of similarity coefficient matrices. They based admission of any individual into a cluster on the average of the similarities of that individual with the members of the cluster. This average similarity was L_n in the original paper, but now is called S_n (Sokal & Sneath, 1963). Members of the cluster mean either the original OTUs or the smaller clusters composing a higher-ranking cluster. As the cluster grows and more remote relatives are considered as prospective members, the value of S_n value of a cluster by 0.03, the prospective member should not be included, and that similarity coeeficients should be recalculated among all clusters already formed at that level as well as between all clusters and those OTUs that have remained single.

Some of the species of *Digitaria* were not joined in a cluster in any one computational cycle; it may be due to the higher relationship of these species to other clusters than to the one under consideration or because these species might cause too large a drop in S_n values which is also in confirmation to the findings of Sokal & Sneath (1963). The OTUs which join a cluster have always the highest average similarity value with their clusters.

Results and Discussion

Genus *Digitaria* is one of the most problematic genera in identification at generic as well as at specific level. Morphologically, it is similar to *Paspalum, Panicum, Axonopus* and *Antherisma*. It can be distinguished from them in fruit and fertile lemma (upper lemma) shape and the position of the spikelets on the main axis (Table 3). The other diagnostic character of *Digitaria* is the absence of awns on both the glumes and the sterile (lower) lemma.

Minute microscopic characters like shape, size, pubescence and presence/absence of scabridities on glumes. Lower lemma and the rachis are important for the identification and differentiation of *Digitaria sp.*
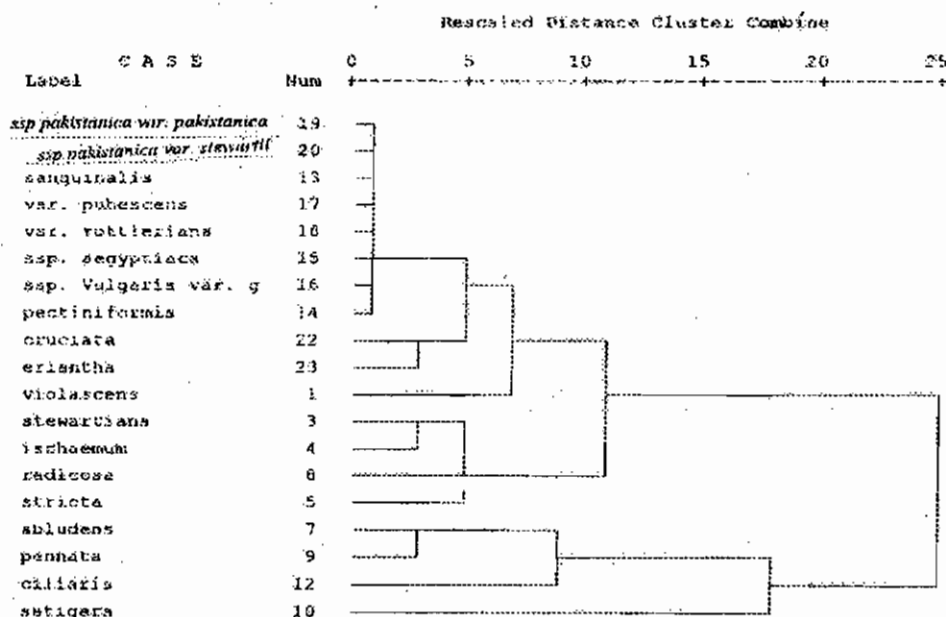
The previous taxonomic treatment of *Digitaria* from Pakistan to 12 species including 2 cultivated species were recognized (Cope, 1982). The present account is the first detailed taxonomic treatment of this genus from Pakistan in which 22 taxa have been included. This revision includes two new varieties, new additions of 3 subspecies, 2 varieties in *D. sanguinalis* (L.) Scop.; the changing of the rank of variety (*D. stricta* var. *denudata* (Link) Henr.) into the species level i.e., *D. denudata* Henr., new addition of *D. bicornis* (Lamk.) Roem. & Schult. ex Loud. (Fig. 1) and *D. cruciata* (Nees) A. Camus. *D. stewartiana* Bor.

In this revision, *D. sanguinalis* (L.) Scop. is divided into four subspecies, of which three of them viz., *D. sanguinalis* (L.) Scop. ssp. *pectiniformis* Henr., *D. sanguinalis* (L.) Scop. ssp. *aegyptiaca* (Retz.) Henr. and *D. sanguinalis* (L.) Scop. ssp. *vulgaris* (Schrad.) Henr., were described by Henrard (1950) and the new subspecies having two varieties (ssp *pakistanica* var. *pakistanica* & var. *stewartii*) is the new addition to the Flora of Pakistan. *D. sanguinalis* ssp *pakistanica* Gilani, Khan and Shinwari is distinguished from other 3 subspecies by having spines on the upper half margins of nerves of the lower lemma while the others have spines on the whole nerves of the lower lemma. Henrard (1950) has mentioned this character but didn't give any attention to it. Cluster analysis confirms the present results and these two varieties are grouped with other subspecies of *D. sanguinalis* (L.) Scop., in the dendrograms 1, 2 and 3. The distribution pattern of these subspecies and varieties is shown in Table 2 to know their geographic range and variation. Most of these taxa were collected from the northern parts of Pakistan i.e., Swat, Hazara, Kashmir and Gilgit.
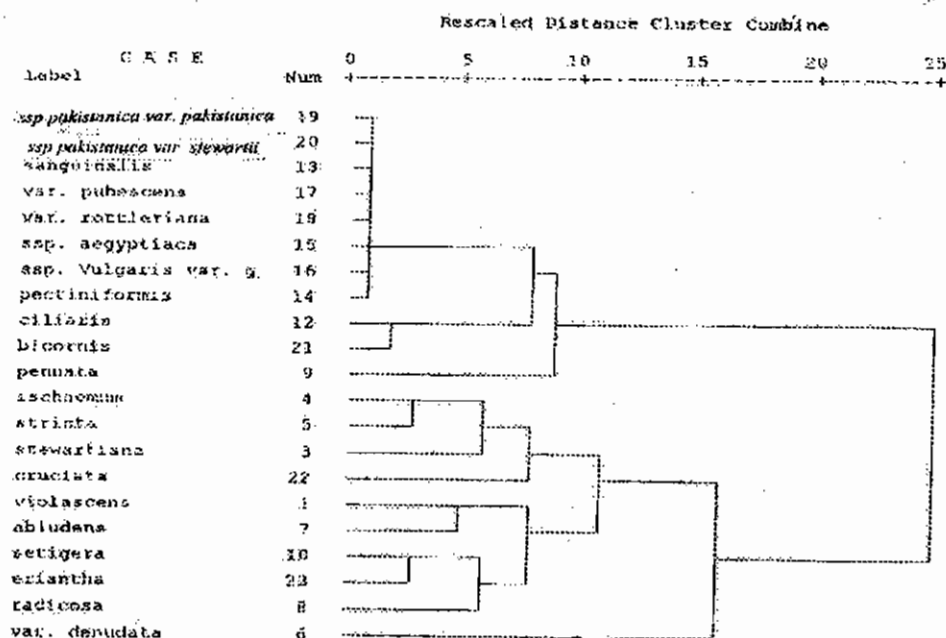
Table 2. Distribution pattern of subspecies and varieties of
***Digitaria sanguinalis* in Pakistan.**

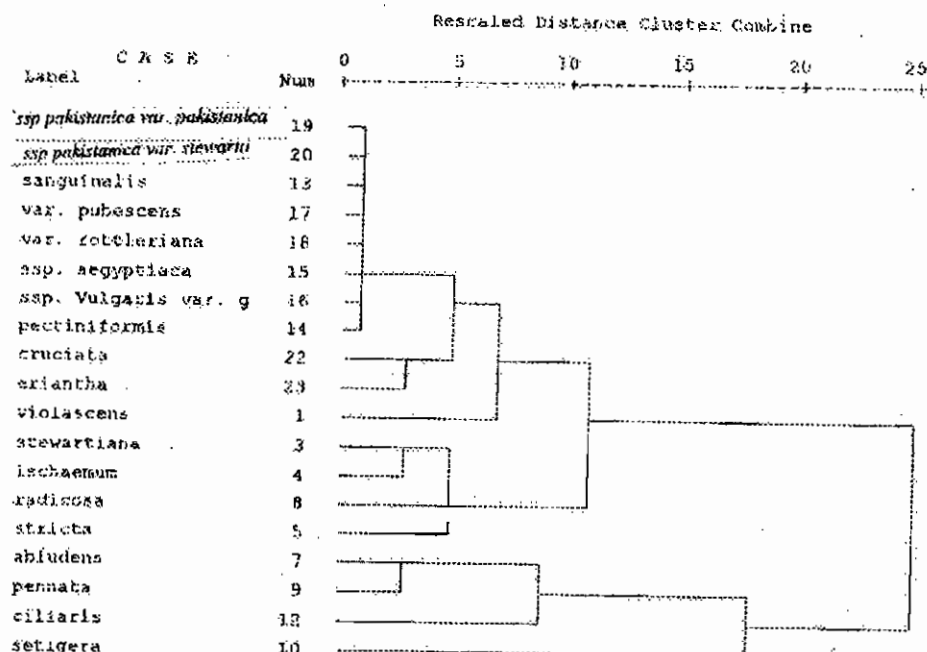| No.	*D. sanguinalis*	Distribution
1.	ssp. *Pectiniformis*	Kaghan, Bahrain
2.	ssp. *aegyptiaca*	Gilgit, Murree, Lower Sind valley, Kashmir.
3a.	ssp. *vulgaris* var. *glabra*	Muzaffarabad, Kashmir, Gilgit.
3b.	ssp. *vulgaris* var. *pubescens*	Lowari Top, Dir, Kiris, Baltistan, Poonch, Kashmir.
3c.	ssp. *vulgaris* var. *rottleriana*	Pahlgam, Kashmir, Sibbi, Baluchistan.
4a.	ssp. *pakistanica* var. *pakistanica* Gilani, Khan and Shinwari	Kaghan, Rawalpindi
4b.	ssp. *pakistanica* var. *stewartii* Gilani, Khan and Shinwari	Keran and Muzaffarabad, Kashmir, Rawalpindi, Islamabad, Abbotabad, Thandiani, Kuchlak, Baluchistan.

Dendrogram using Average Linkage (Between Groups)

Rescaled Distance Cluster Combine

| C A S E | | 0 | 5 | 10 | 15 | 20 | 25 |
| Label | Num | | | | | | |

ssp pakistanica var. pakistanica	19
ssp pakistanica var. stewartii	20
sanguinalis	13
var. pubescens	17
var. rottleriana	18
ssp. aegyptiaca	15
ssp. Vulgaris var. g	16
pectiniformis	14
cruciata	22
erlantha	23
violascens	1
stewartiana	3
ischaemum	4
radicosa	8
stricta	5
abludens	7
pennata	9
ciliaris	12
setigera	10

Dendrogram 1. Hierarchical cluster analysis of the vegetative characters of *Digitaria* species.

Dendrogram using Average Linkage (Between Groups)

Rescaled Distance Cluster Combine

| C A S E | | 0 | 5 | 10 | 15 | 20 | 25 |
| Label | Num | | | | | | |

ssp pakistanica var. pakistanica	19
ssp pakistanica var. stewartii	20
sanguinalis	13
var. pubescens	17
var. rottleriana	18
ssp. aegyptiaca	15
ssp. Vulgaris var. g.	16
pectiniformis	14
ciliaris	12
bicornis	21
pennata	9
ischaemum	4
stricta	5
stewartiana	3
cruciata	22
violascens	1
abludens	7
setigera	10
eriantha	23
radicosa	8
var. denudata	6

Dendrogram 2. Hierarchical cluster analysis of the floral characters of *Digitaria* species.

Dendrogram using Average Linkage (Between Groups)

Rescaled Distance Cluster Combine

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      C A S E                    0        5       10       15       20       25
    Label              Num       +--------+--------+--------+--------+--------+

ssp pakistanica var. pakistanica  19
ssp pakistanica var. stewartii    20
sanguinalis                       13
var. pubescens                    17
var. fotcleriana                  18
ssp. aegyptiaca                   15
ssp. Vulgaris var. g              16
pectiniformis                     14
cruciata                          22
eriantha                          23
violascens                         1
stewartiana                        3
ischaemum                          4
radicosa                           8
stricta                            5
abludens                           7
pennata                            9
ciliaris                          12
setigera                          10
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Dendrogram 3. Hierarchical cluster analysis of all the morphological characters of *Digitaria* species.

Cope (1982) states that **D. ciliaris** (Retz.) Koel. (Fig. 2) is a polymorphic species and the sporadic occurrence of the silicous spines characteristic of *D. sanguinalis* (L.) Scop., (Fig. 4) in spikelets otherwise typical of *D. ciliaris* (Retz.) Koel., suggests that there may be some gene flow between these two species. Webster & Hatch (1981) reported that morphologically, there are intermediate plants between *D. ciliaris* (Retz.) Koel., and *D. sanguinalis* (L.) Scop., but lack conspicuous spicules on the nerves of the lower lemma. The presence of siliceous spines is the only diagnostic character of *D. sanguinalis* (L.) Scop. only (Henrard, 1950; Bor, 1960, 1970; Ahmad & Stewart, 1958; Jafri, 1966; Tzvelev, 1983). Thus *D. sanguinalis* ssp. *pakistanica* var. *pakistanica* Gilani, Khan & Shinwari and *D. sanguinalis* ssp. *pakistanica* var. *stewartii* Gilani, Khan & Shinwari are not the intermediates between *D. ciliaris* (Retz.) Koel., and *D . sanguinalis* (L.) Scop. but the distinct varieties of a new subspecies of *D. sanguinalis* which is also confirmed by the numerical analysis (Dendrograms 1, 2 & 3).

D. pennata (Hochst.) Cooke (Fig. 3) is the only representative of the section *Pennatae* from Pakistan. *D. pennata* (Hochst.) Cooke can be easily distinguished from any taxon of *Digitaria* by the presence of pennate long hairs on the lower half rachis of an inflorescence (Henrard, 1950; Ahmad & Stewart, 1958; Bor, 1960, 1970; Cope, 1982). Cluster analysis of *D. pennata* (Hochst.) Cooke shows that it is separated from the cluster as a distinct taxa in cluster at 9 scale exhibiting its distinct entity from the rest of the group (Dendrograms 2 & 3).

Earlier the taxonomic status of **D. ciliaris** (Retz.) Koel. (Fig. 2) and **D. bicornis** (Lamk.) Roem. & Schult. ex Loud. (Fig. 3) was quite controversial. *D. bicornis* (Lamk.) Roem. & Schult. ex Loud. is also reported from Pakistan by Ahmad and Stewart (1958),
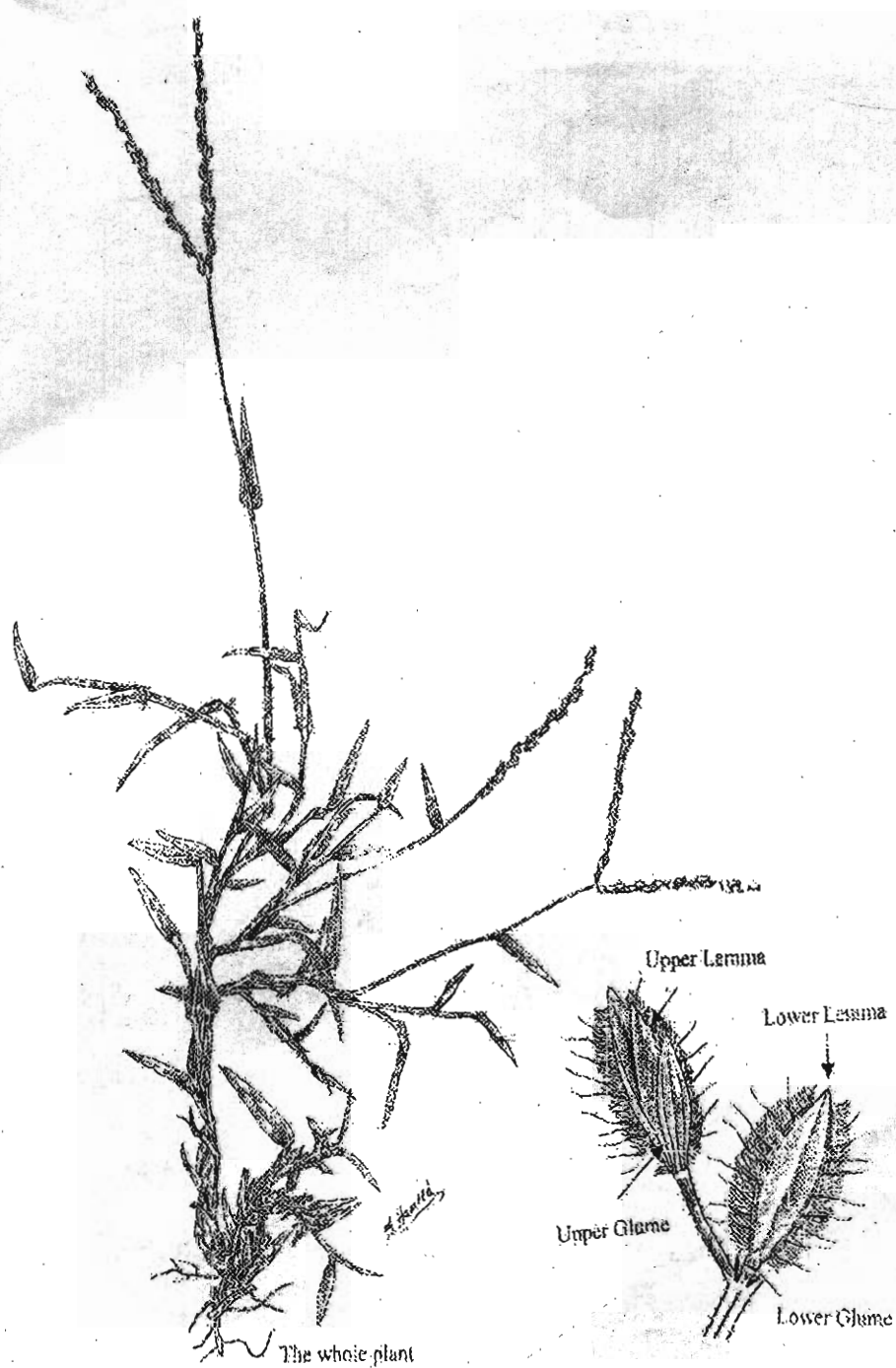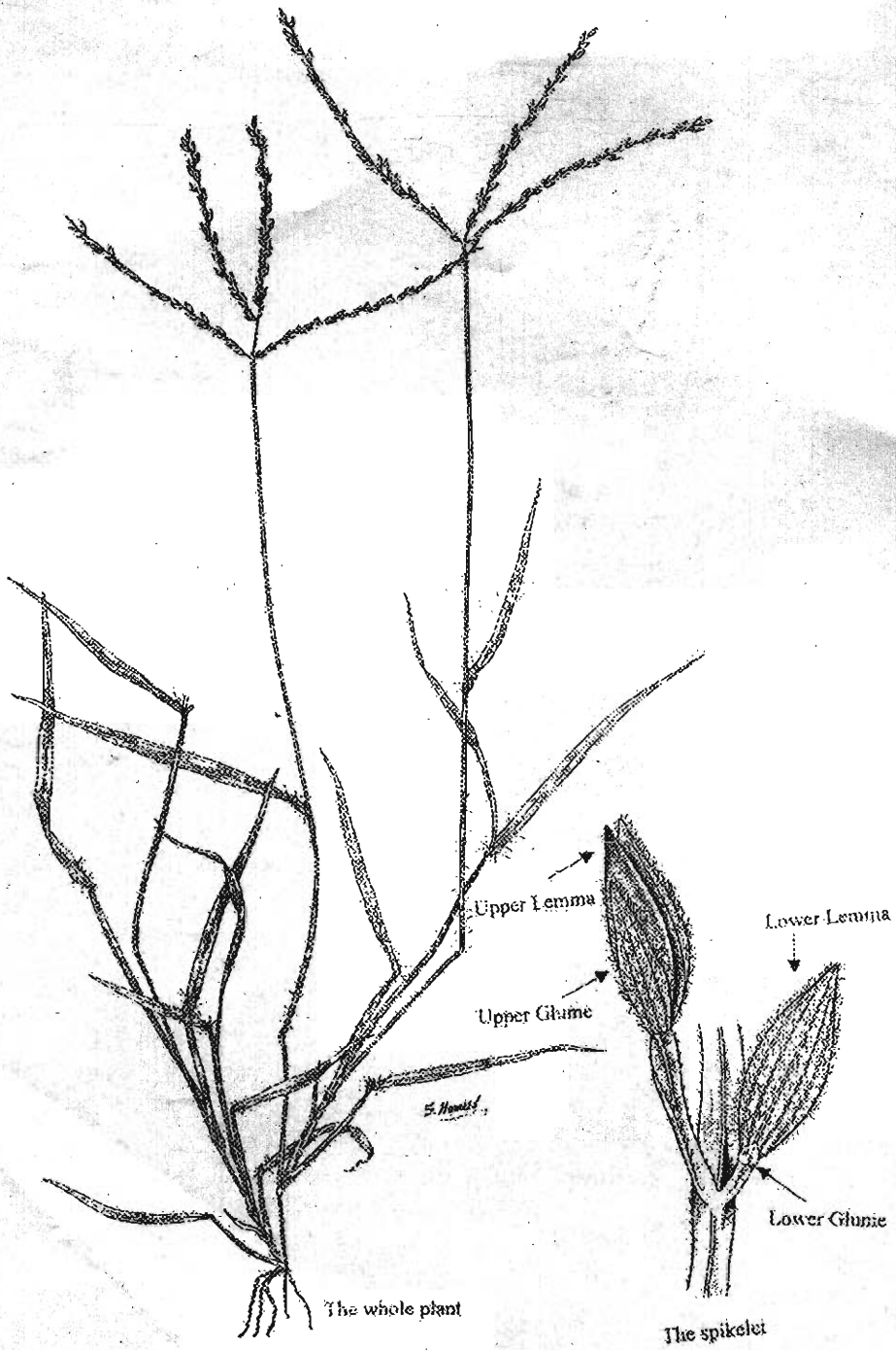
Fig. 1. *Digitaria bicornis.*

The whole plant

Upper Lemma
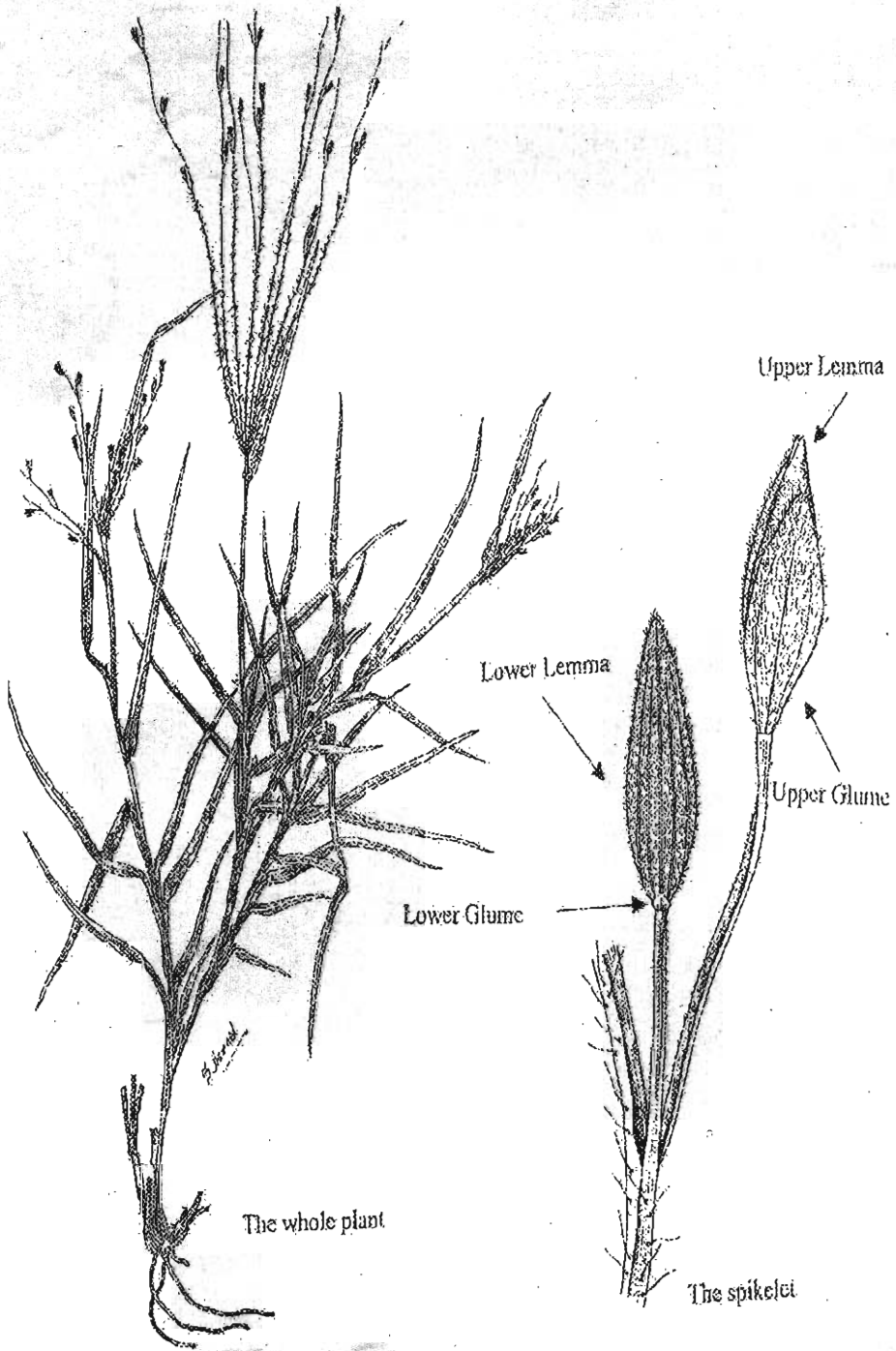
Upper Glume

Lower Lemma

Lower Glume

The spikelet

Fig. 2. *Digitaria ciliaris.*

Upper Lemma

Lower Lemma

Lower Glume

Upper Glume

The whole plant

The spikelet

Fig. 3. *Digitaria pennata.*

Upper Lemma

Upper Glume

The whole plant

The spikelet
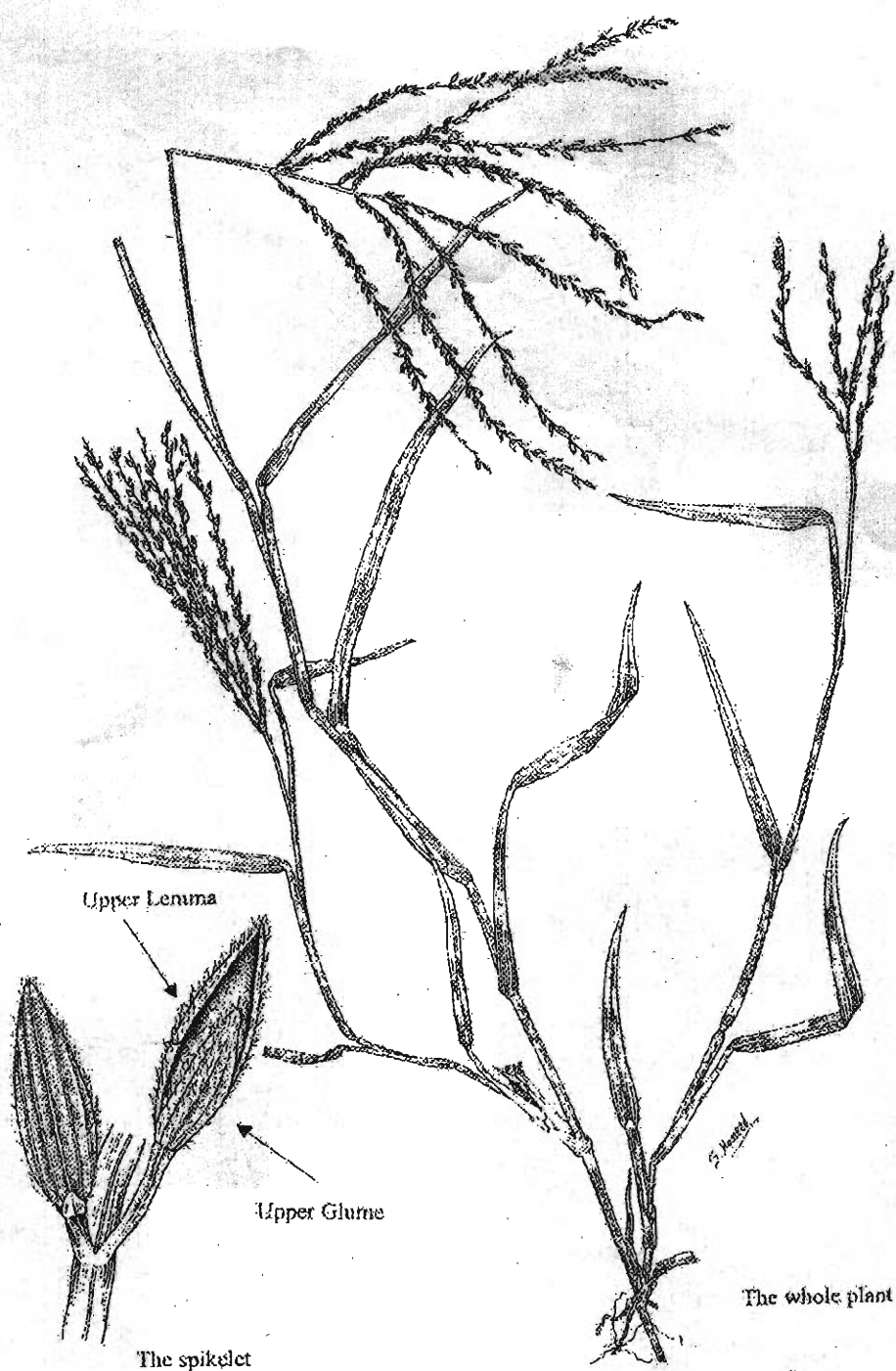
Fig. 4. *Digitaria sanguinalis* spp. *vulgaris* var. *glabra*.

Upper Lemma

Lower Lemma

Upper Glume

The whole plant

The spikelet
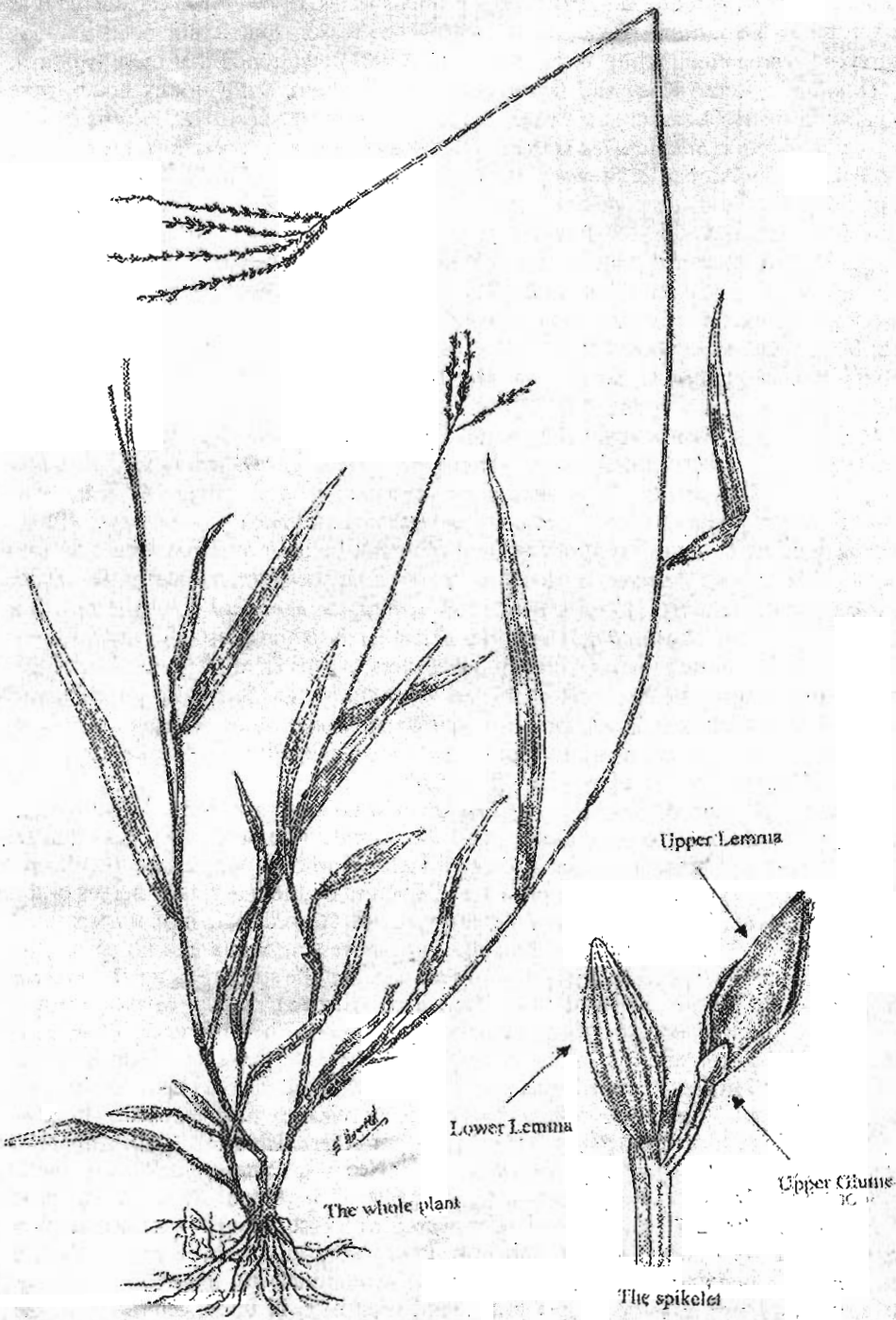
Fig. 5. *Digitaria setigera*.

Chaudhary (1969) and Stewart (1972) as a distinct species. Cope (1982) considered it as the variant of *D. ciliaris* (Retz.) Koel., giving the reason that it did not show any geographic segregation. While Webster & Hatch (1981) mentioned that these two taxa, i.e., *D. ciliaris* (Retz.) Koel. and *D. bicornis* (Lamk.) Roem. & Schult. ex Loud., were sympatric in distribution but still treated them as two distinct species. *D. ciliaris* (Retz.) Koel., of the section *Sanguinales* is the most commonly growing species and is reported from Pakistan by Ahmad & Stewart (1958), Chaudhary (1969) and Stewart (1972). Its morphology was studied as well as numerical analysis was done. *D. bicornis* (Lamk.) Roem. & Schult. ex Loud., was found to have a distinct ciliated frill around the margins of lower lemma, shorter distance to the first lateral nerve on the lower lemma, a longer upper glume and a shorter lower glume as compared to *D. ciliaris* (Retz.) Koel. Minor characters included the lengths and widths of lower glume, upper glume, lower lemma, upper lemma and palea. These characters were not considered previously. Our numerical analysis is concordance to Webster & Hatch (1981) confirming that these are two different species (Dendrograms 2 & 3).

    D. stricta (Fig. 7) was divided by Ahmad & Stewart (1958), Bor (1960, 1970) and Cope (1982) into two varieties viz., *D. stricta* var. *stricta* and *D. stricta* var. *denudata* (Link) Henr., on the basis of the absence or presence of upper glume. *D. stricta* var *stricta* has upper glume while *D. stricta* var. *denudata* (Link) Henr., has no upper glume. Taxonomically it is a distinct character and must not be used as classifying taxa into varietal status thus *D. denudata* Henr., may never be the intermediate of *D. stricta* (Henrard, 1950). Henrard (1950) separated *D. stricta* var *denudata* (Link) Henr., as a separate species i.e., *D. denudata* Henr. Numerical analysis have also shown that these two taxa were separated ·in two different subclusters of cluster no. 2 (Dendrogram 2), based on the analysis of the floral characters of *Digitaria* sp. *D. stricta* var *denudata* (Link) Henr., was completely grouped as a separate subcluster alone. These results show that *D. stricta* var. *denudata* (Link) Henr., must be considered as a separate taxon and specific rank accorded as done by Henrard (1950).

    Ahmad & Stewart (1950) treated *D. cruciata* (Nees) A. Camus as a distinct species while Cope (1982) reduced it subspecies of *D. sanguinalis* (L.) Scop. He argues that *D. cruciata* (Nees) A. Camus is similar and often confused with *D. sanguinalis* (L.) Scop., and neither character alone i.e., the presence of spicules on the margins of nerves of the lower lemma, is sufficient to distinguish the two species. According to him, it is confined mainly to the eastern Himalyas but extending as far west as Simla and no specimens corresponding to the type have been found in Pakistan. But the specimens for *D. cruciata* (Nees) A. Camus were collected from Thandiani (Hazara), Kulali (Swat), Poonch (Kashmir), Gilgit and Baltistan (Ahmad & Stewart, 1958). The difference between *D. sanguinalis* (L.) Scop., and *D. cruciata* (Nees) A. Camus is the presence of spines on the nerves of lower lemma of former species while turgid broad spikelet and the broadly ovate and glabrous upper glume whose 3 nerves never reach to the apex of the glume in the latter species which also confirms the findings of others (Henrard, 1950; Ahmad & Stewart, 1958; Bor, 1970). Therefore, *D. cruciata* (Nees) A. Camus and *D. sanguinalis* (L.) Scop., must be considered as two different species. The present study also suggests that *D. sanguinalis* (L.) Scop., must be considered as a distinct species of the **section sanguinales**, *D. cruciata* (Nees) A. Camus is also distinguished from *D. ciliaris* (Retz.) Koel., and *D. sanguinalis* (L.) Scop. of **section sanguinales** by the apiculate upper lemma and caryopsis, rounded upper glume and protrusion of upper lemma from the spikelet (Ahmad & Stewart, 1958; Bor, 1970; Dassanayake *et al.*, 1994). Cluster anlaysis

of *D. cruciata* (Nees) A. Camus showed that it is grouped alongwith the subspecies and varieties of *D. sanguinalis* (L.) Scop., but as a separate taxon (Dendrograms 2 & 3). *D. eriantha* Steud. is also grouped in this subcluster. Thus these results confirm that *D. cruciata* (Nees) A. Camus is the separate taxon and not the subspecies of *D. sanguinalis* (L.) Scop.

Table 3. Comparison of characters of *Digitaria ischaemum*, *D. violascens* and *D. stewartiana*.

No.	Characters	*D. ischaemum*	*D. violascens*	*D. stewartiana*
1.	Culms (Length)	10-25 cm	23-55 cm	15 cm
2.	Racemes (Number)	2-4	3-6	3
3.	Racemes (Length)	2-11 cm	5-9 cm	7-8 cm
4.	Spikelets (pubescence)	Hairy	Hairy	Glabrous
5.	Spikelets (Length)	0.2 cm	0.15-0.2 cm	0.25 cm
6.	Spikelets (Breadth)	0.1 cm	0.1 cm	0.1 cm
7.	Lower Glume	Hyaline rim	Absent	Absent
8.	Upper Glume (Length)	0.2 cm	0.15-0.2 cm	0.2 cm
9.	Upper Glume (Breadth)	0.1 cm	0.05-0.1 cm	0.1
10.	Upper Glume (No. of Nerves)	3	3	3
11.	Lower Lemma (Length)	0.2	0.15-0.2	0.2
12.	Lower Lemma (Breadth)	0.1	0.05-0.1	0.1
13.	Lower Lemma (No. of Nerves)	5	5-7	5
14.	Fruit (Colour)	Dark brown-black	Purplish black-brown	Dark purple-brown

   D. stewartiana Bor (Fig. 6) is an endemic and probably rare in Azad Kashmir because only 3 specimens were seen. T.T. Thomson made the first collection in 1848 from Kargil (Cope, 1982). Later on, Stewart (1972) beside Kargil also reported it from Ladakh and Baltistan. The collected specimen from Baltistan is deposited in the National Herbarium, Islamabad while rest of the two collections made by Thomson and Stewart are placed in the Kew Herbarium. It was identified and described as a new species by N.L. Bor in 1951 (Bor, 1960). But its placement at section level is still to be done. According to Bor (1960), it is similar to *D. ischaemum* (Schreb.) Schreb. ex Muhl., while Cope (1982) says that it is very closely related to *D. violascens* Link (Fig. 8). It is separated from *D. ischaemum* (Schreb.) Schreb. ex Muhl., and *D. violascens* Link by its glabrous nature of the spikelets which also confirms the findings of others (Bor, 1960; Cope, 1982).

   Comparing *D. stewartiana* Bor to *D. ischaemum* (Schreb.) Schreb. ex Muhl. and *D. violascens* Link, the present findings reveal that there are more similarities between *D. stewartiana* Bor and *D. ischaemum* (Schreb.) Schreb. ex Muhl., than *D. stewartiana* Bor and *D. violascens* Link as shown in Table 3. There are 9 characters of similarities (length of culms, length and number of racemes, length of upper glume, number of nerves of upper glume and lower lemma, and breadth of lower lemma) and 5 characters of differences (length of spikelets, pubescens of spikelets, presence or absence of lower glume, length of lower lemma and colour of fruit) between *D. stewartiana* Bor and *D. ischaemum* (Schreb.) Schreb. ex Muhl., (Table 3), while there were 7 characters of similarities (length and number of racemes, absence of lower glume, length and breadth of upper glume, number of nerves of upper glume and lower lemma, and breadth of lower lemma) and 4 characters of differences (length and pubescence of spikelet, length of lower lemma and colour of fruit) between *D. stewartiana* Bor and *D. violascens* Link (Table 3).
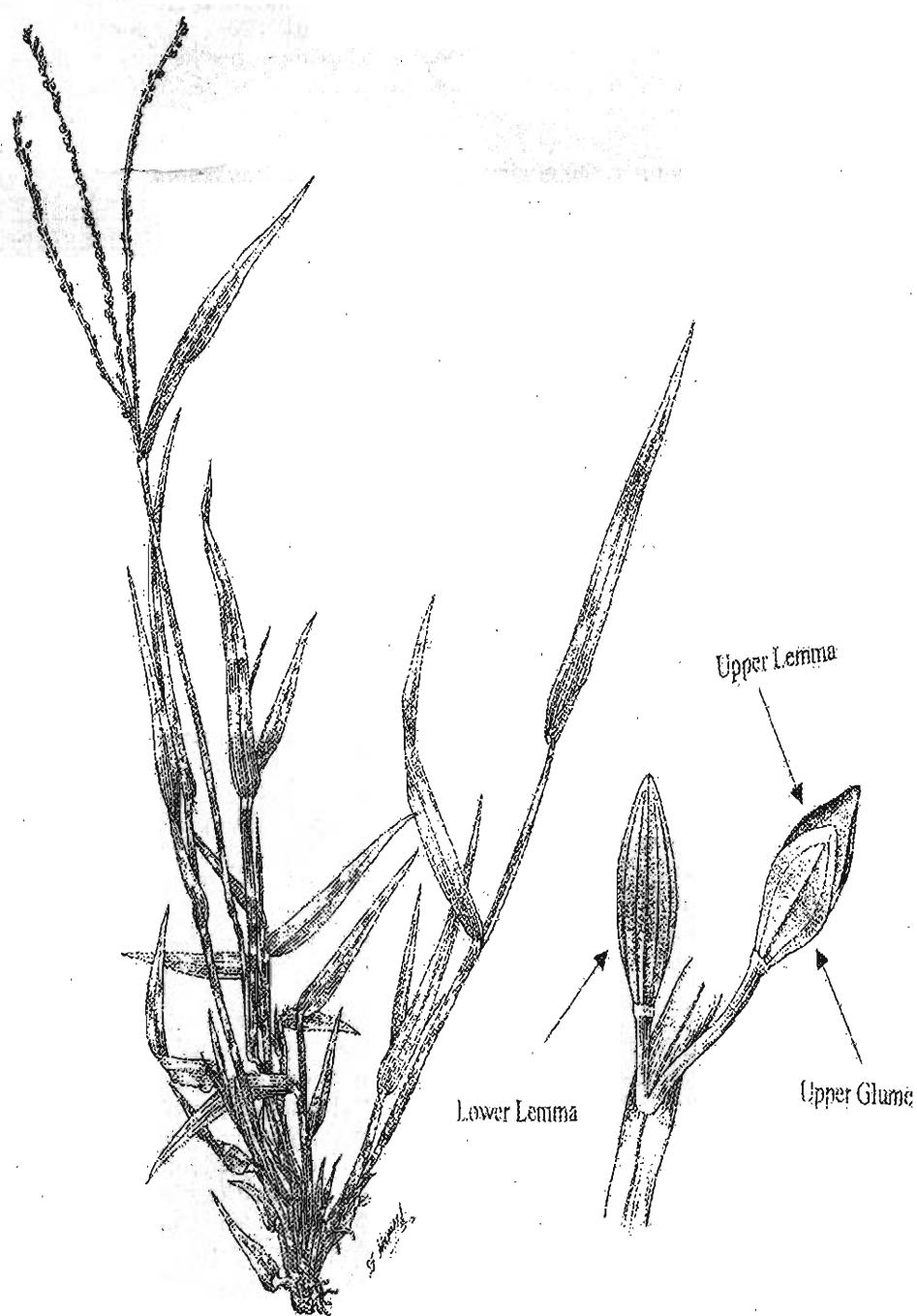
Upper Lemma

Lower Lemma

Upper Glume

Fig. 6. *Digitaria stewartiana*.
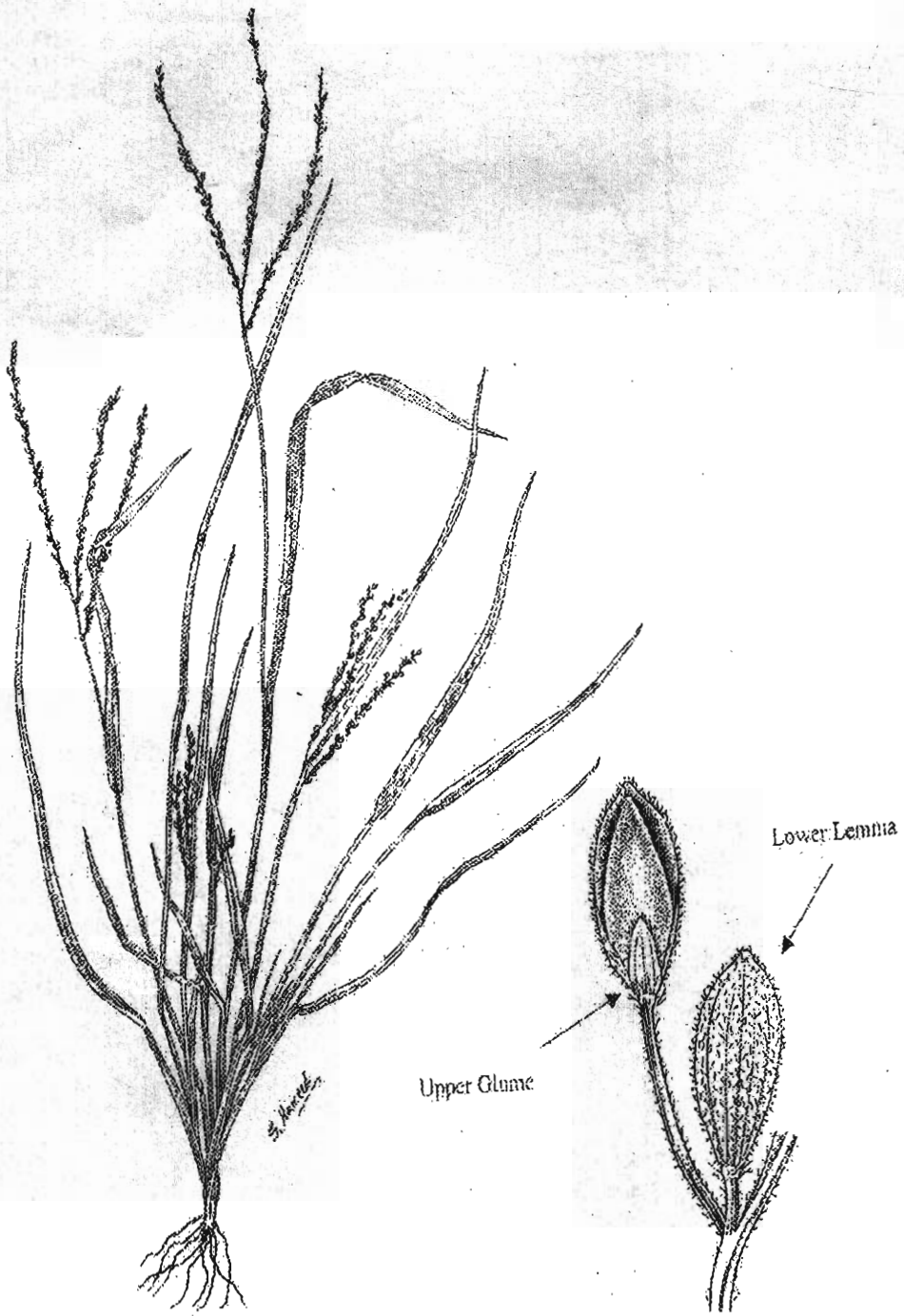
Upper Glume

Lower Lemma
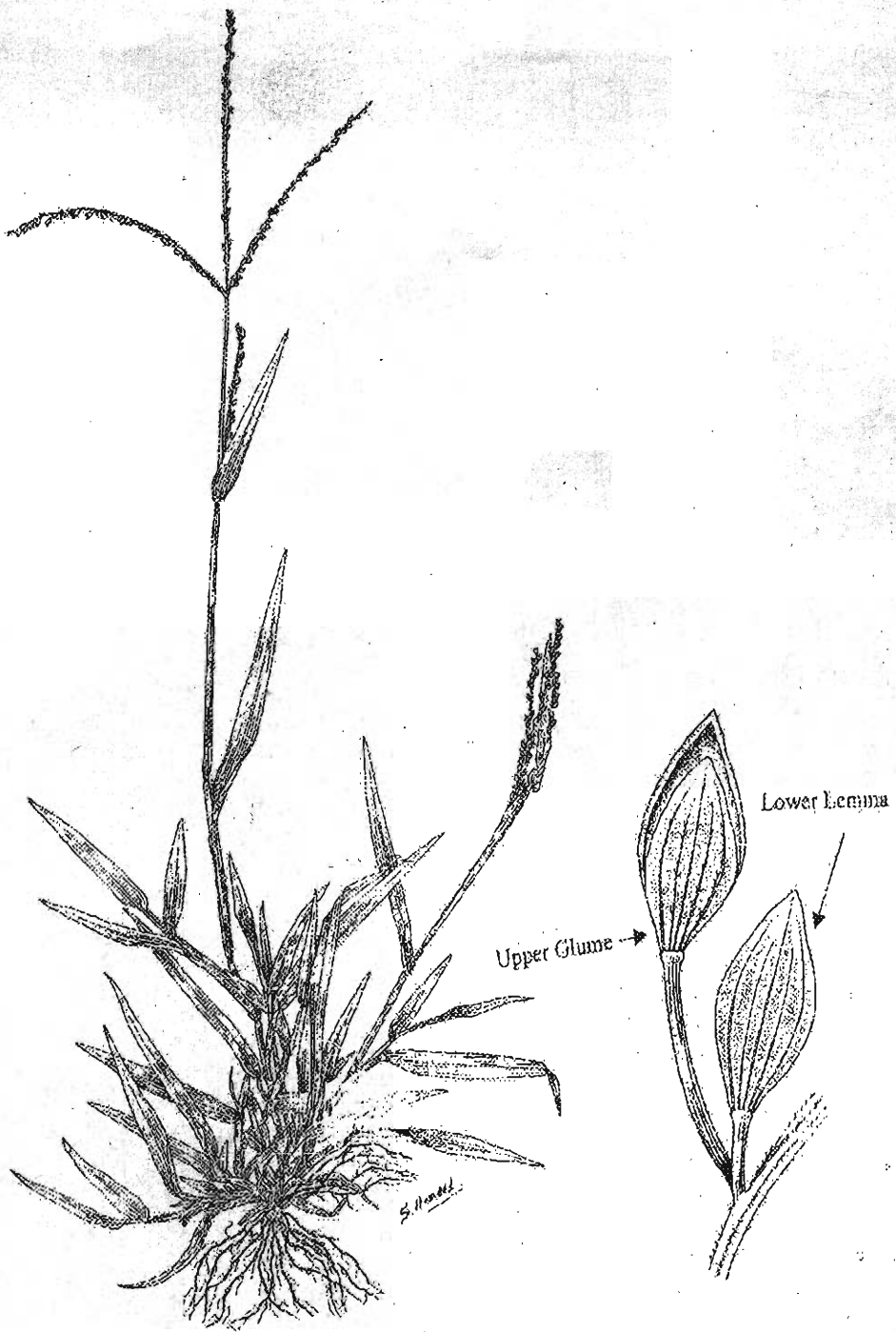
Fig. 7: *Digitaria stricta.*

Fig. 8. *Digitaria violascens.*

In numerical analysis (using floral characters (Dendrogram 2)) showed that *D. stewartiana* clustered with *D. ischaemum* (Schreb.) Schreb. ex Muhl., and *D. stricta* of section *Clavipilae*. The present study of morphological characters and their numerical analysis shows that it is more closely related to *D. ischaemum* (Schreb.) Schreb. ex Muhl., than *D. violascens* Link which also cofirms the findings of Bor (1970). Thus it can be safely concluded that *D. stewartiana* Bor must be placed in the section *Clavipilae* with *D. ischaemum* (Schreb.) Schreb. ex Muhl., than the *D. violascens* Link of the section *Verrucipilae*. Thus following the Henrard's classification with an addition of *D. stewartiana* Bor to the section *Clavipilae* may be as follows:

Section	Name of *Digitaria* species
1. Clavipilae	1. *D. abludens*
	2. *D. ischaemum*
	3. *D. stewartiana*
	4. *D. stricta*
	5. *D. denudata*
2. Biformes	1. *D. bicornis*
3. Erianthae	1. *D. eriantha*
	2. *D. nodosa*
4. Pennatae	1. *D. pennata*
5. Parviglumae	1. *D. setigera*
6. Sanguinales	1. *D. ciliaris*
	2. *D. cruciata*
	3. *D. radicosa*
	4. *D. sanguinalis*
7. Verrucipilae	1. *D. longiflora*
	2. *D. violascens*

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