Pak.J.Bot., 24(1): 95-106, 1992.

GENERIC LIMITS IN *GENTIANA* (GENTIANACEAE) AND RELATED GENERA IN PAKISTAN AND ADJOINING AREAS ALONGWITH A NEW GENUS *KURRAMIANA*.

SAOOD OMER AND M. QAISER

Department of Botany,
University of Karachi, Karachi-75270, Pakistan.

Abstract

The genus *Gentiana* L. (s.l.) is a heteromorphic assemblage. A synthetic approach is adopted to treat *Gentiana* L. (s.l.) from Pakistan and adjoining areas by utilizing the data from palynology, seed morphology and chemistry. Nine genera viz., *Ciminalis* Adans., *Gentianodes* Love & Löve, *Qaisera* Omer, *Aliopsis* Omer & Qaiser, *Gentianopsis* Ma, *Aloitis* Rafin., *Comastoma* Toyok., *Jaeschkea* Kurz and a new genus *Kurramiana* Omer & Qaiser have been recognized. *Gentiana* L. (s.str.) and *Gentianella* Moench (s.str.) do not occur in Pakistan and adjoining areas. The generic limits and their affinities of all the taxa have been discussed. A new genus *Kurramiana* Omer & Qaiser is described, and compared in detail with other related genera. The numerical analysis suggests its affinities with the genus *Jaeschkea* Kurz.

Introduction

Linnaeus (1753, 1754) adopted the generic name of *Gentiana* from Tournefort (1700) and placed 23 species under it. Linnaeus (1754) did not pay any attention to the finer details of floral characters and the protologue used by him was so generalized that it could fit well into several unrelated taxa. Moreover, the generic limits of *Gentiana* were greatly widened by other workers (Grisebach, 1839, 1845; Clarke, 1875, 1883; Boissier, 1879; Schiman-Czeika, 1967) resulting in a rather confusing circumscription. It appears that all the taxa having different floral characters were placed under *Gentiana* L. (s.l.), thus resulting in a complete chaos. The other workers, however, splitted the genus into smaller and uniform groups. More than 23 segregates from *Gentiana* L. (s.l.) are known (Löve, 1986).

In Pakistan and Kashmir, 44 taxa all belonging to *Gentiana* L. (s.l.), 2 pertaining to *Jaeschkea* Kurz and 1 to *Gentianella* Moench (s.l.) were known (Stewart, 1972). All the previous workers dealing with the Gentianaceae of the area under question accepted *Gentiana* L., in a broad sense (Clarke, 1873, 1875; Boissier, 1879; Stewart, 1916-1917, 1957, 1972 & Schiman-Czeika, 1967). During the detailed study of *Gentiana* L. (s.l.) from Pakistan and Kashmir, the authors came across several taxa which were not only different in facies but also in floral characters and could not be placed under *Gentiana* L. (s. str.).

Material and Methods

Large number of specimens present in different herbaria (B, BM, CAL, E, K, KUH, LE, LINN, NA, NY, O, P, RAW, RNG & W) were critically studied. Morphological studies were also supplemented by field observations and most of the taxa were studied in their natural habitats. Beside the general morphology, pollen and seed morphology were also studied by light and Scanning electron microscope using Jeol

JSM-T200. Prior to SEM the pollen were acetolyzed according to the method of Erdtman (1952). Phenolic constituents of most of the taxa were studied by paper chromatographic techniques according to the method of Harborne (1973, 1984). The results are presented elsewhere (Omer & Qaiser, in press).

For the numerical analysis 21 attributes were used (Table 2). Nearest, furthest and group averages were obtained by conventional clustering method using software ASF-4 package developed by School of Plant Sciences, University of Reading, U.K. Variation in 21 characters (Table 2) was observed.

Results and Discussion

The genus *Gentiana* L. (s.str.) is characterized by having plicate but naked corolla and the tube smaller than lobes, basifixed stamens and nectaries at the base of the ovary. Whereas *Gentianella* Moench (s.str.) is characterized by having non plicate but fimbriate corolla, tube equal or longer than lobes, dorsifixed stamens and nectaries situated at the base of the corolla tube. The authors did not come across any taxon having these combination of characters. Therefore, it is evident from the foregoing discussion that the genera *Gentiana* L. (s.str.) and *Gentianella* Moench (s.str.) do not occur in Pakistan and Kashmir.

The present investigations indicate the presence of two broad groups. Both the groups are separable at 56% dissimilarity level (Fig. 1). Group I comprises the taxa having plicate corolla with nectaries situated at the base of the ovary. Group II includes taxa with non plicate corolla and nectaries situated at the base of corolla tube.

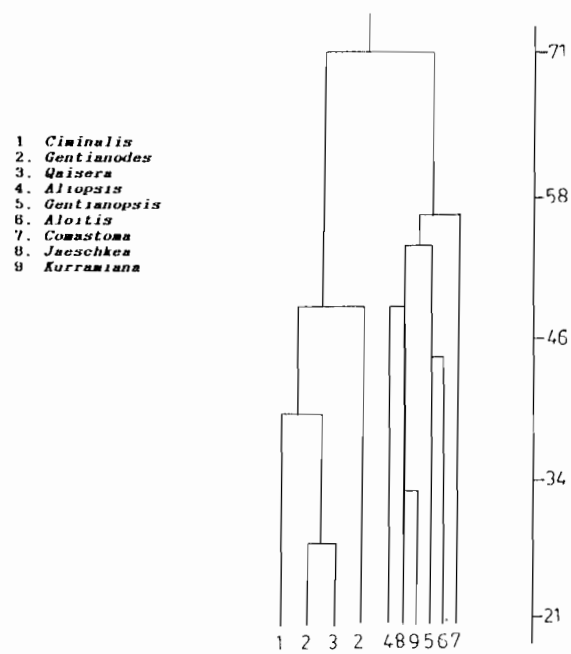

Fig.1. Dendrogram based on the group average showing the existence of 9 genera.

The numerical analysis also supports the existence of 9 genera and at 26% dissimilarity level all the genera are recognizable (Fig.1). The first group consists of *Gentianodes* Löve & Love;*Qaisera* Omer; *Ciminalis* Adans.; whereas the second group includes *Aloitis* Rafin., *Aliopsis* Omer & Qaiser; *Comastoma* Toyok.; *Jaeschkea* Kurz, *Gentianopsis* Ma; and *Kurrami ana* Omer & Qaiser. Out of these 9 genera., 3 viz., *Qaisera* Omer, *Aliopsis* Omer & Qaiser and *Kurramiana* Omer & Qaiser are erected by the present authors. The first two genera have been published elsewhere (Omer, 1989, Omer & Qaiser, 1991). However, *Kurramiana* Omer & Qaiser is being described here as a new genus. Table 1 gives a comparative account of different morphological characters of all the genera along with *Gentiana* L. (s.str.) and *Gentianella* Moench (s.str.). A key for the genera is also given below:

Key to the genera

1	+ Nectaries present at the base of corolla tube. Corolla non plicate.	5
	- Nectaries present at the base of ovary. Corolla plicate.	2
2	+ Corolla tube equal or longer than lobes. Plicae prominent.	3
	- Corolla tube shorter than lobes. Plicae not prominent.	1. Gentiana (s.str.)
3	+ Anthers basifixed. Basal leaves more than one nerved. Mostly annuals or biennials.	2. *Ciminalis*
	- Anthers dorsifixed or versatile. Basal leaves usually one nerved. Mostly biennials-perennials sometimes annuals.	4
4	+ Corolla fimbriate inside the corolla tube.	4. *Qaisera*
	- Corolla naked inside the corolla tube.	3. *Gentianodes*
5	+ Corolla throat fimbriate.	6
	- Corolla throat naked.	7
6	+ Fimbriae linear-filiform. Style absent.	9. *Comastoma*
	- Fimbriae lanceolate. Style present.	5. *Gentianella*
7	+ Nectaries in pair. Corolla lobes usually mucronate.	8. *Aloitis*
	- Nectaries solitary. Corolla lobes not mucronate.	8
8	+ Calyx lobes distichously unequal. Gynophore distinct. Floral buds ellipsoidal.	7. *Gentianopsis*
	- Calyx lobes equal to subequal, but never distichous. Gynophore not distinct. Floral buds not as above.	9
9	+ Anthers dorsifixed. Seeds generally many in each capsule.	6. *Aliopsis*
	- Anthers basifixed. Seeds generally few in each capsule.	10
10	+ Calyx smaller than corolla. Stamens dark coloured, filaments inserted near the sinus. Filaments ciliate at base.	10. *Jaeschkea*
	- Calyx always longer than corolla. Stamens of light coloured, filaments inserted below the middle. Filaments not ciliate at base.	11. Kumamiana

Table 1. A comparative account of different morphological characters of *Gentiana* (s.str.) and related genera

Gentiana	*Ciminalis*	*Gentianodes*	*Qaisera*	*Gentianella*	*Gentianopsis*	*Aloitis*	*Comastoma*	*Aliopsis*	*Jaeschkea*	*Kurramia*
Perennial	Annual	Annual/ perennial	Annual	Perennial	Perennial	Pernnial	Perennial	Annual	Perennial	Annual
Erect	Prostrate	Erect/ prostrate	Erect/ prostrate	Erect	Erect	Erect	Erect	Erect	Erect	Erect
Basal leaves										
>1-nerved	>1-nerved	1-nerved	1->nerved	>1-nerved	>1-nerved	>1-nerved	>1-nerved	>1-nerved	>1-nerved	>1-nerved
Calyx lobes										
Equal	Equal	Unequal	Equal	Unequal	Unequal	Unequal	Unequal	Equal	Unequal	Unequal
Corolla										
5-lobed naked Plicate	5-lobed naked Plicate	5-lobed naked Plicate	5-lobed fimbriate Plicate	4-5 lobed fimbriate Non-plicate	4-lobed naked Non-plicate	5-lobed naked Non-plicate	4-lobed fimbriate Non-plicate	4-lobed naked Non-plicate	5-lobed naked Non-plicate	4-lobed naked Non-plicate
Plicae										
wanting	prominent	prominent	prominent	-	-	-	-	-	-	-
Ratio of Corolla tube and lobes										
less than lobes	more than lobes	more than lobes	more than lobes	more than lobes	more than lobes	more than lobes	more than lobes	more than lobes	more than lobes	more than lobes
Stamens										
basifixed	basifixed	dorsifixed	dorsifixed	dorsifixed	dorsifixed	dorsifixed	dorsifixed	dorsifixed	basifixed	basifixed
Position of nectaries										
Base of ovary	base of ovary	base of ovary	base of ovary	base of corolla	base of corolla	base of corolla	base of corolla	base of corolla	base of corolla	base of corolla
Seed Surface										
striated	striated	striated-papillose	striated	striated	papillose	striated	striated	striated	striated	-

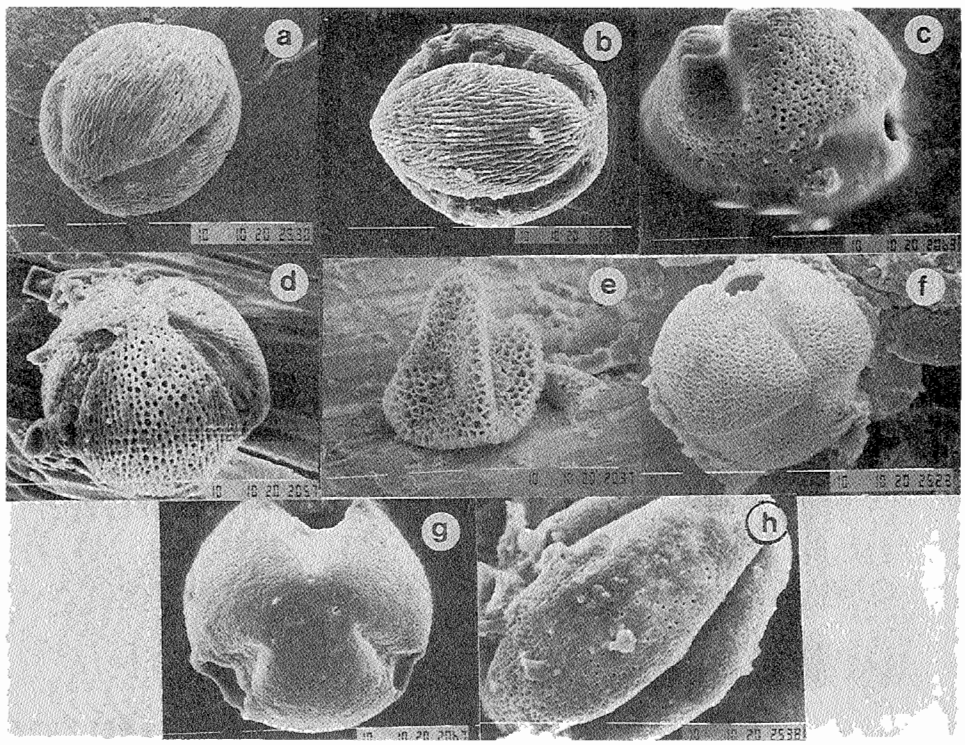

Fig.2. Different pollen types: a, *Ciminalis leucomalaena*; b, *Gentianodes olvierii*; c, *Qaisera carinata*; d, *Aliopsis pygmaea*; e, *Gentianopsis paludosa*; f, *Aloitis falconeri*; g, *Comastoma falcatum*; h, *Jaeschkea oligosperma* (one bar = 10 μ).

All the 9 genera are not only distinguishable in gross morphology but also differ in pollen and seed morphology and phenolic constituents. However, due to insufficient material, pollen, seeds and phenolic constituents of *Kurramiana* Omer & Qaiser could not be studied.

1. *Gentiana* L., Sp. Pl. 227. 1753 (s. str.).

Erect, perennial, with non prominent plicae. Corolla divided almost to the base. Corolla non fimbriate. Stamens basifixed. Nectaries at the base of ovary.

Distribution: Europe - Asia minor.

2. *Ciminalis* Adans., Fam. 2: 504. 1763.

Prostrate, mat forming small annuals with prominent plicae. Corolla tube equal or longer than lobe. Corolla non fimbriate. Stamens basifixed. Nectaries at the base of the ovary.

Distribution: Cold and alpine regions of America, Europe and Asia.

3. *Gentianodes* Löve & Löve in Bot. Not. 125: 256. 1972.

For details of generic description and affinities, see Omer, Ali & Qaiser, 1988.

Distribution: Europe-Asia.

Gentianodes Löve & Löve is the largest genus in Pakistan and exhibits a good range of variation in habit, morphology of calyx and corolla lobes.

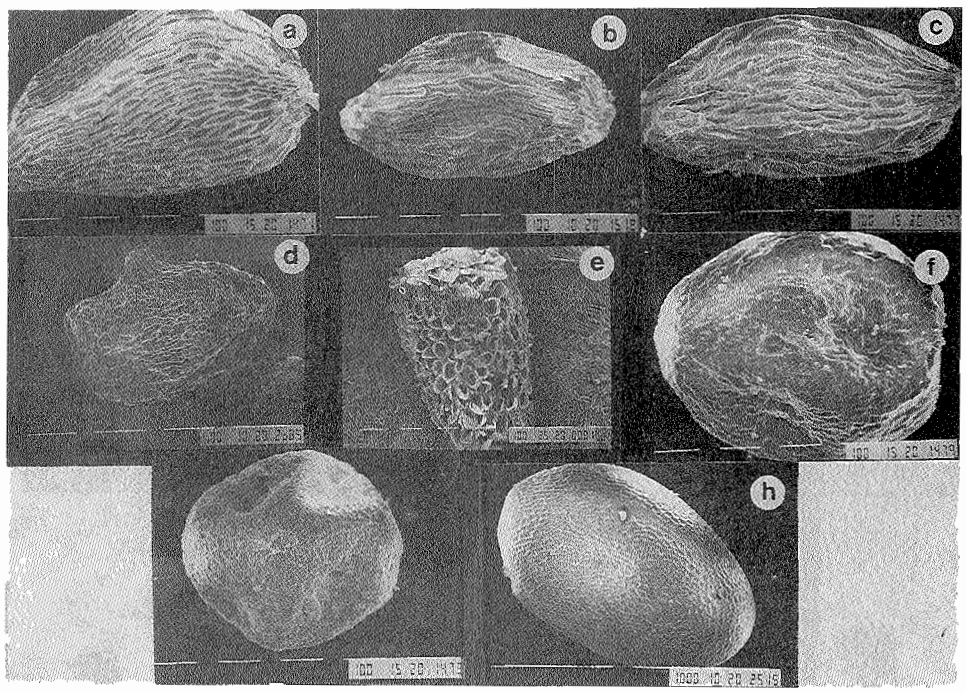

Fig.3. Different seed types: a. *Ciminalis pseudoaquatica*; b. *Gentianodes huxleyi*; c. *Qaisera hugelii*; d. *Aliopsis pygmaea*; e. *Gentianopsis paludosa*: f. *Aloitis stolickzai*, g. *Comastoma falcatum* (one bar = 100 μ).

4. ***Qaisera*** Omer in Bot. Jahrb. 111: 205. 1989.

For details of generic description, see Omer, 1988.

Distribution: Himalayas (Pakistan: Hazara to Nepal).

The pollen grains of *Qaisera* Omer are unique in this group by having reticulated tectum (Fig. 2), a condition similar to the genera of second group while the other two genera viz., *Ciminalis* Adans., and *Gentianodes* Löve & Löve are characterized by having striato-reticulate tectum. The seeds of all the three genera are similar i.e., alveolate with excavated lines or striated type (Fig. 3). However, the seeds of *Qaisera* Omer are quite distinct by having alveolate under surface, a condition not found in other genera. The chemical analysis indicates the close proximity of *Gentianodes* Löve & Löve and *Ciminalis* Adans., as luteolin and apigenin are absent in both the genera. However, the general distribution pattern of phenolic constituents are not very helpful in this complex.

5. ***Gentianella*** Moench, Meth. Pl. 482. 1794 (s. str.).

Erect, biennials-perennials (rarely annuals), non-plicate. Corolla tube equal or longer than lobes. Corolla fimbriate, fimbriae lanceolate. Stamens dorsifixed or versatile. Style present. Nectaries present at the base of corolla tube.

Distribution: America, Europe - Asia.

6. ***Aliopsis*** Omer & Qaiser in Wildenowia, 21: 190. 1991.

For details of generic description, see Omer & Qaiser, (1991).

Distribution: Pamir-Kashmir.

The tectum of pollen grains of *Aliopsis* Omer & Qaiser are quite distinct from the

other genera of second group. The luminae are thin and muri are thick (Fig. 2).

7. *Gentianopsis* Ma in Acta Phytotax. 1:6. 1951.

Erect, perennials, non plicate. Floral buds ellipsoidal. Calyx distichously unequal. Corolla tube equal or longer than lobes. Corolla non fimbriate. Stamens versatile. Nectaries at the base of corolla tube. Gynophore distinct with a swollen stigma. Seeds papillose.

Distribution: Asia- America (except Africa).

8. *Aloitis* Rafin. Fl. Tellur. 3: 21. 1837.

For generic description, see Omer, Qaiser & Ali, (1988).

Distribution: High and cold mountains of Europe, Asia & America.

Aloitis Rafin., is closely related to *Gentianopsis* Ma but differs beside morphological characters (differences already mentioned in the key) in pollen and seed characters also. The pollen grains of *Gentianopsis* Ma are coarsely reticulate (Fig.2) and seeds are papillose (Fig. 3) while the pollen of *Aloitis* Rafin. are not as coarsely reticulate as in the former genus and the size of luminae and muri is different (Fig. 2). Similarly the seeds are not papillose (Fig. 3).

9. *Comastoma* Toyok. in Bot. Mag. Tokyo 74: 198. 1961.

Erect, perennial, non plicate. Corolla tube equal or longer than lobes. Corolla fimbriate, fimbriae linear-filiform. Stamens versatile. Nectaries at the base of corolla tube. Style absent.

Distribution: Colder and alpine regions of Asia, Europe and America.

The pollen grains in *Comastoma* Toyok., are similar to *Aloitis* Rafin., in having reticulate tectum but muri and luminae size is different (Fig. 2). Similarly the seeds of both the genera are similar but the walls in *Comastoma* Toyok. are well developed as compared to *Aloitis* Rafin. (Fig.3).

10. *Jaeschkea* Kurz in J. As. Soc. Beng. 39: 229. 1870.

Erect, annual-perennial, non plicate. Corolla tube equal or longer than lobes. Corolla non fimbriate. Stamens basifixed. Few ciliae at the base of anther filaments. Filaments inserted at the sinuses of corolla lobes. Nectaries at the base of the corolla tube.

Distribution: Himalayas (Pakistan - Nepal).

Jaeschkea Kurz can readily be distinguished from all the genera by having the cilia at the base of stamen filament and filaments are inserted near the sinuses of corolla lobes. The pollen are reticulate, similar to other genera (Fig. 2) but the seeds are the largest than all the genera (1.0-3.0 mm) and the walls of striations are ringed (Fig. 3).

11. *Kurramiana* Omer & Qaiser **Gen. nov.**

Herba erecta, annua, 10 cm alta. Folia caulina opposita, c. 2.0 x 0.5-0.8 cm, obovato-oblonga, laxe disposita. Inflorescentia cymarum axillarum terminaliumque; flores axillares oppositi, in quaque axilla solitarii; cyma terminalis umbellata pauciflora. Flores hermaphroditi, actinomorphi, tetrameri, 1.0-1.25 cm longa, campanulati. Calyx corolla semper longior, ± ad medium vel interdum magis divisus. Corolla tubulosa, coerulescens, sine plicis lobis subsidia riisve, intus glabra (fimbriae nullae). Stamina 4, lobis corollae alternatia, antherae plerumque basifixae filamen tis tubum deorsum currentibus et infra medium insertis. Nectaria et basem tubi corollae edsunt, petalose opposita, ad basem ovarii samper desunt. Ovarium superius, uniloculare, ovula numerosa, placentatione parietali; stigmata 2, sessilia. Capsula matura, seminaque non visa.

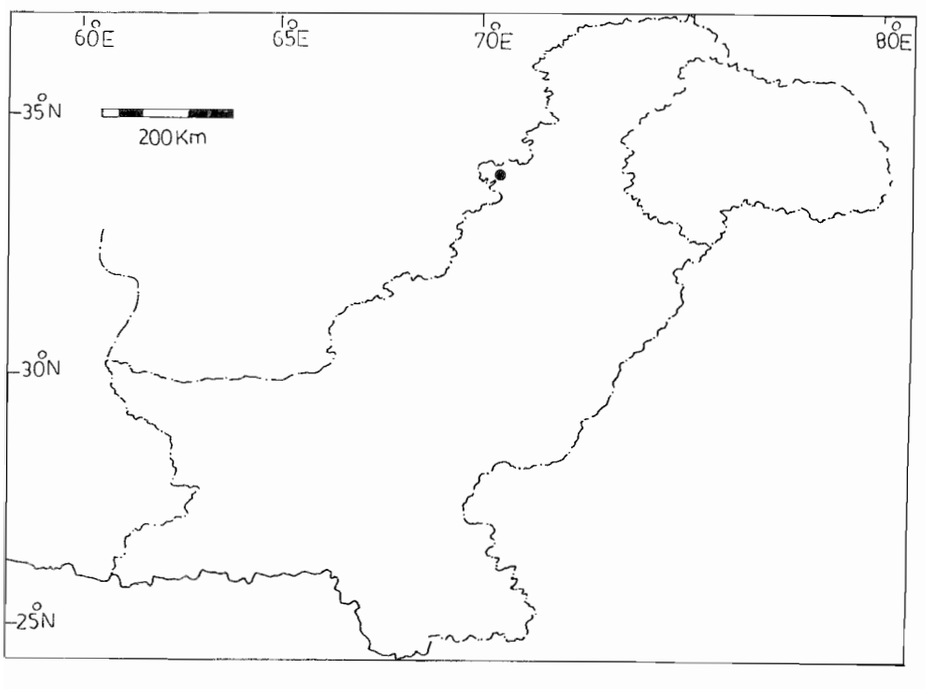

Fig.5. Distribution map of *Kurramiana micrantha* (Aitch. & Hemsl.) Omer & Qaiser.

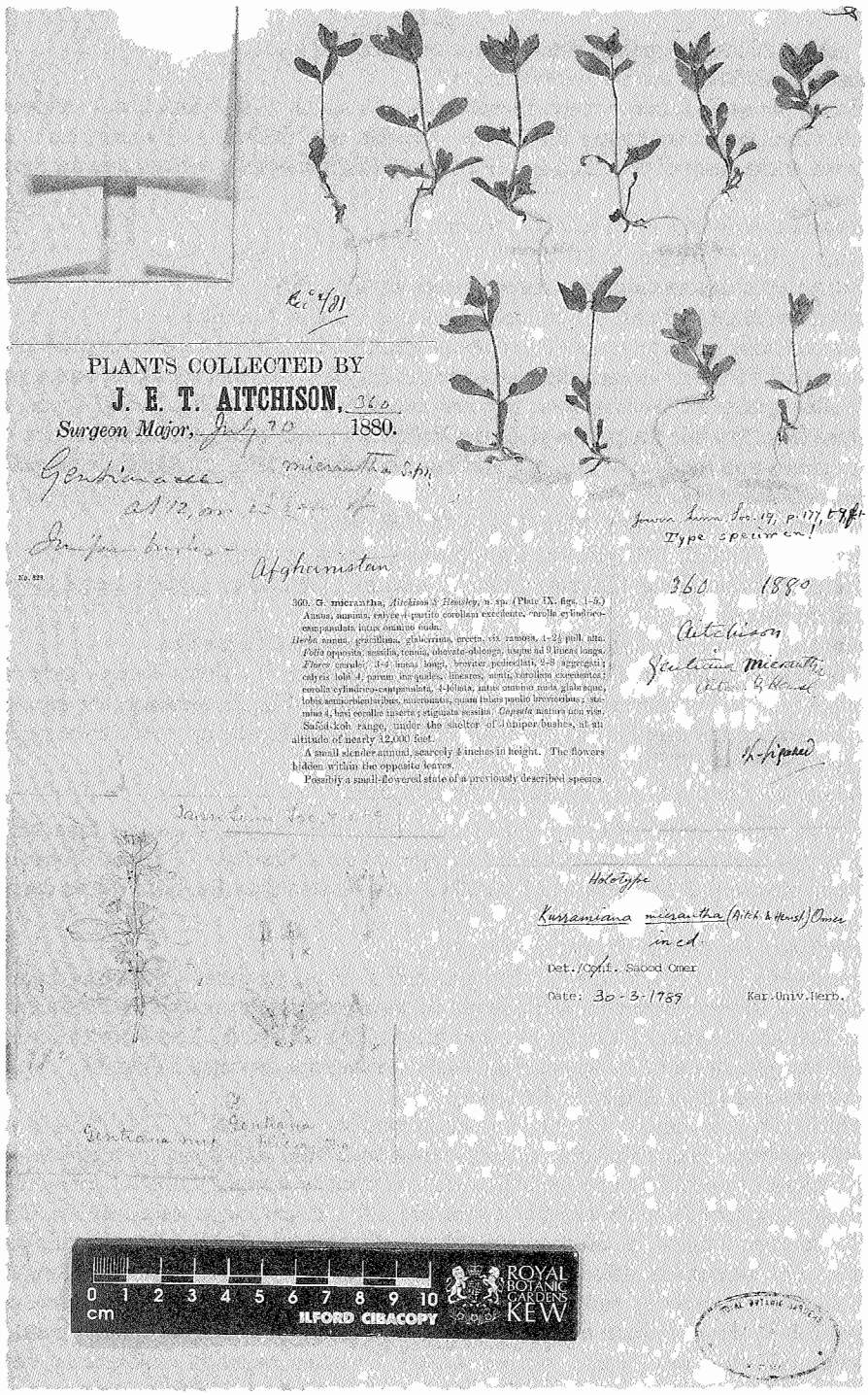

Fig.4. Holotype of *Kurramiana micrantha* (Aithch. & Hemsl.) Omer & Qaiser.

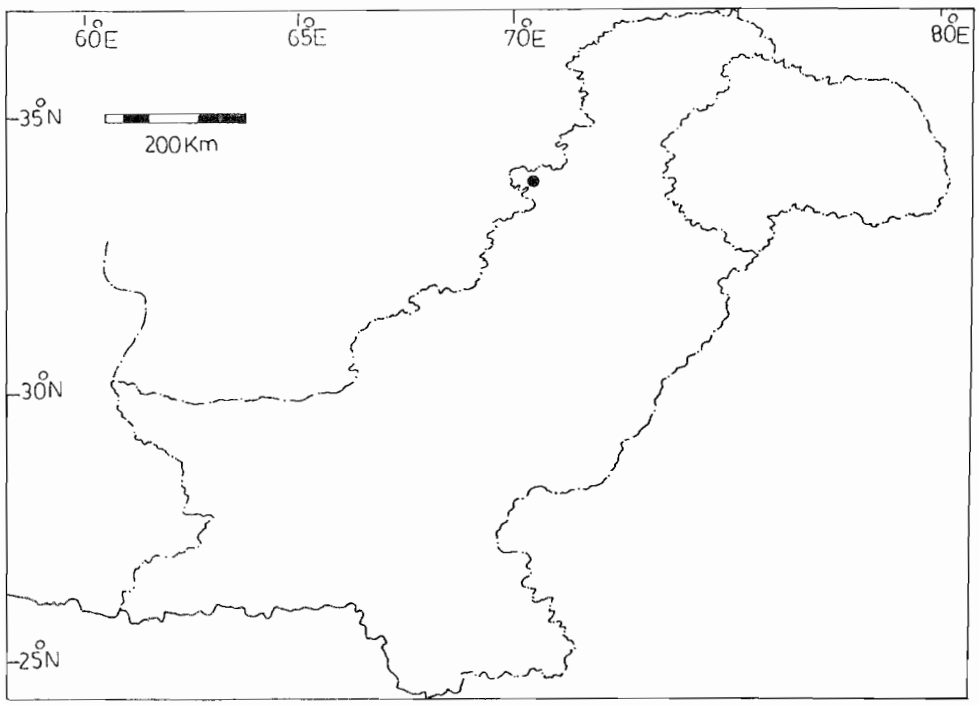

Fig.5. Distribution map of *Kurramiana micrantha* (Aitch. & Hemsl.) Omer & Qaiser.

Distribution: A monotypic genus, confined to Kurram agency (Pakistan - Fig. 5).

Kurramiana Omer & Qaiser is closely related to *Jaeschkea* Kurz on the basis of non plicate corolla, epipetalous nectaries and basifixed stamens. On the other hand *Kurramiana* Omer & Qaiser is different by having filaments inserted below the middle of corolla lobes and the ciliae at the base of filaments are lacking.

Kurramiana micrantha (Aitch. & Hemsl.) Omer & Qaiser **Comb. nov.** (Fig. 4).

Gentiana micrantha Aitch. & Hemsl. in J. Linn. Soc. Bot. 19: 177. 1882; Stewart in Biologia, 13: 92. 1967; Schiman-Czeika in Rech. f., Fl. Iran. 41: 22. 1967; Stewart in Nasir & Ali, Ann. Cat. Vasc. Pl. Pak. & Kashm. 556. 1972.

Type: Kurram Agency; Safed Koh Range, under the shelter of Juniper bushes, at an altitude of nearly 12000', *Aitchison* 360 (Holo-K!).

GENERIC AFFINITIES

Dendrogram obtained by nearest neighbour clustering (Fig. 6) gives the relationship of different genera. The three genera of first group (plicate corolla) exhibit close affinities with each other. However, *Qaisera* Omer and *Gentianodes* Löve & Löve are more closely related and share several common characters (dorsifixed stamens, plicate corolla, and biennial - perennial, sometimes annual habit) (Table I). Nevertheless, both the genera are separable at 28% dissimilarity level. In the former genus the calyx lobes are equal and corolla is fimbriate while in the latter genus the calyx lobes are unequal or

Table 2 . Summary of the attributes used in numerical analysis

1. Habit	:	Annual/Biennial/Perennial
2. Basal leaves	:	Uninerved/ > 1-nerved
3. Stem surface	:	Glabrous/hairy
4. Numerical plan of Flowers	:	Tetramerous/pentamerous
5. Symmetry of flowers	:	Actinomorphic/zygomorphic
6. Calyx lobes length	:	Equal/Unequal
7. Calyx lobe nature	:	Distichous/Non-distichous
8. Calyx corolla ratio	:	Shorter than corolla/Longer than corolla
9. Corolla	:	Non-plicate/Plicate
10. Corolla throat	:	Fimbriate/Non-fimbriate
11. Anthers	:	Basifixed/Dorsifixed/Versatile
12. Stamen filaments insertion	:	Inserted near sinuses/Inserted below the sinuses.
13. Nectaries location	:	At the base of ovary/At the base of corolla lobes.
14. Number of nectaries	:	Single/Double
15. Stigma stalk	:	Absent/Present
16. Stigma	:	Not prominent/Prominent and swollen
17. No. of seeds per Capsule	:	Many seeded/Few seeded.
18. Seed Indumentum	:	Epapillose/Papillose
19. Seed surface pattern	:	Striated/Non-striated
20. Seed surface fissures	:	Longitudinal fissures absent/longitudinal fissures present.
21. Tectum of pollen	:	Very finely reticulated/Coarsely - Striately reticulated.

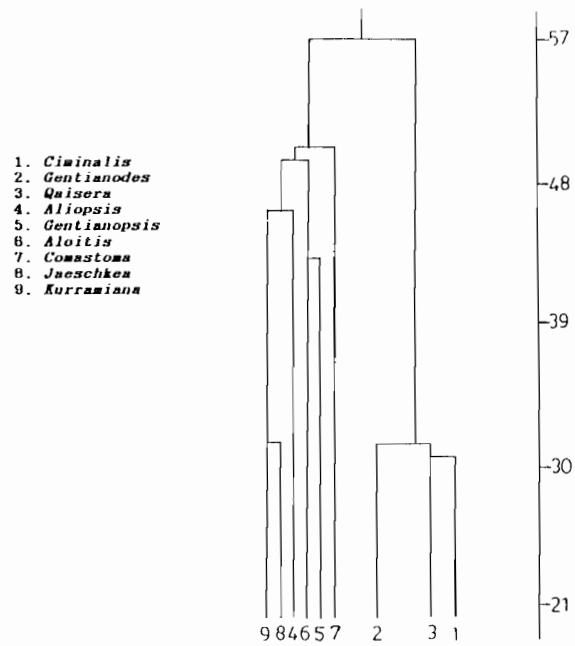

Fig.6. Dendrogram based on nearest neighbour showing the relationship of the different genera.

equal and corolla is naked. The third genus *Ciminalis* Adans., is also close to the other two genera having about 70% common characters (Table 1) (plicate corolla, nectaries at base of ovary, flowers campanulate - infundibuliform) but separates out at 30% dissimilarity level (basifixed stamens, basal leaves more than one nerved, mostly annuals). In the second group (non-plicate corolla) two subgroups are formed (Fig.1). However, both the subgroups are linked with each other at 54% similarity level. In the first subgroup *Aliopsis* Omer & Qaiser, *Jaeschkea* Kurz and *Kurramiana* Omer & Qaiser are present. All these three genera are closely related to each other (non-plicate corolla with naked throat). However, the latter two genera are more closely related than the former genus. They are linked with each other at 74% of similarity (common characters are basifixed stamens, non-plicate corolla, epipetalous and single nectaries). Nevertheless both the genera group with *Aliopsis* Omer & Qaiser at 54% similarity level (Fig. 1). The other subgroups include *Comastoma* Toyok., *Aloitis* Rafin., and *Gentianopsis* Ma (unequal calyx lobes, non-plicate corolla, epipetalous nectaries). *Gentianopsis* Ma and *Aloitis* Rafin., are more closely related as compared to *Comastoma* Toyok. The former two genera share more common characters (unequal calyx lobes, distinct gynophore, naked corolla throat) (Table I) and are separable at 42% level dissimilarity while at 50% of dissimilarity *Comastoma* Toyok. is separable. It is readily distinguishable in the subgroup by having fimbriate corolla.

Acknowledgements

The authors wish to express their gratitude to the Directors, Curators and Librarians of the following herbaria: B, BM, CAL, E, K, KUH, LE, LINN, NA, NY, O, P, RAW,

RNG & W. We would like to thank Dr. R. R. Mill (E) for the latin description of the new genus. We are thankful to Prof. S. I. Ali (KUH); Mr. I. C. Hedge (E); Prof. Dr. H. W. Lack and Dr. M. I. Hakki (B); Dr. S. L. Jury, Dr. R. M. Wardsworth, Dr. S. Z. Husain, Prof. J. B. Harborne and Dr. J. R. Barnett (RNG); Dr. R. K. Brummitt, Dr. K. Vollessen, Dr. D. Goyder and Mrs. S. Bidgood (K) for extending all the help and support. The financial assistance to senior author from the Overseas Development Administration through the British Council, United Kingdom is gratefully acknowledged.

References

Boissier, E. 1879. *Flora Orientalis*. Genevae, Basel: Georo Bibliopolam Lugduni.

Clarke, C.B. 1875. Notes on Indian Gentianaceae. *J. Linn. Soc. Bot.*, 14: 428-457.

Clarke, C.B. 1883. In Hooker, J.D. (Ed.), *Flora of British India*. Ashford: L. Reeve.

Erdtman, G. 1952. *Pollen morphology and plant taxonomy - Angiosperm*. Almqvist & Wiksell, Stockholm.

Grisebach, A.H.R. 1839. *Genera et species Gentianearum adjectis observationibus quibusdam phytogeographicis*. J. G. Cottae, Stuttgart, Tubingen.

Grisebach, A.H.R. 1845. In: A.P. De Candolle, *Prodromus Syste matis Naturalis Regni Vegetabilis* 9. Fortin, Masson et Socio rum, Paris.

Harborne, J. B. 1973. *Phytochemical methods*. Chapman & Hall, London.

Harborne, J. B. 1984. *Phytochemical methods: A guide to modern techniques of plant analysis*. Chapman & Hall, London.

Linnaeus, C. 1753. *Species Plantarum*. 1: 227-232.Holmiae, Laurentii salvii, Stockholm.

Linnaeus, C. 1754. *Genera Plantarum*, ed. 5: 285. Holmiae, Laurentii salvii, Stockholm.

Löve, A. 1986. In: Löve, A. (Ed.). Chromosome number reports. XCIII. *Taxon* 35: 897-903.

Löve, A. and D. Löve, 1972. *Favergera* and *Gentianodes*, two new genera of alpine Gentianaceae. *Bot. Not.* 125: 255-258.

Omer, S. 1989. *Qaisera* Omer, a new genus of Gentianaceae. *Bot. Jahrb.*, 111: 205-212.

Omer, S.; S.I. Ali, and M. Qaiser. 1988. New combinations and taxa in the genus *Gentianodes* (Gentianaceae) from Pakistan. *Pak. J. Bot.* 20: 1-19.

Omer, S. and M. Qaiser, 1991. *Aliopsis* Omer & Qaiser, a new genus of Gentianaceae from C. Asia. *Willdenowia* 21:189-194.

Omer, S. and M. Qaiser. Generic limits in *Gentiana* L. (s.l.) from Pakistan and Kashmir. *Proceed. Int. Conf. Pharm.Sc.* University of Karachi. (In press).

Omer, S.; M. Qaiser, and S.I. Ali, 1988. Studies in the family Gentianaceae: The genus *Aloitis* Rafin. from Pakistan and Kashmir. *Pak. J. Bot.*, 20: 153-160.

Schiman-Czeika, H. 1967. Gentianaceae. In: K. H. Rechinger (Ed.), *Fl. Iranica*, 47. Akademische Druk u. Verlagsanstalt, Graz.

Stewart, R.R. 1916-1917. Flora of Ladak. *Bull. Tor. Bot. Club.* pt. 1, 43: 572-590. pt. 2, 44: 625-650.

Stewart, R.R. 1957. The Flora of Rawalpindi district, West Pakistan. *Pak. J. For.* 237-300; 13-63.

Stewart, R.R. 1972. In: Nasir, E. & S.I. Ali (Ed.), *Annotated catalogue of Vascular plants of Pakistan and Kashmir*. Fakhri Press, Karachi.

Tournefort, J. P. DE 1700: Institutiones rei herbariae, editio altera. Paris.

(Received for Publication 4 March 1992)