

Asteraceae of Sikkim



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PREFACE

Asteraceae is the fourth largest family of flowering plants in the world and occupies a still higher position in Flora of Sikkim being the second largest family with more than 300 taxa falling under 84 genera. Since Sikkim is a floristically very rich state and Flora of Sikkim is still being worked out by scientists of Botanical Survey of India, it was decided to undertake the work on larger plant families on priority basis and families like Asteraceae, Poaceae, Orchidaceae etc. were selected for this purpose. The present book on **Asteraceae of Sikkim** is an outcome of the work carried out by the authors during their stay in Sikkim Himalayan Circle of Botanical Survey of India at Gangtok. Our long stay in Sikkim provided an opportunity to confront the plant in their original habitat and getting first hand information on various taxa of this fascinating group. The field observations were further supported by studies at various herbaria viz. BSHC, CAL, LWG, DD and Lloyd Botanic Garden, Darjeeling and of available literature on this subject.

The book is divided in four chapters. The first chapter on introduction deals with a brief account of topography, soil, climate and vegetation types of the state. The second chapter provide an account of earlier studies by various explorers, naturalists and scientists who traversed through the nook and corner of the state. The third chapter deals with general account of family Asteraceae with particular reference to earlier studies in this group. The fourth chapter deals with taxonomic studies which include key to the genera, species and infraspecific taxa, nomenclature, a brief description of morphological features, flowering and fruiting period and altitude and locality. Suitable notes on rarity, endemism and economic importance of various taxa have also been provided. The arrangement of genera and species is in alphabetical order. The text is enriched with twenty colour photographs and thirty illustrations representing various taxa. Selected references

on Botanical Studies in Sikkim are also given. To make the book more user friendly an index to Botanical names is provided in the end.

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INTRODUCTION

Sikkim or Denzong (the land of rice) is one of the smallest states of India occupying an area of about 7096 sq km. located in Eastern Himalaya between 27°5' to 28°9' N latitude and 87°9' to 88°56' E longitude. The elevation ranges from 225 m in south, 6100 m in north and north-east and 8598 m in north-west. The State of Sikkim is bounded by Tibet in north-east, Bhutan in the south-east, Nepal in the west and West Bengal in the south.

Topography

The topography of Sikkim is quite varied with almost no flat piece of land anywhere. The mountain system as a whole, in general, is in east-west direction. However, the chief ridges run in more or less north-south direction (Chola and Singalila ridges). The Chola ranges separate the state from Tibet in the north-east and Bhutan in the south-east. The Singalila ranges form the boundary with Nepal in the west. The stupendous mountain ranges stretch out in the northern horizon from one end to the other. The shining silvery peaks of Kanchendzonga (8598 m), the third highest peak in the world, with many other famous peaks viz. Pandim (6606 m) Kangchinphu (6957 m), Kabra (7203 m), Phalung (4845 m), Jongri (4542 m), Lingtu (3855 m) add to the scenic beauty of this Himalayan state. The other important north-south ridge running through central Sikkim separates the Rangeet and Tista valley. The main peaks of this ridge are Tendong (2583 m) and Mayneur (3190 m). The renowned mountain passes along these ranges have always attracted the traders, explorers, naturalists and pilgrims to travel through these routes since ancient times. Donkyala (5520 m), Jelep La (4380 m), Kangra La (4809 m) and Nathu La (4392 m) are important passes in northern and eastern regions. Teesta and Rangit are two main rivers of the state flowing in north-south direction and traversing through hilly tract leaving high slopes and valleys throughout their route. The northern portion is deeply cut into steep slopes and gorges and is without human population except in Lachen and Lachung valleys.

The southern part of the state is of rather low level and more open and reaches almost to the plain level bordering the state of West Bengal.

Geology

Sikkim Himalaya represents Tethys sea of geological past and is much younger in age viz., "paleozoic age". The major portion of Sikkim is covered by Precambian rock. The north eastern and western portions are constituted of hard massive gneiss rock which resist denudation. The southern and central region is chiefly formed of relatively soft thin slates, sedimentary and metasedimentary and half-schistose rocks which denude very easily. This area is the least elevated and thickly populated although being highly landslide prone. The physical configuration of the state has been dependent on the direction of the drainage (which is southern) and also on geological structure.

The snow capped ridges in the northern and eastern regions of the state descend down to as low as 3700 m near Kanchendzonga although in earlier times they used to descend upto Lachung (2740 m). The perpetual snow line however, is *ca* 5000 m above mean sea level.

Soils

The soils of Eastern Himalaya, particularly in Sikkim, are highly variable. The regional centre of National Bureau of Soil Survey and Land use planning, Calcutta during 1981 established 15 soil series in Sikkim described as below.

Markong series : It comprises deep, well-drained loamy skeletal soil with dark brown to dark reddish brown colour. They have been developed on mica schists on strongly sloping (10-15%) hill tops, with moderate to severe erosion and dense forests and pasture land.

Putuli series : It comprises shallow, excessively drained, dark

brown loam. skeletal soil having some rock particles scattered over the surface. They have been developed on micaceous gneissic parent rock of talus deposits over moderately slopping to very steep upper hill slopes. They are moderately to severely eroded and are susceptible to land slides.

Ligtse series : It comprises very deep, moderately drained fine loamy soils of dark greyish brown to dark brown colour, developed on gneissic parent rock in steep low hill slopes and are moderately eroded.

Thekabong series : It comprised moderately deep, moderately drained, loamy, dark greyish-brown skeletal soils developed on micaceous gneissic parent rock over the steep to very very steep, middle and lower slopes of the hills in East Sikkim. Such soils are moderately eroded and susceptible to severe erosion.

Machong series : It comprises deep, moderately well-drained, greyish brown, fine loamy soils formed over the underlying micaschists on the moderately steep to steep low hill slopes predominant in East Sikkim. Erosion is moderate to severe.

Chatrikhola series : It comprises deep, moderately well-drained fine loamy soils of greyish brown to dark brown colour developed over micaceous gneiss parent rock on steep to very steep slopes of low hills. Such soils are moderately to severely eroded.

Gompa series : It comprises shallow, excessively drained, loamy skeletal soils of brown to dark brown colour. They are developed on gneissic parent rock on moderately sloping and steep to very steep escarpments. Such soils are under severe to very severe erosion and susceptible to sliding.

Losep series : It comprises deep, moderately well-drained, loamy skeletal soils of greyish brown to yellowish brown colour developed

over colluvial materials over gneissic parent rock on the steep lower slopes of hills and are moderately to severely eroded.

Namthang series : It comprises deep, well drained, loamy skeletal soils of brown to dark yellowish brown colour developed from phyllite parent rock occurring on moderately sloping to strongly sloping mid hill slopes in South Sikkim. Such soils are moderately eroded.

Simikara series : It comprises moderately deep, excessively drained, coarse loamy, fragmental soils of yellowish brown to light olive brown colour developed on micaschist parent rock occurring on very steep escarpment slopes and are severely eroded.

Nandugaon series : It comprises well drained, coarse loamy, fragmental soils of brown to dark brown colour, developed from sandstone parent rock occurring on steeply sloping mid and upper parts of the hills in South Sikkim. Such soils are severely eroded.

Hilley series : It comprises deep, moderately well drained, fine loamy soils of dark reddish brown colour developed from gneissic material on steeply sloping upper hill slopes in West Sikkim. Such soils are moderately eroded.

Padamchen series : It comprises moderately deep, moderately drained, fine loamy soils with brown to yellowish brown colour and developed from gneissic parent material on moderately steep to upper hill slopes. Such soils face severe erosion due to very thin forest cover.

Taraku series : It comprises very deep, moderately well drained, fine loamy soils of dark brown colour developed from sandstone on moderately steep to steep upper and mid hill slopes in South Sikkim. They are moderately eroded.

Majitar series : It comprises deep, well drained, loamy soils of greyish brown colour developed over alluvial and colluvial material

on gently to moderately sloping uplifted river terraces along the rivers Tista and its tributaries in East Sikkim. Such soils are susceptible to river bank erosion and flooding.

The soils of Sikkim are acidic with pH ranging between 4.2-5.5 and are formed over different geological formations under varying physiological, climatic and vegetational cover. The high rainfall results in leaching down the soluble bases and as such Calcium, Magnesium, Potassium and Sodium ions are replaced by Hydrogen ions leading to acidic soils with low pH. In general, the organic matter in the soils is usually 2-5%, but at some places as low as 1% and at others as high as 10%. Available Nitrogen varies from 10 to 60%, Phosphorus 25-30% and Potash 20 to 45%. The water holding capacity of soils is medium and as such the soils fall in hydrological group "B".

Climate

The climate of Sikkim is very humid and cold due to its proximity to the Bay of Bengal and direct exposure to the south-west monsoon. The rainfall varies from 200-500 cm in most of the inner valleys except in northern most region (bordering Tibet) with rather scanty rainfall. It rains almost throughout the year and the temperature ranges between subzero level (at high altitudes) to 26° celsius during summers.

Due to great variations in the degree of sloping in mountains and in elevation, the Himalayan climate of Sikkim maintains several micro-climates. The climate between 225 to 1400 m, is low-medium hill type with annual average maximum and minimum temperatures varying between 23.4°-27.5°C and 13.4°-16.4°C respectively. The relative humidity is about 63-64 per cent and annual average rainfall varies between 122-299 cm. The winters are dry and warm at lower elevations. Subtropical forests are characteristic of this climate. The climate between 1401 and 2000 m, is high hill type where the average annual maximum

and minimum temperatures vary between 18.6°-22.6°C and 9°- 10.1°C respectively. The relative humidity increases to 87 per cent. The maximum rainfall, however, occurs during summers. The temperate forests are characteristic of such climate. Further, between 2001 and 4000 m very high hill type of climate occurs, wherein temperature gradually fall to 0°C with increase in elevation. The rainfall is received mainly during summers, while the winters are characterised with snowfall. The temperate forests exist at lower elevation and at higher peaks Rhododendrons and Primulas make their appearance with other tall trees. Snow peak type of climate occurs above 4001 m where mountain peaks are mostly covered by snow throughout the year, temperature is below 0°C and there is no rainfall. The maximum precipitation in the form of snow occurs between October to May. The flora is mostly herbaceous.

The monsoon winds dominate the climate of Sikkim and Himalaya acts as a barrier forcing them to ascend and cause orographic rainfall and snowfall. It also acts as a barrier for cold winds from Central Asia, resulting in snowfall on mountain tops and higher elevations and a dry winter season at low elevations at leeward side. Due to seasonal reversal of winds there has been a seasonal rhythm like cold weather during December to February, spring from March to May, south-west monsoon during June to September and the period of retreating monsoon during October-November. During cold winter conditions, the wind blow out from northern plains of C. Asia towards equatorial region leading to heavy snowfall at the peaks of Himalaya and light rainfall or snowfall or often hail storms upto 1400 m in Sikkim. The mountains mostly remain cloudy and north westerly cold dry winds prevail in valley of Tista and Rangit. In Spring season, the high pressure is gradually replaced by low pressure and as such the velocity and direction of wind is changed and by the beginning of June there develops a strong low pressure over northern plains of C. Asia and as a result the warm and moist south-westerly winds passing over southern Indian ocean and Bay of Bengal strike the Eastern Himalaya, causing heavy rainfall in the

state (300-400 cm). The low pressure through south west monsoon becomes less intense from the beginning of September.

Vegetation types

The unique geographic position, varied climate and topography of Sikkim makes this state an ideal representative of all kinds of vegetation viz. Tropical to Alpine. The vegetation of Sikkim can be broadly classified in following categories :

- (1) Tropical
- (2) Subtropical
- (3) Temperate
- (4) Alpine

Tropical vegetation

This vegetation type occurs at lower altitudes of Teesta and Rangeet valley upto 1200 m, bordering the state of W. Bengal and consists of moist deciduous to semievergreen forest with Sal as a dominant species. The other important plant species included *Alstonia scholaris*, *Chakrasia tabularis*, *Duabanga grandiflora*, *Eugenia kurzii*, species of *Ficus*, *Tetrameles nudiflora*, *Barleria cristata*, *Buddleja asiatica*, *Clerodendrum* spp., *Justicia procumbens*, *Pavetta indica*, *Bauhinia vahlii*, *Cryptolepis buchannani*, *Entada phaseoloides*, *Coffea benghalensis*, *Phoenix humilis*, *Rhus parviflora*, *Woodfordia fruticosa*, *Oroxylum indicum*, species of *Saccharum*, *Setaria*, *Digitaria*, *Dicanthium* etc.

The important asteraceous taxa of this region include *Blumea* spp. *Tridax procumbens*, *Galinsoga parviflora*, *Mikania micrantha*, *Ageratum* spp., *Eupatorium* spp., *Eclipta*, *Bidens pilosa*, *Xanthium indicum* etc.

Subtropical vegetation

This type of vegetation is found along Teesta and Rangeet rivers and their tributaries and ranges between 1200-1800 m altitudes. The main constituent of the mixed forest type vegetation include *Alangium chinense*, *Bischofia javanica*, *Castanopsis indica*, *Adina cordifolia*, *Callicarpa arborea*, *Fraxinus floribunda*, species of *Ficus*, *Gynocardia*, *Macaranga denticulata*, *Michelia* spp., *Magnolia hodgsonii*, *Engelhardtia spicata*, *Exbucklandia populnea*, *Schima wallichii*, *Saurauia nepalensis* etc. The predominant shrubby species include *Clerodendrum* spp., *Buddleja asiatica*, *Mussaenda roxburghii*, *Melastoma malabaricum*, *Vitex negundo* etc. *Cissus*, *Piper*, *Smilax* and *Tetrastigma* are common climbers. Ferns and Fern allies along with Aroides and Orchids chiefly contribute to epiphyte flora whereas thick pockets of Bamboos are seen growing on hillocks. Large cardamom is cultivated in this region.

The Asteraceae is chiefly represented by species of *Artemisia*, *Vernonia*, *Blumea*, *Sonchus* etc. *Eupatorium* spp. *Ageratum* spp. and *Mikania micrantha* are commonly growing exotic weeds on disturbed forest lands.

Temperate vegetation

This type of vegetation ranges between 1800 m to 3300 m altitudes. Lachen and Lachung valleys are excellent examples of this kind of vegetation. Temperate vegetation can be broadly classified into two categories viz. (a) Coniferous forest, (b) Broad leaved forests.

Coniferous forests : The predominant coniferous forests comprise *Abies densa*, *Picea spinulosa*, *Larix griffithiana*, *Juniperus* spp. *Tsuga dumosa* and *Taxus wallichiana*. Coniferous forests are common in Lachen, Lachung, Lonak, Yumthang and Zemu valley. The undergrowth in these forests include *Berberis* spp. *Mahonia nepalensis* and species

of *Prunus*, *Ribes*, *Rubus*, *Rosa*, *Spirea*, *Gaultheria* and *Rhododendron*. *Picris formosa*, *Piptanthus nepalensis* and *Maddenia himalaica* etc. are predominant species at some places.

Broad leaved forests : Oak is the characteristic feature of this vegetation type. The predominant species of these forests include *Alnus nepalensis*, *Exbucklandia populnea*, *Prunus nepalensis*, *Juglans regia*, *Malus sikkimensis*, *Betula utilis*, species of *Acer*, *Castanopsis*, *Quercus*, *Lithocarpus* and *Rhododendron*. The shrubby flora include species of *Berberis*, *Elaeagnus*, *Gaultheria*, *Rubus*, *Rhododendron*, *Princepia utilis*, *Hippophae salicifolia*, *Picris formosa*, *Rosa sericea*, *Viburnum erubescens*, *Zanthoxylum oxophyllum* etc.. Species of *Anemone*, *Arisaema*, *Primula*, *Gentiana*, *Swertia*, *Galium*, *Polygonum*, *Ranunculus* etc. constitute the herbaceous flora. Aroids, Orchids, ferns and fern allies and species of *Vaccinium* are representatives of epiphytic flora. The chief genera of Asteraceae include *Anaphalis*, *Aster*, *Artemisia*, *Inula*, *Gnaphalium*, *Erigeron*, *Senecio*, *Saussurea* etc.

Alpine vegetation :

Alpine vegetation in Sikkim is confined to 3300 m and above upto 5000 m. The tree line continues upto 3900 m. At lower altitudes, species of *Rhododendron*, *Salix*, *Berberis*, *Gaultheria*, *Cotoneaster*, *Diapensia himalaica* etc. are seen growing. The herbaceous flora include species of *Aconitum*, *Arenaria*, *Astragalus*, *Corydalis*, *Sedum*, *Pedicularis*, *Primula*, *Epilobium*, *Lychnis* etc. At higher elevations, stunted bushy growth of *Juniperus squamata* and species of *Rhododendron* and *Salix* can be seen. The herbaceous flora included species of *Anemone*, *Campanula*, *Delphinium*, *Arenaria*, *Primula*, *Pedicularis*, *Mecconopsis*, *Rhodiola*, *Saxifraga*, *Draba*, *Sedum*, *Gentiana* etc.

The asteraceae in alpine region is chiefly represented by *Artemisia*, *Aster*, *Cremanthodium*, *Leontopodium*, *Saussurea*, *Sorooseris*, *Waldheimia*, *Youngia*, *Erigeron*, *Cirsium*, *Onopordon*, *Cacalia*, *Synotis* etc.

Table 1. Various vegetation types in Sikkim

Sl. No.	Altitude	Type of vegetation	Representative dominant sp.
1.	Upto 1200 m	Tropical	Zone of Sal
2.	1200-1800 m	Sub tropical	Zone of <i>Castanopsis indica</i> , <i>Myrica</i> & <i>Photinia</i>
3.	1800-3300 m	Temperate	(a) Zone of <i>Tsuga</i> , <i>Betula</i> , <i>Picea</i> & <i>Abies</i> . (b) Zone of Oak and deciduous trees.
4.	3300-5200 m	Alpine	Zone of alpine shrubs, Rhododendron and alpine herbs.
5.	5200 and above	No vegetation	Snow line.

It is worth mentioning here that this classification of vegetation type is just arbitrary and no strict line can be drawn as there is always intermixing of species depending upon the climate and local factors.

Earlier studies

The State of Sikkim has attracted the plant collectors and explorers and enjoyed intensive collections since 1843 starting with W. Griffith, Hooker (1848-50), Thomson (1850, 57), Anderson (1862-68), Kurz (1868) etc., and followed by Clarke (1869-75, 1884), Gamble (1872-77, 1879-82), Schlich (1873), Treutler (1874), Brandis (1879), Watt (1881), King (1878, 1886-92), Pantling (1885-96), Gammie (1887-97), Cummin (1888-93), Walsh (1888), Haines (1889-99), Prain (1900-02), Lace (1902-03), Cave (1903, 1912-16), Walton (1903-04), Scaright (1904-05), Burkill (1906), Smith (1909-10), Ribu & Rhomoo (1909-10), Cooper (1913), Lacaita (1913), Cowan (1916, 1918-23), Lowndes

(1943), Sinclair (1945) etc. After independence, Ghose (1951-57) Biswas (1954), Rao, (1955). Hara *et al.* (1960-72), Sharma & Ghosh (1966), Pradhan *et al.* (1972) etc. have made extensive and intensive botanical exploration in the State. With the establishment of a unit of Botanical Survey of India at Gangtok, large number of collections were made by scientists of Botanical Survey of India. The notable among these are Hajra (1980-85), Singh (85-90) Raju (1985-90), Kumar (89-94) Kumar & Singh (1992) Mandal (90-92) Singh (90-96). The important literature which deals with the Asteraceous flora and floristics of Sikkim include G.A. Gammie (1893, 94a, 94b), J. Gammie (1894), Smith & Cave (1911), Smith (1913), Lacaita (1916), Burkill (1907, 1916), Buchanan (1916), Osmaston (1935), Fischer & Froderstrom (1937), Banerji (1949), Choudhary (1951), Ghose (1951, 53-59), Hara (1963), Biswas (1956, 67), Rao (1964), Sharma & Ghosh (1971), Bennet (1983), Mathew (1983), Kumar *et al.* (1994), Sinha & Shukla (1997), etc. Recently a checklist on monocotyledons of Sikkim has been published by scientists of Botanical Survey of India. However, the part II dealing with dicotyledons is yet to be worked out.

General account of the family

Asteraceae (Compositae) is the fourth largest family of vascular plants with over 30,000 species falling under more than 1100 genera, distributed almost throughout the globe. In India, the family is estimated to have about 900 species under 167 genera (Hajra *et al.*, 1995; Sinha & Shukla, 1997). The majority of the species are herbaceous, the trees and shrubby representatives being only about 2 per cent. This plant family is a natural assemblage of well knit species characterised by involucrate head as inflorescence, pappus, scales or awns in place of calyx, the syngeneceous androecium, inferior bicarpellate unilocular ovary with a single basal ovule and achene type fruits. The diversity in life forms is due to specialised pollination and seed dispersal mechanism and its chemical evolutionary lability. Phylogenetically, the ancestry of the Asteraceae remains in dispute. It lies in or near the Rubiaceae, along a line parallel in some respects, to the line leading to Dipsacales and Calycerales. The fossil data, however is silent about the ancestry

of Asteraceae except that their origin is relatively recent (late Oligocene - mid Miocene). Turner (1977), however, considers the family as a very old phyletic line whose origin stems back to atleast the Cretaceous period. Its relative abundance in the fossil record since Miocene period, being due to adaptive mechanisms in the exploitation of short term, mostly disturbed habitats which presumably became more characteristic of the continental land mass since that period. He attributes its world wide distribution to the continental drift. However, all the proclaimed fossils have not been confirmed evidently to be truly asteraceae leaving enough scope for doubt about the period of its origin (Cronquist 1977).

The family Asteraceae is also very distinctive in its chemical attributes viz. presence of terpenoids based sesquiterpene lactones, the fatty acid derived polyacetylenes and the polysaccharide fructans, and absence or poor representation of non-portion aminoacids and alkaloids. Further, it has wide ranging medicinal and other economic uses viz. food, flavouring material, rubber, oil insecticides, dye and ornamental value. The diversity in floristics, ecology, geography, morphology, chemistry, phylogeny etc. insisted the authors to enumerate the compositaceous taxa of floristically rich (ca 4500 species of flowering plants) state of Sikkim.

A perusal of literature and the history of botanical exploration revealed that although the State has been extensively explored, no work has been done towards publication of comprehensive flora of Sikkim. As such, Asteraceae of this area has also been neglected although it dominates the flora of Sikkim with about 300 species under 84 genera inhabiting all sort of habitats from kitchen garden to the high peaks of Himalayas. There is only little mention of the state in Rao *et al.* (1988) "Flora Indicae enumeratio-Asteraceae" and Hajra *et al.*, (1995) (ed.) Fl. India vol. 12 & 13. This prompted the authors to bring out an account of Asteraceae of Sikkim based on their own studies and collections in the field and herbarium collections deposited in various Indian herbaria and literature. The keys to the genera and species and also at infraspecific level have been provided for easy identification of taxa by users.

TAXONOMIC STUDIES

Asteraceae in Sikkim is represented by 84 genera 290 species and ± 20 infraspecific taxa. The detailed taxonomic treatment is as follows :

KEY TO THE GENERA

- | | |
|----------------------------------------------------------------------------------|------------------------|
| 1a. Heads homogamous; all florets ligulate, tubular or tubuliform | 2 |
| b. Heads heterogamous; florets ray or disc | 69 |
| 2a. All florets ligulate | 3 |
| b. All florets tubular or tubuliform | 15 |
| 3a. Scapigerous perennial herbs | 4 |
| b. Non scapigerous herbs | 5 |
| 4a. Receptacles paleaceous; achenes oblong-linear, pappus feathery | 44. <i>Hypochoeris</i> |
| b. Receptacles naked; achenes oblong-obovoid; pappus simple | 77. <i>Taraxacum</i> |
| 5a. Plants usually with radical leaves; achenes contracted at both ends | 6 |
| b. Plants with radical and cauline leaves; achenes distinctly beaked or truncate | 8 |
| 6a. Subterranean herbs with very dwarf stems | 71. <i>Sorosseris</i> |
| b. Erect herbs with tall stem | 7 |
| 7a. Hispid herbs with straight spines or hooked hairs; pappus feathery | 61. <i>Picris</i> |
| b. Glabrous or hairy herbs without spines; pappus simple | 25. <i>Crepis</i> |
| 8a. Achenes distinctly beaked | 9 |
| b. Achenes without beak or with a short stout beak | 12 |
| 9a. Heads campanulate or subcampanulate; involucrel bracts black bristly | 10 |
| b. Heads cylindrical or narrow cylindrical; involucrel bracts not black bristly | 11 |
| 10a. Involucrel bracts in more than 3 series; achenes rugose | 18. <i>Cicerbita</i> |
| b. Involucrel bracts 2-3 seriate; achenes smooth | 29. <i>Dubyaea</i> |
| 11a. Radical leaves long petioled | 46. <i>Ixeris</i> |
| b. Radical leaves sessile | 48. <i>Lactuca</i> |
| 12a. Ligules purple, blue or violet | 63. <i>Prenanthes</i> |
| b. Ligules yellow | 13 |

- 13a. Achenes with short stout beak, 10-20 ribbed 84. *Youngia*
 b. Achenes without a beak, not more than 5 ribbed 14
- 14a. Achenes narrow, truncate at both the ends 50. *Launaea*
 b. Achenes compressed, mucriate between the ribs 70. *Sonchus*
- 15a. Anther cells tailed, auricled or sagittate at base 16
 b. Anther cells cleft at base or subentire 20
- 16a. Leaves spiny 19. *Cirsium*
 b. Leaves not spiny 17
- 17a. Filaments papillose; heads yellow 79. *Tricholepis*
 b. Filaments glabrous; heads purple, blue, violet or white not yellow 18
- 18a. Pappus hairs multiseriate 47. *Jurinea*
 b. Pappus hairs 1-2 seriate 19
- 19a. Corolla pale red; pappus 2-seriate 42. *Hemistepta*
 b. Corolla usually purple, pink, violet or white; pappus 1-2 seriate with inner pappus hairs forming a ring at base 66. *Saussurea*
- 20a. Leaves opposite 21
 b. Leaves alternate 24
- 21a. Involucral bracts 3-5 55. *Mikania*
 b. Involucral bracts more than 5 22
- 22a. Pappus of 10 or more capillary bristles 37. *Eupatorium*
 b. Pappus of usually 3-5 scales or hairs 23
- 23a. Pappus scaly 3. *Ageratum*
 b. Pappus of clavate hairs 2. *Adenostemma*
- 24a. Style branches subulate, hairy; florets tubular 25
 b. Style branches linear, obtuse, truncate or appendaged, florets tubuliform 27
- 25a. Pappus absent 36. *Ethulia*
 b. Pappus present 26
- 26a. Heads in glomerules; florets 1-5 81. *Vernonia*
 b. Heads distinct, florets 1-many 31. *Elephantopus*
- 27a. Anther cells without tail or auricle 28
 b. Anther cells tailed or auricled 45
- 28a. Involucral bracts 1-seriate, herbaceous or foliaceous 29
 b. Involucral bracts 2-many seriate, dry or with scarious tip 40

- 29a. Heads unisexual 83. *Xanthium*
 b. Heads bisexual 30
- 30a. Receptacle epaleaceous 1. *Adenocaulon*
 b. Receptacle paleaceous 31
- 31a. Leaves divided to the base or deeply pinnatifid 58. *Parthenium*
 b. Leaves simple or pinnately compound 32
- 32a. Achenes of disc florets rounded or laterally compressed; pappus of 2 weak scales or absent 33
 b. Achenes of disc florets angular or dorsally compressed; pappus present or absent 37
- 33a. Outer involucre bracts clavate, spreading, inner enclosing the achenes 68. *Siegesbeckia*
 b. Outer involucre bracts erect; inner not enclosing the achenes 34
- 34a. Receptacle conical 73. *Spilanthes*
 b. Receptacle flat or convex 35
- 35a. Heads homogamous; pappus absent 32. *Eleutheranthera*
 b. Heads heterogamous, pappus present 36
- 36a. Pales bristle like; pappus a ring of thick scales; anther base sagittate 30. *Eclipta*
 b. Pales obtuse, lacerate; pappus of 2-5 unequal bristles; anthers base, obtuse 9. *Blainvillea*
- 37a. Pappus of 5 or more scales 38
 b. Pappus of 2-4 bristles or awns 39
- 38a. Plants erect, pappus of short fimbriate scales, ca 1 mm long 38. *Galinsoga*
 b. Plants prostrate, ascending, pappus of fine plumose bristles ca 5 mm long 80. *Tridax*
- 39a. Achenes fusiform or linear, angled; pappus of 2-4 barbellate bristles 8. *Bidens*
 b. Achenes compressed; pappus of 2 unbarbed awns 74. *Synedrella*
- 40a. Heads rayed 41
 b. Heads disciform 42
- 41a. Ray florets female; pappus absent 17. *Chrysanthemum*

1891. *Verbesina lavenia* L. Sp. Pl. 902. 1753. *A. viscosum* Forst. var. *typica* Hook.f. FBI. 3: 242. 1881.

Key to the varieties

- 1a. Leaves attenuated at both ends; achenes only lightly muricate
 1.1. var. **angustifolium**
 b. Leaves not attenuated at both ends; achenes densely muricate 2
 2a. Leaves alternate, sessile; involucre bracts eciliate on margins
 1.2. var. **elatum**
 b. Leaves opposite, petioled; involucre bracts ciliate on margins
 1.3. var. **lavenia**

1.1. var. **angustifolium** (Clarke) Koster in Blumea 1: 475. 1935; Panigrahi in Kew Bull. 30(4): 652. 1975. *Adenostemma viscosum* Forst. var. *angustifolium* Clarke, Comp. Ind. 29. 1876. *A. viscosum* Forst. var. *typica* Hook.f., FBI. 3: 242. 1881, *pro parte*.

Leaves linear-lanceolate, 15-22 x 0.8-1.3 cm, attenuated at both ends, glabrous, distantly crenate in upper half. Peduncles glandular hairy, not tomentose. Involucre bracts free to the base, glabrous dorsally. Achenes lightly muricate.

Flrs. & Frts. : July - Sept.

Sikkim *s.n.*; Dulkajhar tarai; 150-1000 m.

1.2 var. **elatum** (D. Don) Hochr. in Candollea 7: 298. 1934; Panigrahi in Kew Bull. 30(4): 654. 1975. *Adenostemma elatum* D. Don, Prodr. Fl. Nep. 181. 1825. *A. viscosum* Forst. var. *elata* (D. Don) Hook.f. FBI. 3: 242. 1881.

Leaves alternate, the upper ones generally sessile, almost glabrous.
Involucre bracts obtuse, more or less hairy at base, eciliate at

Flrs. & Frts. : July - Sept.

Sikkim *s.n.*; 1225-2440 m. (Hooker's Collection at Kew).

1.3. var. **lavenia**

Herbs with thick pubescent stems and broadly ovate-deltoid, crenate-serrate, pubescent leaves with winged petioles. Heads solitary on peduncled racemes. Involucral bracts in two rows. Achenes obovate, glandular-tuberculated.

Flrs. & Frts. : July - Sept.

Pantropical weed.

3. **AGERATUM** L.

Key to the species

- 1a. Leaves glandular punctate beneath; involucral bracts glabrous; corolla shorter than pappus scales **1. A. conyzoides**
- b. Leaves sparsely pilose beneath; involucral bracts pilose on back; corolla equal to the length of pappus scales **2. A. houstonianum**

1. **Ageratum conyzoides** L. Sp. Pl. 839. 1753; Hook.f. FBI. 3: 243. 1881.

Herbs with decumbent stems and decussate, broadly ovate-rhomboid, acute, crenate, pubescent leaves. Heads in dense terminal corymbs. Involucral bracts glabrous, in 2-3 rows, light blue.

Flrs. & Frts. : Throughout the year.

Pantropical weed; Gangtok; up to 1800 m.



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