Taxonomic Study of the Genus *Galium* L. (Rubiaceae) of Nepal

1. BACKGROUND

Rubiaceae is fourth biggest family, comprises of 660 genera and 11,500 species with cosmopolitan distribution (Robbercht and Manen 2006). *Galium* is largest genera of Rubiaceae with 670 species (APG IV). Galium itself is problematic taxonomically, because taxa from different sections exhibit similar habit (Schischkin 2000). It is distributed from 900m-4700m in Nepal (Press et al. 2000). *Galium* is glabrous, hispid, scabrid or prickly erector scandent herbs. Stem and branches weak, 4-angled, leaves whorled, sessile, broad or narrow, minute flowers (Malla et al, 1986).

2. LITERATURE REVIEW

In flora Indica three species of *Galium* have been described (Roxburgh, 1820). In flora of India 20 species of *Galium* were described (Hooker, 1882). In "An Enumeration of The Flowering Plant of Nepal" (Hara et al 1982) 16 taxon of *Galium* have been listed. In "Flora of Bhutan" (Grierson and Long 1999) 12 species of *Galium* have been described. In "Annotated checklist of The Nepal Flowering plant of Nepal" (Press et al. 2000) 12 species of *Galium* with two sub species, six varieties and two forma have been listed.

3. RESEARCH QUESTIONS

- What is the status and distribution pattern of the species belong to genus *Galium* in Nepal?
- What are the differences between the morphological and gross morphological characters among the species belong to the genus *Galium* in Nepal?

4. JUSTIFICATION OF THE STUDY

Nepal comprises of two endemic species of genus *Galium* however, their authentic taxonomic study is still lacking. So this study aims to gather all the information about all taxon of Nepalese Galium. According to Khalik et al. 2007 pollen grains of *Galium* shows zonocolpate type and number of colpi ranges from 5 to 10.Thus, present attempt focus on pollen to show its phylogeny as well as make a detailed taxonomic study based on morphological, anatomical, cytological and palynological character which will help to update nomenclature as well as help in flora writing of the country.

5. RESEARCH OBJECTIVS

The general objectives of the present study is taxonomic treatment of the genus *Galium* in Nepal and specific objectives is:

1. To accomplish the comparative study and produce a complete taxonomic account of the species of *Galium* of Nepal along with elevation.

6. MATERIALS AND METHODS

6.1 Study Area

Nepal, a landlocked country in the central part of the Himalayas in South Asia lies between 26˚22′ to 30˚27′ N latitude and 80˚04′ to 88˚12′E longitude covering an area of 1,47,181 km^2. Altitudes range from 64 m to 8,848m within a small horizontal territory. Nepal is approximately 900km long having an average width of 190 km. The country has plain area in the south, hills and valleys in the middle part and lofty Himalayas in the north.

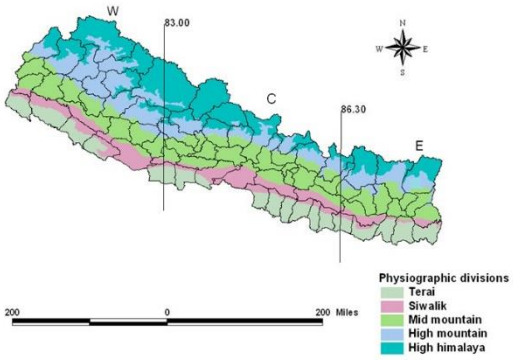

Fig.1 Map of Nepal Showing Physiographic division

Nepal's vegetation has been divided into various phyto-geographical divisions (Chaudhary 1999). The vegetation types as classified on the basis of levels of altitude, with different types of bio-climate falling under each of them can be studied as following:

(i) Tropical; (ii) Sub-tropical; (iii) Temperate; (iv) Sub-alpine; (v) Alpine

All together 12 species with two sub-species, six varieties and two forma of *Galium* have been found in Nepal. The genus has wide altitudinal range from 900m - 4700m in context of Nepal. Thus, my field visit mainly be concerned from tropical ton alpine region of Nepal.

6.2. Taxonomic study

6.2.1 Protologue and Literature Review

Protologue and related literature will be reviewed as it provides the nomenclatural accuracy and species identification easier and also clarifies the major taxonomic problems within this genus.

6.2.2 Literature based Character Matrix

After reviewing the protologue texts and different literatures, character matrix will be prepared as it helps in distinguishing characters of the taxon as well as to separate the herbarium specimens into different piles according to the characters.

6.2.3 Collection and preparation of Herbarium Specimens

Fresh as well as herbarium specimens deposited at TUCH and KATH will be examined and proper photographs will be taken during the study. Also majority of characters from both reproductive and vegetative parts will be observed. Plant specimens will be collected from the different parts of the country. Plant specimens at the stage of flowering and fruiting will be collected with proper photographs.

6.2.4 Identification of the species

Identification of the species will be done by consulting standard literatures as well as by the help of the expert along with the identification keys. Identification will also be done by the comparing with the specimens deposited at TUCH and KATH.

6.2.5 Morphological Study

General systematic studies are primarily based on gross morphological data. For the most part this framework is adequate for reflection of grouping of phyletic nature (Heywood 1971). Gross morphological (macro and micro) characters will be studied including both the vegetative and reproductive characters by using electronic microscope, stereomicroscope and dissecting microscope.

6.2.6 Anatomical Study

Anatomical study will be based on personal collection as well as herbarium specimens deposited at TUCH. Basically, the anatomical features including the root anatomy, stem anatomy and leaf anatomy (stomata, epidermal surface and trichome) will be studied and also the proper photographs will be taken.

6.2.7 Palynological study

Palynology (Gr. palynos, dust or flour) is the study of spores and pollen grains. Shape, size, polarity, aperture and ornamentation will be studied and the photographs will be taken.

6.2.7 Cytological study

Chromosomes characters are also very much important in modern taxonomic study for elucidation of taxonomic problems (Naik, 1984). Hence number, shape & size of chromosomes, and chromosome banding pattern will be studied.

6.2.9 Illustration

Free hand diagrams which include habit sketch, root, stem, leaf, inflorescence, flowers and fruit will be prepared based on the herbarium specimens studied and photographs will be taken.

6.2.10 Construction of Identification Keys

Artificial keys will be prepared for the easy identification of species based on observed characters. Keys will be arranged on "Bracketed Format".

6.2.11Cluster analysis

On the basis of gross morphological, anatomical, cytological and palynological characters including both qualitative and quantitative characters, cluster analysis will be performed to find the similarity among the species. The characters will be given the equal weightage. Dendrogram will be made of all the species of *Galium* found in Nepal.

7. EXPECTED OUTCOMES

Following outputs are expected by the completion of proposed work.

- It will assess detail morphological, anatomical, cytological and palynological characters of the different species of the genus *Galium*.
- Nomenclatural change will be updated.
- New record and new collection could be added.
- It will probably contribute to the Flora of Nepal.

8. REFERENCES

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