A SYSTEMATIC STUDY OF VERNONIA (SENSU LATO OF UPPER BRAHMAPUTRA VALLEY AGRO-CLIMATIC ZONE, ASSAM

A thesis submitted to

Assam Science & Technology University,

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In partial fulfilment of the requirements for the award of the degree of

Master of Science in BOTANY

Submitted by,

ANANYAA KHAUND

Roll No: 202820047001

Reg. No: 44832820

PG DEPARTMENT OF BOTANY

Silapathar Science College

Silapathar-787059

Under the Guidance of

Dr. JITU GOGOI

Assistant Professor

PG DEPARTMENT OF BOTANY

Silapathar Science College

(Affiliated to Assam Science & Technology University)

Amritpur, Silapathar, Dhemaji, Assam-787059

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CERTIFICATE

This is to certify that this thesis entitled "A Systematic Study of *Vernonia* (*Sensu Lato*) of Upper Brahmaputra Valley Agro-Climatic Zone, Assam" submitted to Assam Science & Technology University, Guwahati for the award of the degree of Master of Science in Botany is a bonafide research work carried out by the student Miss. Ananyaa Khaund (Roll No. 202820047001) under my guidance and supervision during the period between April 2022 to August 2022 in the Department of Botany. I further certify that no part of this thesis has been submitted anywhere else for the award of any Degree, Diploma, Associateship, Fellowship or any other similar titles.

Date: 28-08-2022

Place: Silapathar Science College

Dr. JITU GOGOI

Internal Guide

Department of Agronomy
Assam Agricultural University
Jorhat-785013

Dr. Iswar Chandra Barua, ISWS Fellow
Principal Scientist, AICRP on Weed Management
Phone No.: 94350 94326
email: iswarbarua0101@gmail.com

NO.: AAU/Agron/WC-MAP/2022-23/

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CERTIFICATE

This is to certify that the thesis entitled "A Systematic study of *Vernonia* (*sensu lato*) of Upper Brahmaputra Valley Agro-climatic zone, Assam" submitted to the Assam Science and Technology University, Guwahati, for the award of the degree of Master of Science in Botany is a bonafide research work carried out by the student Miss Ananyaa Khaund (Roll No. 202820047001, Reg. No. 448328220) under my guidance and supervision during the period between April to August, 2022 in the Department of Agronomy, Assam Agricultural University, Jorhat. I further certify that no part of this thesis has been submitted anywhere else for the award of any Degree, Diploma, Associate-ship, Fellowship or other similar titles.

Date : 30.08.2022

Place : Jorhat

(Iswar Chandra Barua)

External Guide
Principal Scientist
AICRP on Weed Management
AAU, Jorhat-13

DECLARTION

ANANYAA KHAUND
PG Department of Botany
Silapathar Science College
Silapathar, Dhemaji, Assam

I hereby declare that the work embodied in this thesis entitled "A Systematic study of *Vernonia* (*sensu lato*) of Upper Brahmaputra Valley Agro-climatic zone, Assam" is a research work done by me under the supervision and guidance of Dr. JITU GOGOI, Assistant Professor of Botany, Silapathar Science College, Silapathar. I further declare that this work has not been submitted earlier in full or in parts to any other university for the award of any other Degree, Diploma, Associateship, Fellowship or other similar titles.

Date: 28-08-2022

Ananyaa Khaund

Place: Silapathar Science College

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CONTENTS

ABSTRACT

Asteraceae is the family to which the genus *Vernonia* belongs. Capitulum, or head inflorescence, is a feature of the genus and is frequently densely crowded into laxly corymbose, paniculate, or thyrsoid arrangements or reduced to a solitary capitulum. Flowers are typically pink or purple, seldom white, and have cypsela (achenal) fruits that are frequently ribbed or terete, glandular, and have lingering bristly pappus. In Assam, there is comparatively little systematic knowledge of the genus. In response to the incomplete study of Kanjilal and others of the erstwhile Assam (now politically confined into North Eastern Indian territories), Barua and Nath in the year 1998 released the sensus of Asteraceae of Assam. A second checklist for Assam in 2021 has just made public by Chowdhury. An updated enumeration along with morphological illustrations of *Vernonia* (s.l.) in North East India, particularly in Assam, are currently required due to the fact that most of the members are known for having a variety of economic potential and the same are known for economic interference in agricultural and forest lands. We therefore decided to work on Vernonia in the UBV zone of Assam. The bioregions of the Eastern Himalayas and North East (NE) India meet at the Brahmaputra Valley, which is part of Assam. The Upper Brahmaputra Valley agro climatic Zone is one of four agro climatic zones that make up Assam's six agro climatic zones. The genus *Vernonia* and the family Asteraceae have received considerable attention from biologists in the current global environment, not only for their numerous human-beneficial characteristics but also for their significant roles in plant evolution and evolutionary affinities. In recent years, the genus *Vernonia*, like many other genera in the family Asteraceae, has undergone a number of taxonomic operations, including its splitting into a number of new genera, which has resulted in a number of nomenclatural changes in the taxa. Taxonomical study is essential for comprehending the taxonomy as well as for determining the availability of plant resources because each member of the family has frequently gone outside of its initial geographic range due to the family's effective seed dispersal system.

CHAPTER 1

Introduction

Schreb established *Vernonia* (s.l.) in 1791. One of the key elements of North East India's floral diversity is this genus, which is also known as ironweed. The presence of capitulum, or head inflorescences, which are frequently tightly clustered to laxly corymbose, paniculate, or thyrsoid arrangements or reduced to solitary capitulum, characterises the genus as a significant member of the family Asteraceae. The fruits are cypsela (achenal), typically ribbed or terete, glandular, and have persistent bristly pappus. Florets are typically pink or purplish, seldom white.

The genus *Vernonia* has about one thousand species and members of the genus are widely used as food and medicine in different parts of the world and few species has already established themselves as troublesome weeds with tremendous adaptability across the soil types and climatic variations.

The genus Vernonia as well as its family Asteraceae has received much attention of biologist in Global scenario not only for their various useful properties to the benefit of mankind, but also for their great role in plant evolution as well as phylogenetic affinities. As a consequence the genus *Vernonia,* like many other genera of the family Asteraceae, has undergone several taxonomical operations in recent past and experienced it’s splitting in a number of new genera or shifting of species to some other genera, resulting in several nomenclatural changes of taxa. With excellent seed dispersal mechanism, the members of the entire family has frequently changed their geographical boundaries, and therefore the taxonomical exploratory works are proved to be essential to record the changing phyto geographic scenario of the taxa as well as to document the availability of plant resources of a place.

1.1 Classification

At the end of the eighteenth century, two French botanists, B.de Jussieu and A.L.de Jussieu, created a method of categorization that was based on Linnaeus sexual system but was improved upon. Later, in his renowned work "Genera Plantarum," A.L. de Jussieu made numerous alterations and published it in his own style in 1789. In his system of classification, he recognized more than 100 orders and 15 classes. His system **was mostly based on petal adhesion, cotyledon location and number and therefore, his classification scheme is a natural one.**

An important classification system was created by the well-known English systematists and debuted in the latter half of the nineteenth century. In the colossal book "Genera Planterum," Bentham and Hooker created a combined classification scheme with 202 orders (families) (1862-1883). **The classification scheme proposed by Bentham and Hooker is based on that proposed by De Candolle and Jussieu** in the year. The Phanerogams or Seed Plants were categorised into Dicotyledones, Gymnospermae, and Monocotyledones by Bentham and Hooker. The dicotyledones were further separated into three subgroups: Polypetalae, Gamopetalae, and Monochlamydeae, or incompleteae. **They arranged the family Compositae (later renamed as Asteraceae) in fourth place and the order Asterales under the rank subclass Gamopetalae.**

Bentham and Hooker's classification system was refined by Charles E. Bessey (1845–1915). He distinguished Angiosperms from Gymnosperms. The Angiosperm orders were rearranged by him. His method was commonly referred to as the Besseyan system. The phylogenetic Taxonomy of Flowering Plants is the title given to the publication. **Bessey's theory was based on the development of plant groups through evolution and their primitiveness**. Ranales was a fundamental group, in his opinion. Monocots and the majority of dicot groupings descended from it. **Bessey placed the Asteraceae at the peak of his cactus and highlighting the strong relationships between the Asteraceae and the Campanulales and Rubiales.** (Fig.1).

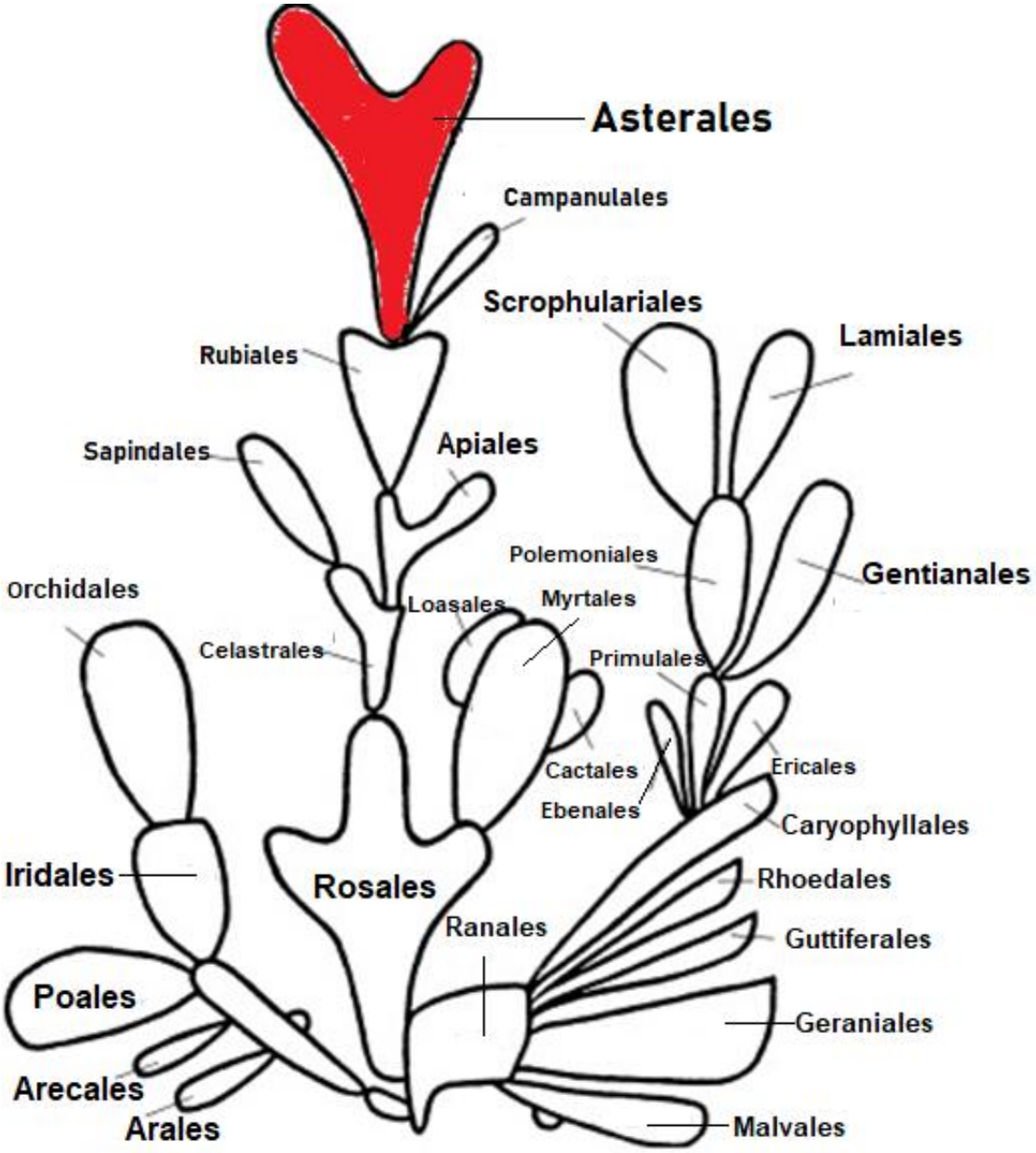


Fig.1.1 : “Bessey's cactus”. Diagram to show the relationships of orders. The size of each order is represented by the shape and dimensions of each component of the diagram.

Armen Takhtajan introduced a phylogenetic system of Angiosperm classifications during 1942-1980. He asserted Angiosperms of monophyletic origin and which have descended from a prehistoric group of gymnosperms. He placed the order Asterales at the culminate position (order number 71) under the class Magnoliopsida, Sub-class Asteridae belonging to the super order XX and Division Magnoliophyta after the order 69 Campanulales and order 70 Calycerales.

Rolf Dahlgren first presented a method of Angiosperm classification in 1975, and then updated and modified versions in 1980, 1981, and 1983. He essentially heavily relied on chemical features in his technique of classification. According to him, the Angiosperms are monophyletic in origin and believed to be originated from a single line of Gymnosperms.He classified the Order Asterales as belonging to the Super Order Asteriflorae, Class Angiospermae, and Subclass Dicotyledonae.

Early work on the sub familial classification of the family was carried out by several researchers. In 1976, Carlquist concluded that on the basis of morphological studies that there are two subfamilies in the Asteraceae, namely the Asteroideae and the Cichorioideae. In the same year Wagenitz also proposed a two sub familial classification that differed from that of Carlquist by placing the Eupatorieae with the Asteroideae which is one of the examples of incorporating chemical characters in combination with morphological and molecular data into a cladistic analysis of the Asteraceae.

Later, in 1995, in the Proceedings of the International Compositae conference held at Kew Gardens in London, Bremer presented a new subfamilial view of the Asteraceae based on a cladistic study of morphology, in which he proposed four subfamilies, namely: the Asteroideae, Cichorioideae, Carduoideae, and Barnadesioideae(Bremer K.,1996**). He placed Astereae in between Calenduleae and Anthemideae. (Fig. 1.2)**

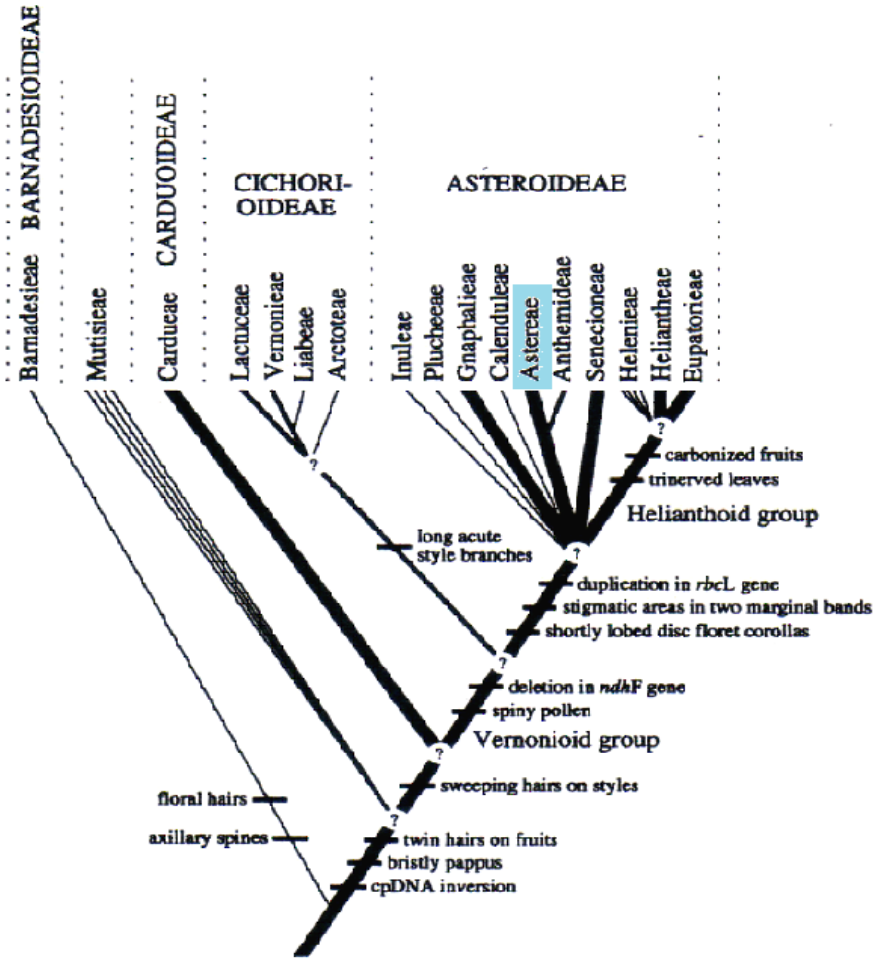


Fig.1.2: Morphologically-based diagram showing tribes of Asteraceae according to Bremer(1996).

It became possible to use cladistics principles for plant categorization as a result of the availability of DNA data from numerous plants and the development of strong data-handling technologies. An international team of committed systematic botanists known as the "Angiosperm Phylogeny Group" worked together to develop the APG classifications as a result. Over time, they published a number of APG classifications, the most recent of which is APG IV. These include APG I, APG II, APG III, and APG IV. In 2009, APG III appeared in the Botanical Journal of the Linnean Society. The following informal monophyletic higher groups in APG are used to classify families: magnoliids, monocots, commelinoids, eudicots, core eudicots, rosids, eurosids I and II, asterids, euasterids I and euasterids II. A handful of families without assignment to order are listed under these informal groups as well. The dicotyledon and monocotyledon categories of flowering plants were previously separated. The APG has recently discovered that while the monocots do not form a monophyletic group (clade), the dicots do (they are paraphyletic). The bulk of dicot species do, however, belong to the eudicots or tricolpates, a monophyletic group. A third large group with around 9,000 species, the Magnoliidae, contains the majority of the remaining dicot species. The remaining group consists of the families Ceratophyllaceae and Chloranthaceae, as well as a paraphyletic collection of primitive species known as the basal Angiosperms. The APG III system consists of 59 orders and 415 families; two families (Apodanthaceae and Cynomoriaceae) are completely omitted from the classification. Ten families are not assigned to any orders. In **the top third of the APG III classification, the Asterales represent the apex of plant evolution. Along with the Dipsacales, Aquifoliales, and Apiales, the Boraginales, Lamiales, Solanales, and Gentianales are also closely connected to the Asterales.** (Fig. 1.3)

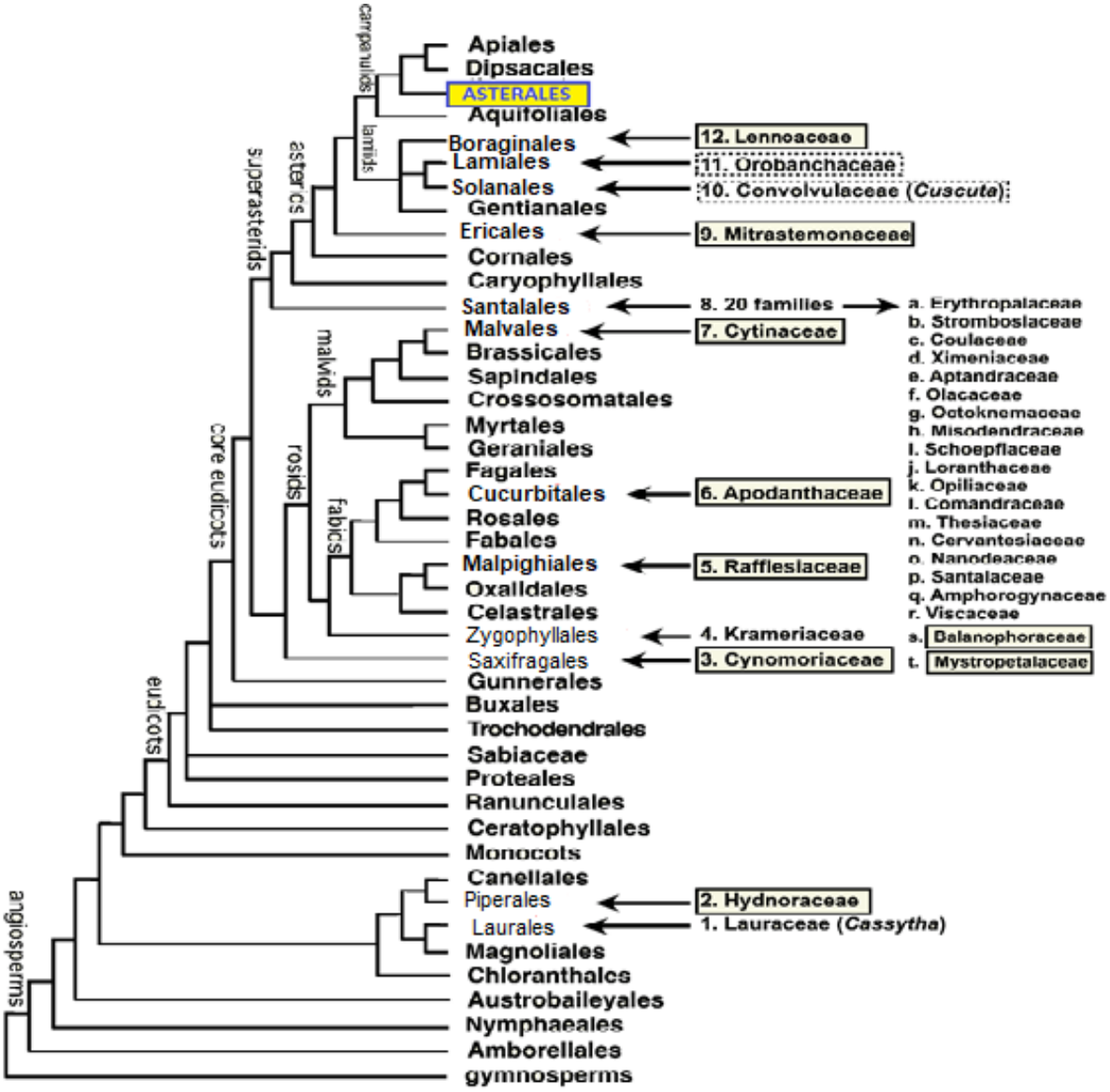


Fig.1.3: Position of Asterales in APG III Classification (2009)

1.2 Phylogenetic Relationship Of Asteraceae

The two subfamilies Cichorioideae and Asteroideae were proposed by Carlquist (1976) based on a variety of morphological and anatomical traits. Instead of the Asteroideae, Carlquist placed the Eupatorieae and Vernonieae in the Cichorioideae. The Heliantheae, Vernonieae, and Mutisieae are the primary home ranges of species with primitive features, according to Carlquist. In addition, he did not believe any tribe to be primitive or descended from another tribe within the family, emphasising that "characters, not genera or tribes, are primitive." The Asteraceae are isolated and don't have an immediate, closely related family, according to Carlquist, who talked about possible related families.

According to Turner (1977), the Calyceraceae are the Asteraceae's nearest relatives. He cited similar pollen the capitula, and similar floral characteristics as evidence for this idea (Skvarla *et al*., 1977).

The Asteraceae, Calyceraceae, Rubiaceae, and Campanulaceae were compared by Stebbins (1977). He came to the conclusion that the only characteristic shared by hypothetical ancestors of the Asteraceae and any other of these families would be the sympetalous flower. Stebbins claimed that the anatomical and morphological evidence are so imprecise that it is difficult to draw any conclusion about relationships. He found little evidence to support the notion that the Asteraceae and the Calyceraceae or the Rubiaceae have close kinships, and mentioned that Asteraceae and Campanulaceae might have had an"immediate or not very distant common ancestor" (Bremer,1987)

Table 1 : The morphological characters of Asteraceae comparing to Rubiaceae and Campanulales.

Characters	**Asteraceae**	**Rubiaceae**	**Campanulales**
Habit:	Usually herbs with milky juice.	Herbs or woody shrubs.	Shrubs, and rarely small trees.
Leaves:	Simple, alternate, exstipulate.	Simple, opposite and stipulate-interpetiolar.	Alternate,more rarely opposite,simple, entire but often with dentate margin.
Inflorescence:	Capitulum	Cymose- Biparous generally	Cymose and racemose
Flower	Unisexual, or bisexual, actinomorphic, or zygomorphic epigynous.	Hermaphrodite, actinomorphic and epigynous.	Bisexual and protandrous.
Calyx	Represented by pappus.	Sepals 4 or 5, gamosepalous.	Synsepalous, with 5 imbricate or valvate, persistent lobes.
Corolla	Petals 5, gamopetalous, valvate.	Petals 5 or 4, gamopetalous, valvate or imbricate.	Petals 5, sympetalous,bilabiate.
Androecium	Stamens 5, syngenesious, epipetalous, anthers introrse.	Stamens 5 or 4, epipetalous, polyandrous anthers introrse.	Stamens 5, whorled, alternipetalous, connivent or connate with a staminal tube, epipetalous or not
Gynoecium	Bicarpellary, syncarpous with basal placentation, Ovary inferior.	Bicarpellary, syncarpous, bilocular, axile placentation, inferior.	Gynoecium is syncarpous, with an inferior ovary, axile placentation.
Fruit	Cypsela	Berry, drupe or capsule	Berry or capsule

A capitulum is a compact raceme or spike, and such inflorescences typically contain flowers with bilabiate corollas, according to Jeffrey (1977). Therefore, the Campanulaceae, Goodeniaceae, and Stylidiaceae would be related families, the primitive corolla type in the Asteraceae would be bilabiate, and the Mutisieae would be the family's initial tribe. Jeffrey, on the other hand, claimed that the Campanulaceae, Calyceraceae, and Asteraceae belong to a single evolutionary lineage because the Brunoniaceae and the Calyceraceae share capitate inflorescences, an inflorescence structure with the Asteraceae.

The Campanulaceae sensu lato, according to Stebbins (1977), Jeffrey (1977), and other researchers (including Dahlgren, 1983), appear to be the family that is most closely related to the Asteraceae. The apically thickened and short bilobed style present in the Lobeliaceae and numerous Mutisieae, especially the Barnadesiinae, as well as the presence of latex in the Campanulaceae sensu lato and in several cichorioid tribes are important characteristics. It was thought that these two characteristics are more likely than any other to result in synapomorphies between the Lobeliaceae and the Asteraceae.

The concerns posed by presuming a tight relationship between the Asteraceae and the Campanulaceae have been highlighted by a number of authors, most notably Stebbins (1977). If the Lobeliaceae are classed with the Campanulaceae, then this must be read as a parallelism or "tendency," for example, the consistently connate anthers are only found in the Lobeliaceae and the Asteraceae.

The Calyceraceae and a number of taxa in other families also have the indeterminate capitulum and connate anthers. It is possible to consider the capitulum and related pollen as synapomorphies for the Calyceraceae and the Asteraceae (Skvarla *et al*., 1977)

The Apiaceae and Asteraceae have several chemical similarities in characteristics, particularly the presence of polyacetylenes and sesquiterpene lactones, but so do other families, making it impossible to deduce a sister group relationship solely from chemical information. Additionally, no physical traits can be proposed as putative synapomorphies for the Apiaceae and the Asteraceae.

1.3 Classification and Relationship of taxa within Asteraceae

The familial classification of the Asteraceae began with the French botanist Henri Cassini who in 1816 published a diagram showing the interrelationships of nineteen tribes of the Asteraceae (Fig.1.4). Then in 1873, Bentham revised Cassini’s arrangement reducing the number of tribes to thirteen (Fig.1.5)

It is believed that the Astereae and the Eupatorieae are sister taxa. Small pollen and sterile style-branch appendages are shared by both groups. Between the Eupatorieae and the Heliantheae (s.l), there is significant homoplasy. These two groups have calcinated cypselas and opposite, trinerved leaves.

The issue of intertribal interactions in the Asteraceae has previously been tackled in two different approaches. First, several groups within the family have been labelled as ancient or primitive. Second, different classifications have placed the tribes into two subfamilies. Approximately half of the major tribes—the Heliantheae (Bentham, 1873; Cronquist, 1955); Senecioneae (Small, 1919); Cynareae (Cardueae; Leonhardt, 1949); Vernonieae (Augier and du Merac, 1951); Mutisieae (Jeffrey, 1977; Carlquist, 1976); and Eupatorieae—have been categorised as primitive at (at least within the Asteroideae; Robinson, 1981). The Mutisieae are categorically identified as the family's stem by this research.

Early Asteraceae molecular phylogenies were based on plastid markers and support the close ancestry of the Fab Five (Jansen *et al.*, 1990; Kim & Jansen, 1995; Panero & Funk, 2002). which is mainly consistent with morphology. (Bremer, 1987; Karis, 1993).

Robinson (2004, 2005) defined three super tribes within the sub family Asteroideae (Cass.)Lindl. based on these molecular phylogenies to accommodate its 17 000+ species, including Senecionodae H. Rob. (Senecioneae), Asterodae H. Rob. (Anthemideae, Astereae, Calendulae, and Gnaphalieae), and Helianthodae H. Rob (Heliantheae Alliance, sunflowers, plus its sister tribes) Asteroideae is distinguished by having small central (disc) flowers and true ray flowers on the periphery of the capitulum (head), which are frequently yellow but can also be white, pink, and blue. However, many members of the subfamily have lost their ray flowers in case of evolution and only produce larger central flowers, which are frequently white or violet in colour.

Fig.1.4: Diagram according to Cassini (1816) showing the interrelationships of nineteen tribes of the Asteraceae.

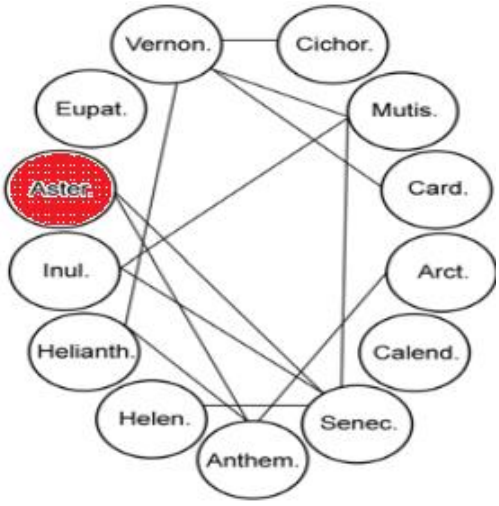


Fig.1.5: Diagram according to Bentham (1873) reducing the number of tribes to thirteen from Cassini's arrangement for nineteen tribes.

1.4 Exploration of Vernonia and Research Gap

C.B. Clarke published the first comprehensive study of Vernonia (s.l.) in the Indian subcontinent in Hooker's Flora of British India in 1881. Pullaiah *et al*. (2007) focused on the Vernonia of the Eastern Ghats. Asteraceae and Vernonia have also been mentioned in various floristic reports from across the nation. The systematic description of the genus in Assam is, however, incredibly sparse. The unfinished study of Kanjilal *et al.* (1934) of former Assam (now politically circumcised into North Eastern Indian regions) was followed by Barua and Nath (1998, who published the sensus of Asteraceae of Assam). Additionally, Chowdhury has released a checklist for Assam in 2021. Therefore, an updated enumeration along with morphological illustrations of Vernonia(s.l) in North East India, particularly in Assam, are required at this time because most of the species' members are known for their various economic potential and for interfering with agricultural and forest lands. A taxonomic exploration of *Vernonia (sensu lato)* was conducted from April 2022 to August 2022 as part of the M.Sc. Research Program of Assam Science and Technology University in the Upper Brahmaputra valley Agroclimatic Zone of Assam.

1.5 Objectives

1. To explore the *Vernonia* species of Upper Brahmaputra Valley agro-climatic (UBV) zone, Assam
2. To bring out a detailed morphological account of each of the taxon for their easy recognition
3. To bring out the recent nomenclatural changes of *Vernonia* taxa of UBV zone, Assam

CHAPTER: 2

REVIEW OF LITERATURE

Review of Literature

Vernonia Schreb.(s.l) belongs to the family Asteraceae, which is the largest and most complex genus of the tribe *Vernonieae* Cass. Several species from the tribe *Vernonieae*, were placed under the genus *Vernonia (*s.l) due to the great morphological homogeneity in their reproductive characters and a wide vegetative plasticity (Keeley *et al*., 2007 and Keeley and Jones, 1977).

The erstwhile genus *Vernonia*(s.l) comprises over 24,000 described species dispersed across 17 tribes and three sub-families. (Funk *et al*., 2009; Petacci *et al*., 2012)

Harold Robinson made revolutionary changes in Vernonia along with Keeley and few other scientist mostly during the late 90's.In the year 1999, Robinson revised paleotropical Vernonia. But *"Name changes are not complete for old world species formerly ascribed to this genus, however and the generic status of these species will certainly change the future when these large scale studies are completed"*(Bunwong *et al*.;2014)

According to phytochemical investigations, the genus' primary elements are sesquiterpene lactones, triterpenes, steroids, carotenoids, flavonoids, lignoids, alkaloids, and tannins (Toigo *et al*., 2004).

Numerous authors subsequently divided the genus Vernonia into new genera including Monosis, Strobocalyx, Cyanthillium, Decaneuropsis, Gymnenthemum, etc.

Monosis D.C., has a distinct lophate pollen type as well as leaves with thick petioles, cuneate leaf bases, and spreading secondary veins. The type species, *Monosis wightiana* D.C., is included, as are six new species: *M. aplinii, M. parishii, M. shevaroyensis, M. talaumifolia, M. travancorica, and M. volkameriifolia*. (Robinson & Skvarla,2006)

Robinson and Skvarla (2006) & Robinson *et al*.(2008) have splitted Asian and Indonesian taxa of *Vernonia*(s.l) raising to the rank of genus under Monosis DC. The Asian and Malaysian members of the genus exhibit distinct stylar nodes, blunt stylar hairs, and pollen that is tricolporate and echinate(Robinson & Skvarla)The

Asian and Indonesian *Strobocalyx arborea* is the type species, and combinations are offered for the six other East Asian and Malaysian species viz; *Vernonia bockiana, Vernonia chunii, Vernonia esculenta, Vernonia solanifolia, Vernonia sylvatica,* and *Vernonia vidalii.On the other hand, Vernonia elliptica* is the sole species found in Tarlmounia. *Monosis* D.C., has a distinct lophate pollen type as well as leaves with thick petioles, cuneate leaf bases, and spreading secondary veins. The type species, *Monosis wightiana* D.C., is included, as are six new species: *M. aplinii, M. parishii, M. shevaroyensis, M. talaumifolia, M. travancorica, and M. volkameriifolia*. (Robinson & Skvarla,2006)

The works of Robinson & Skvarla 2007) have shown that, the species classified as *Decaneuropsis* typically have a woody habit with imbricated, somewhat deciduous inner involucral bracts that are typical of Eastern Hemisphere members of the *Vernonieae* subtribe Gymnantheminae. Decaneuropsis' scandent or subscandent habit sets it apart from the majority of Gymnantheminae.In contrast to other *Gymnantheminae,* especially in the genus *Strobocalyx*, the basal corolla tube expands significantly from near the base, *Decaneuropsis*'s corolla is slender with an extended basal tube and a narrowly campanulate limb. The African *Gymnanthemum* also has the lack of a basal stylar node. But *Strobocalyx* of Asia and Malaysia, which has a well-developed basal stylar node, is very different from it. As in *Strobocalyx, Decaneuropsis*' sweeping hairs on the upper style shaft and branches are blunt as opposed to *Gymnanthemum* and *Monosis*' pointed sweeping hairs.

Over the years, several taxonomical classifications have been proposed for *Vernonieae* and the genus Vernonia s.l. According to traditional classification (Bentham, 1873), *Vernonieae* has two subtribes and the genus *Vernonia* s.l. comprises more than 1000 species and is divided into sections, subsections and series (Baker, 1873; Bentham, 1873; Jones, 1977). Harborne and Williams (1977), Jones (1977) and Robinson et al. (1980) developed seminal studies that gathered cytogenetic, chemical, micromorphological and macromorphological information into the *Vernonieae* taxonomy (Marília Elias Gallon *et al*. 2018)

Several classes of compounds have been used as chemotaxonomic markers in the Asteraceae family, mainly flavonoids and sesquiterpene lactones (Alvarenga et al., 2001; Emerenciano *et al*., 2001; Seaman, 1982) (Marília Elias Gallon *et al*. 2018)

Differential patterns of specialized metabolites accumulation were found in species of the genus *Vernonia* (s.l.) which highlighted the application of metabolomic approaches as potential chemotaxonomic tool (Martucci *et al*., 2014) (Marília Elias Gallon *et al*. 2018)

Nwakanma *et al.(*2018) carried out genetic diversity study of *Vernonia (s.l)* by using Random Amplified Polymorphic DNA(RAPD) Markers and classified 50 African Vernonia samples into 5 groups, of which few cosmopolitan species have also common occurrence in Africa and India including Assam. Earlier Basak and Mukherjee (2003) tried to distinguish Indian *Vernonia (s.l)* based on cypselar features. Though the Flora of British India (Hooker,1881) embraced the extensive work of Indian sub-continent, several major taxonomic and nomenclatural changes has increased the complicacy of taxonomy of *Vernonia(s.l).*

The first ever systematic account of *Vernonia* (s.l) in Indian sub-continent was carried out by C.B. Clarke which was published in Hooker's Flora of British India (1881); Pullaiah *et al*.(2007) explored on the *Vernonia* of Eastern Ghats. However, the systematic account of the genus in Assam is very scanty. The incomplete work of Kanjilal *et al*.(1934) of erstwhile Assam(presently political circumcision into North East Indian provinces) followed by Barua and Nath(1998), they published the sensus of Asteraceae of Assam. Recently Chowdhury also published another checklist of Assam in the year 2021.Hence an up to date enumeration couple with morphological illustration of *Vernonia* (s.l) in North East India, especially in Assam, is the need of time as most of the members are known for various economic potential and same are known for economic interference in Agriculture and Forest lands.

The species of *Vernonia (s.l)* have wide ethno-pharmacological use for treatment of several diseases as snake bite antidote, and as food in some African regions (Toyang and Verpoorte, 2013)

In his analysis, S. C. Masaba (2009) showed that the acetone-water and aqueous extracts of V. amygdalina have antimalarial properties. However. The aqueous extract's antimalarial activity was significantly lower than the acetone extract's.

According to Triguna N. Misra *et al*.(1993), a novel triterpenoid known as 3β-acetoxyurs-19-ene has been discovered from the roots of Vernonia cinerea Less. (Compositae). Lupeol acetate has been identified as a different component.

Materials And Methods

3.1 Study Area

The Brahmaputra Valley region is located between the eastern and north eastern Himalayan peaks. The Brahmaputra Valley spans 71,516 km sq. and is divided into 30 districts. The Brahmaputra Valley, with its rainforest-like climate, has some of the world's most prolific soil.

The Upper Brahmaputra Valley Agro climatic zone comprises the following districts- Golaghat, Jorhat, Majuli, Sivsagar, Charaideo, Dibrugarh, Tinsukia

With Arunachal Pradesh bordering to the south, Nagaland and Manipur to the west, Meghalaya to the east.

Appendix-I provides a geography of the UBV districts, while Appendix-II contains a list of national parks and wildlife sanctuaries.

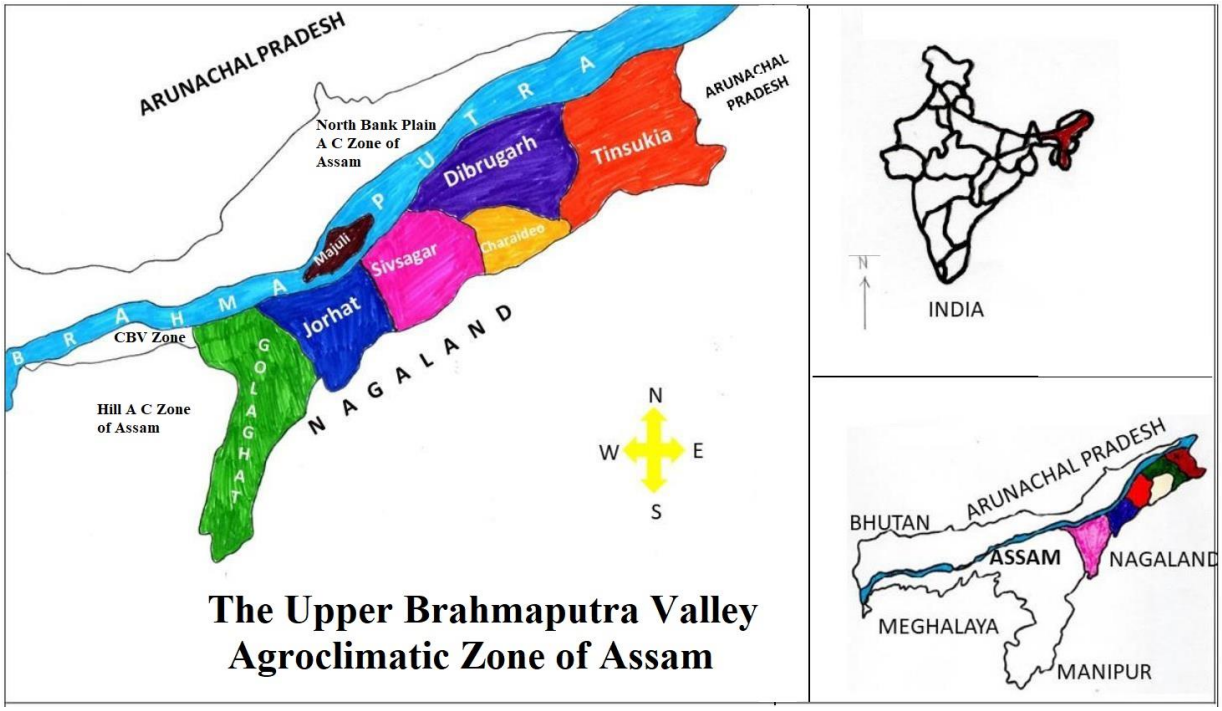


Fig.3.1. Map showing Upper Brahmaputra valley Agro-climatic zones of Assam

3.2 Meteorological data:

(i) Jorhat

Jorhat experiences a pleasant, mild temperature. In contrast to the dry winters, the summers here have a lot of rainfall. Here, summer lasts through September, beginning at the end of June. July is often the month with the highest relative humidity. In terms of relative humidity, March is the driest month. July records the most days with precipitation. December has the fewest days that are rainy overall. Jorhat continues to have a 26 °C average annual temperature. Jorhat has year-round temperatures of 22 to 10 °C in the winter and 25 to 35 °C in the summer.

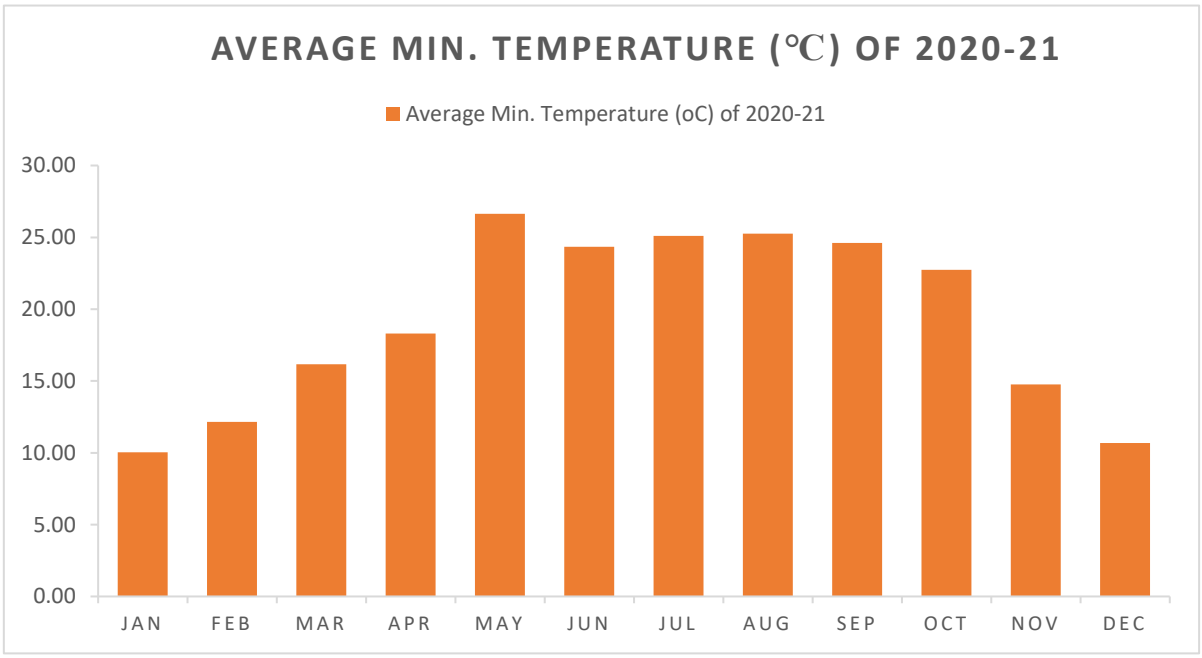


Fig 3.2. Average Minimum Temperature of 2020-21 of Jorhat District.

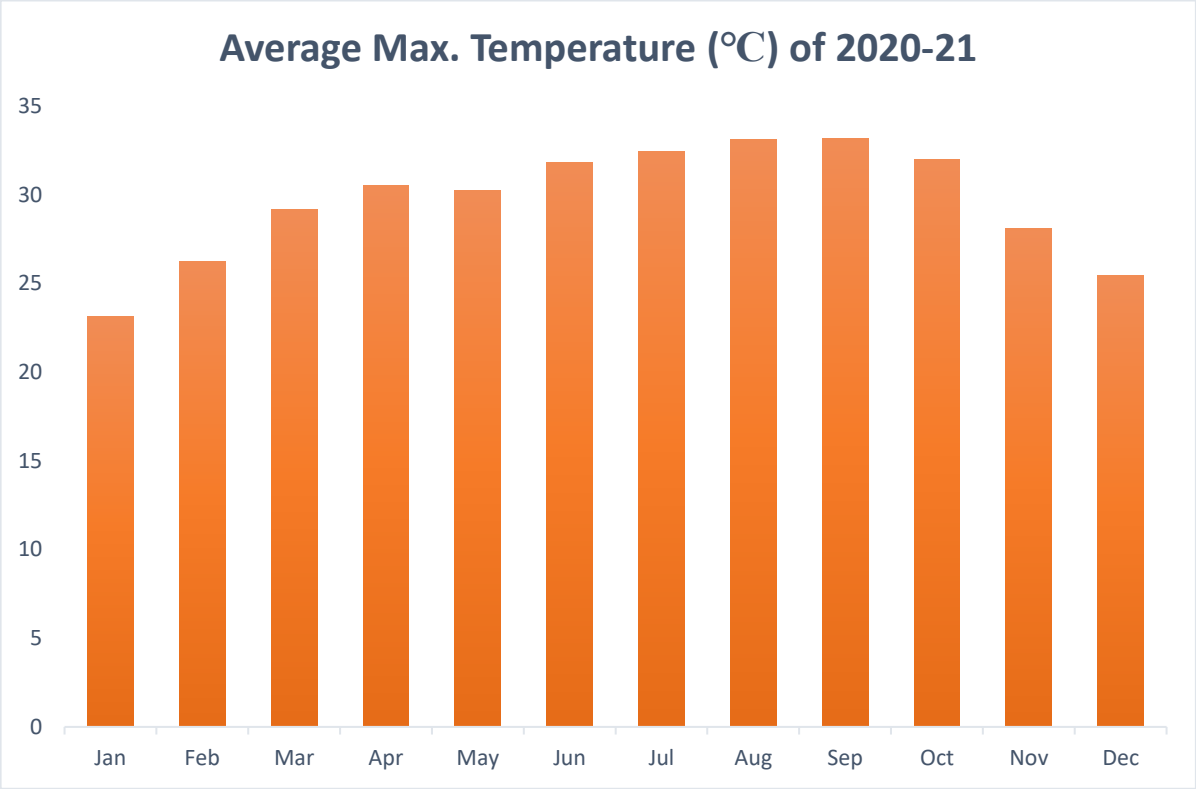


Fig. 3.3. Average Maximum Temperature of 2020-21 of Jorhat District.

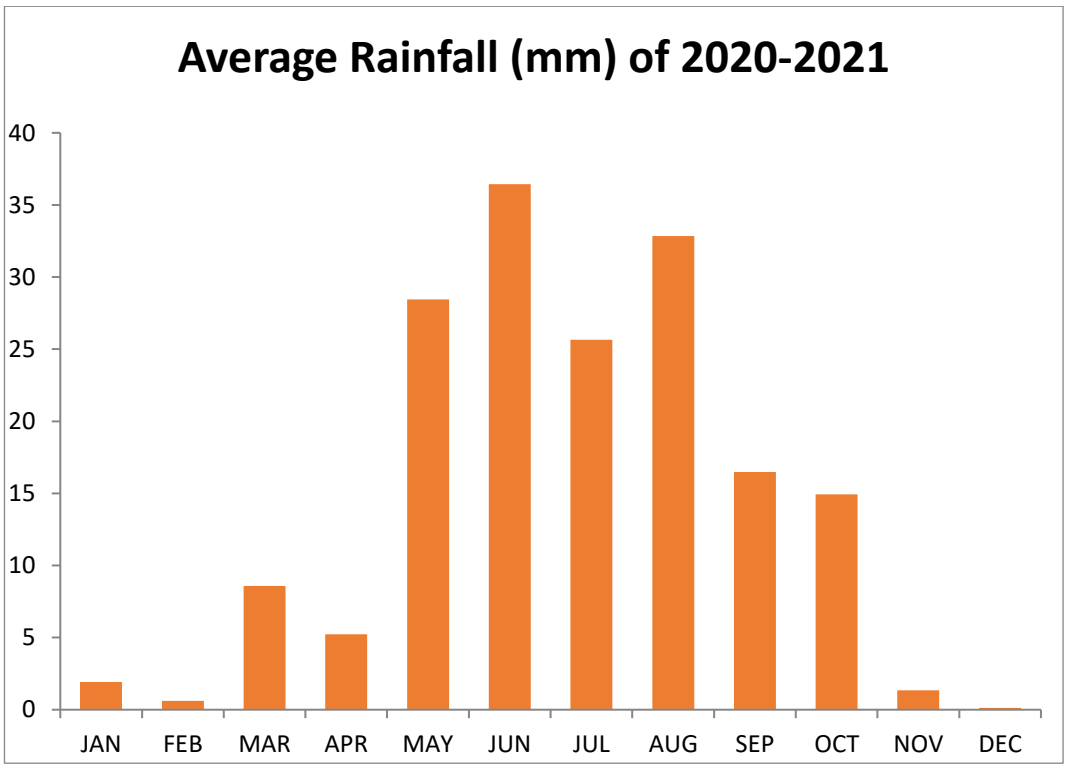


Fig. 3.4. Average Rainfall of 2020-21 of Jorhat

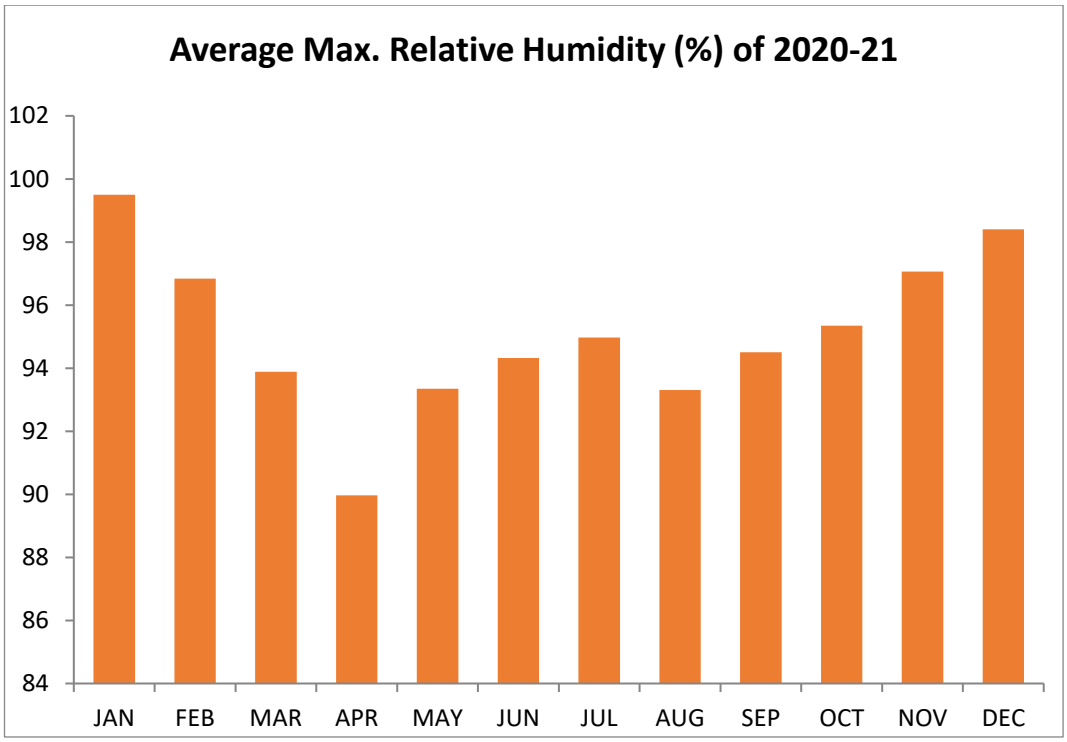


Fig. 3.5. Average Max. Relative Humidity (%) of 2020-21 of Jorhat District

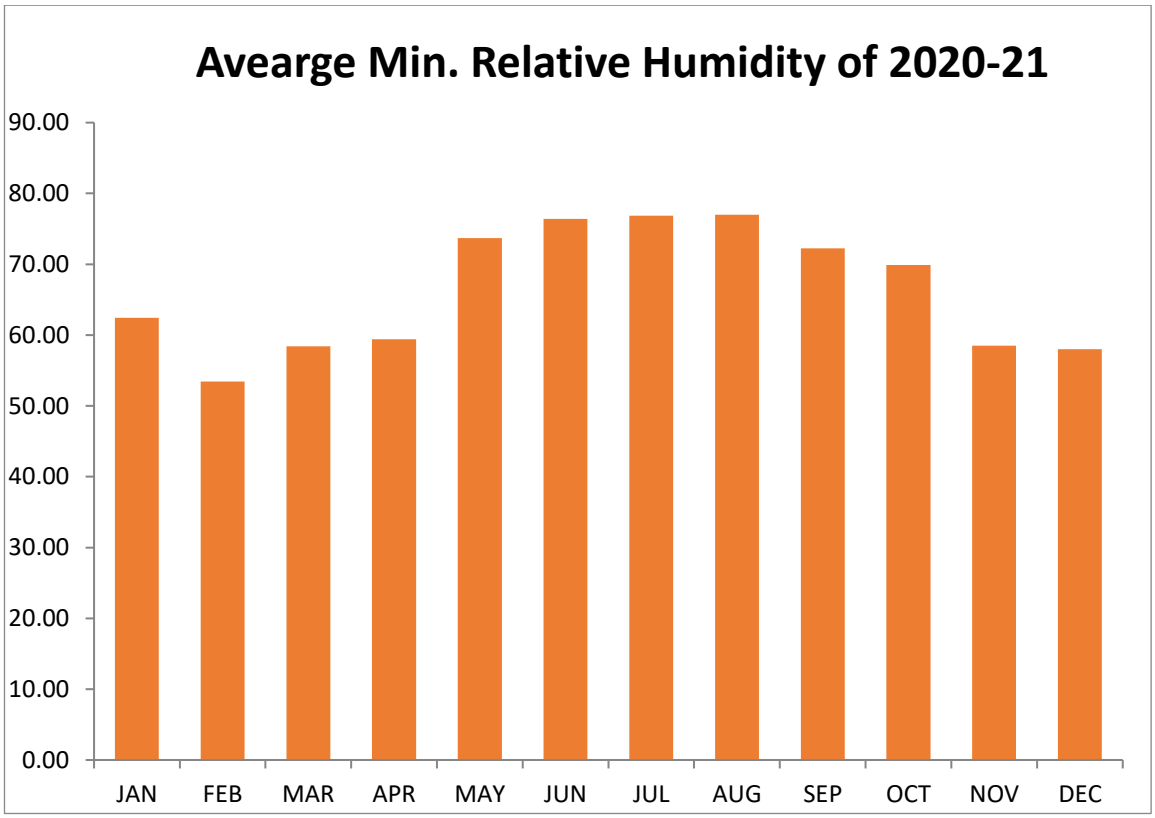


Fig. 3.6 Average Minimum Relative Humidity of 2020-21 of Jorhat district.

(ii) Dibrugarh

Dibrugarh has a subtropical climate; the dry season is warm and mainly clear, while the wet season is oppressively hot and partly cloudy. The average annual temperature ranges between 51°F and 88°F, with lows of 47°F and highs of 94°F being rare. With an average daily high temperature above 85°F, the hot season lasts about 5.3 months, typically from May to October. August is typically the hottest month of the year in Dibrugarh, with an average high of 88°F and low of 78°F. With an average daily high temperature below 75°F, the cool season lasts for approximately 2 months, from December to February. Dibrugarh experiences the coldest weather of the year in January, with average lows of 51°F and highs of 72°F

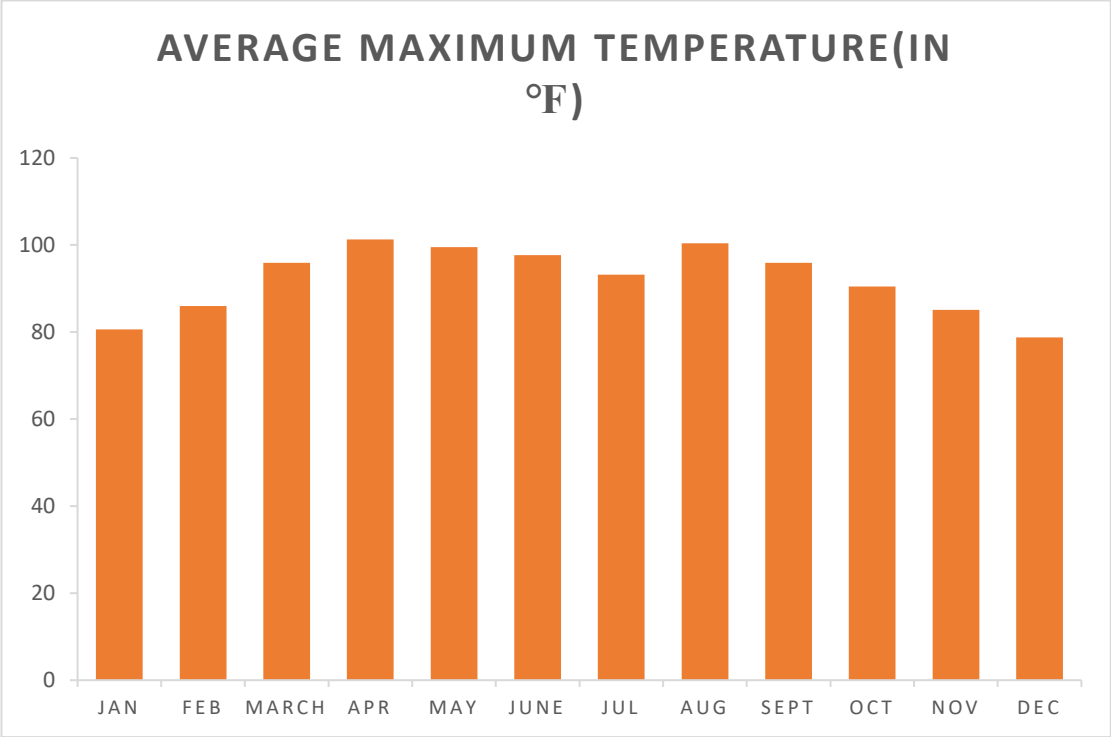


Fig.3.7 Average Maximum Temperature of 2019-20 of Dibrugarh District.

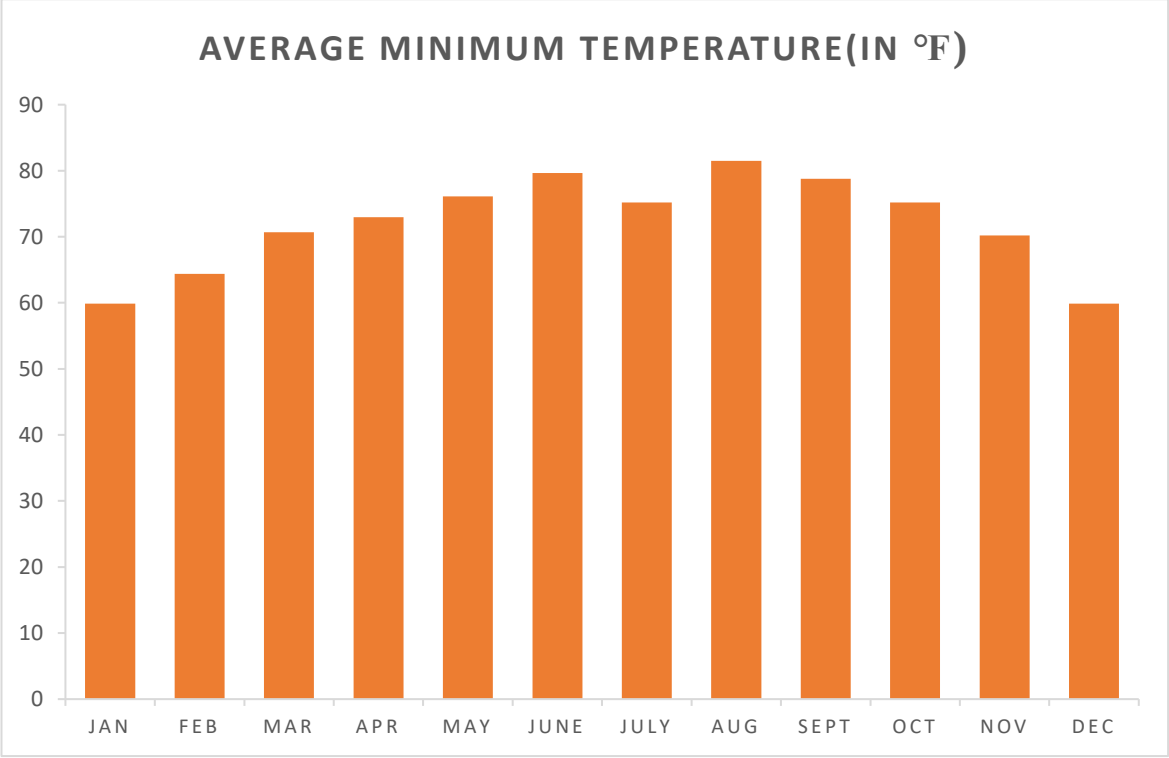


Fig. 3.8 Average Minimum Temperature of 2019-20 of Dibrugarh district.

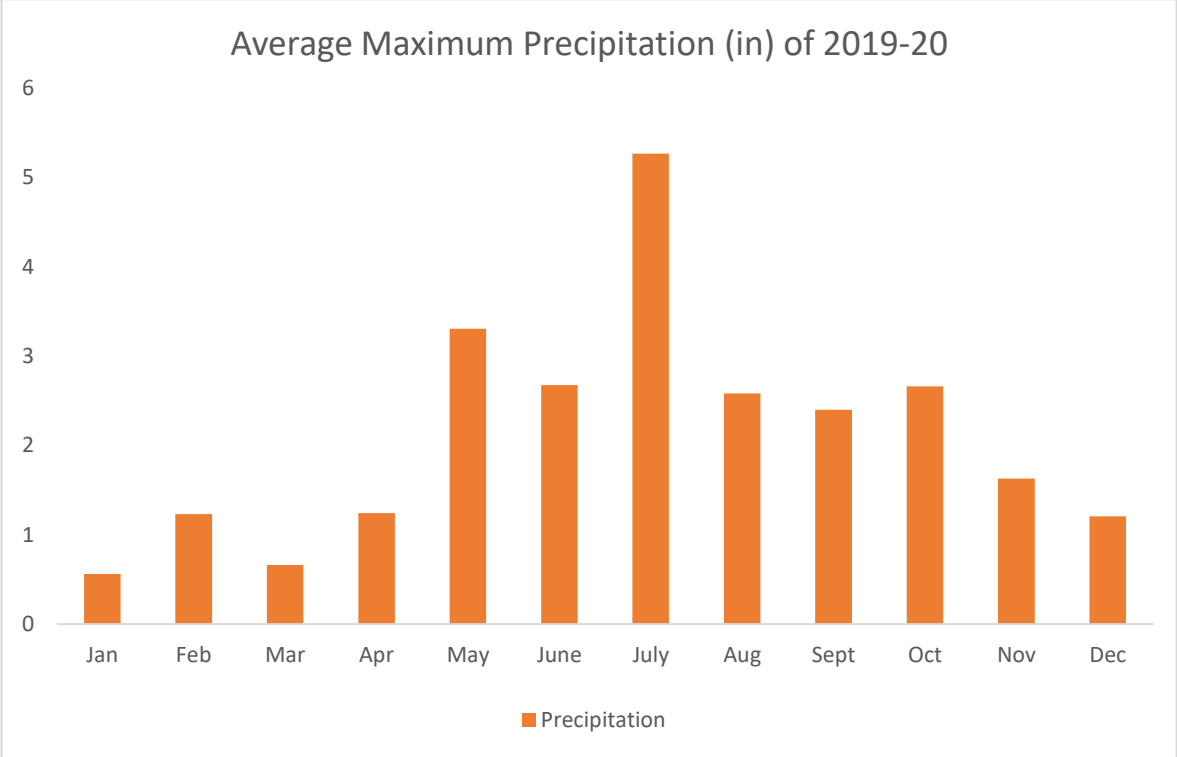


Fig. 3.9 Average Maximum Precipitation of 2019-20 of Dibrugarh district.

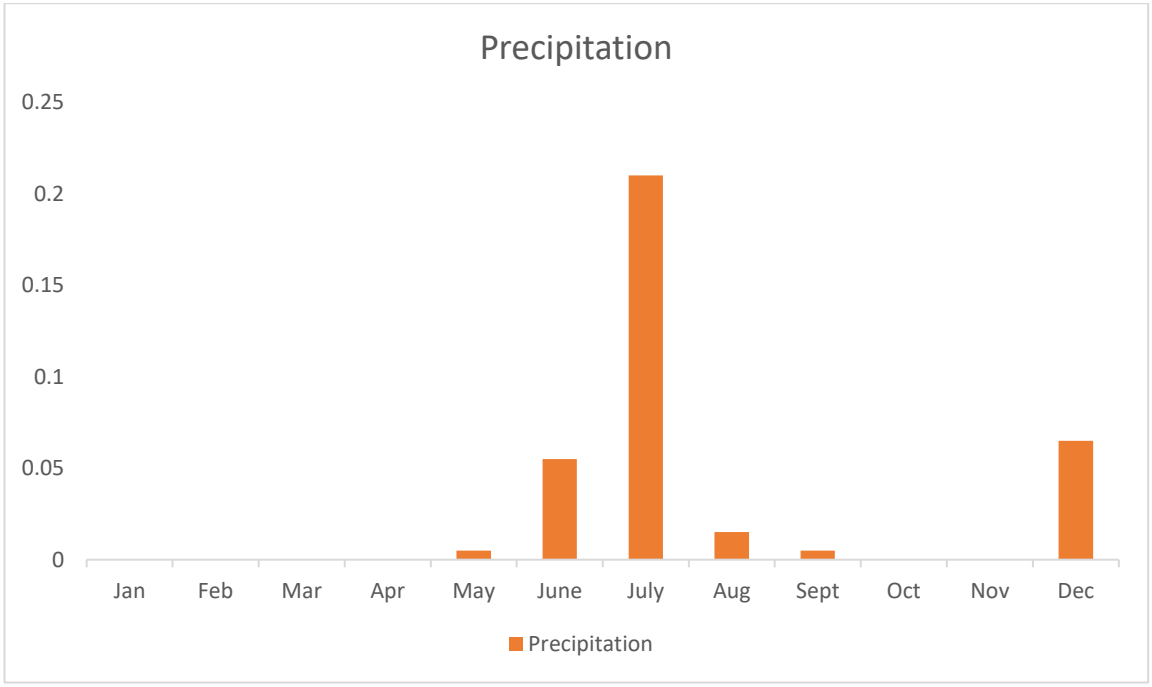


Fig.3.10 Average Minimum Precipitation of 2019-20 of Dibrugarh

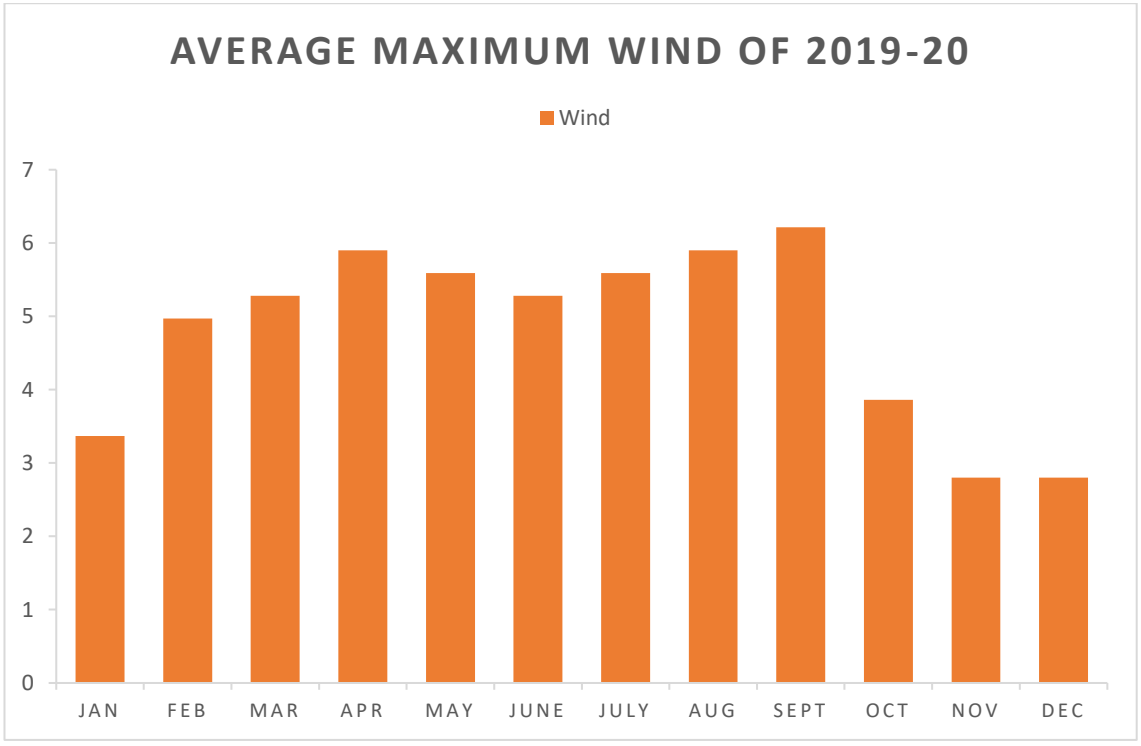


Fig.3.11 Average maximum Wind of 2019-20 of Dibrugarh

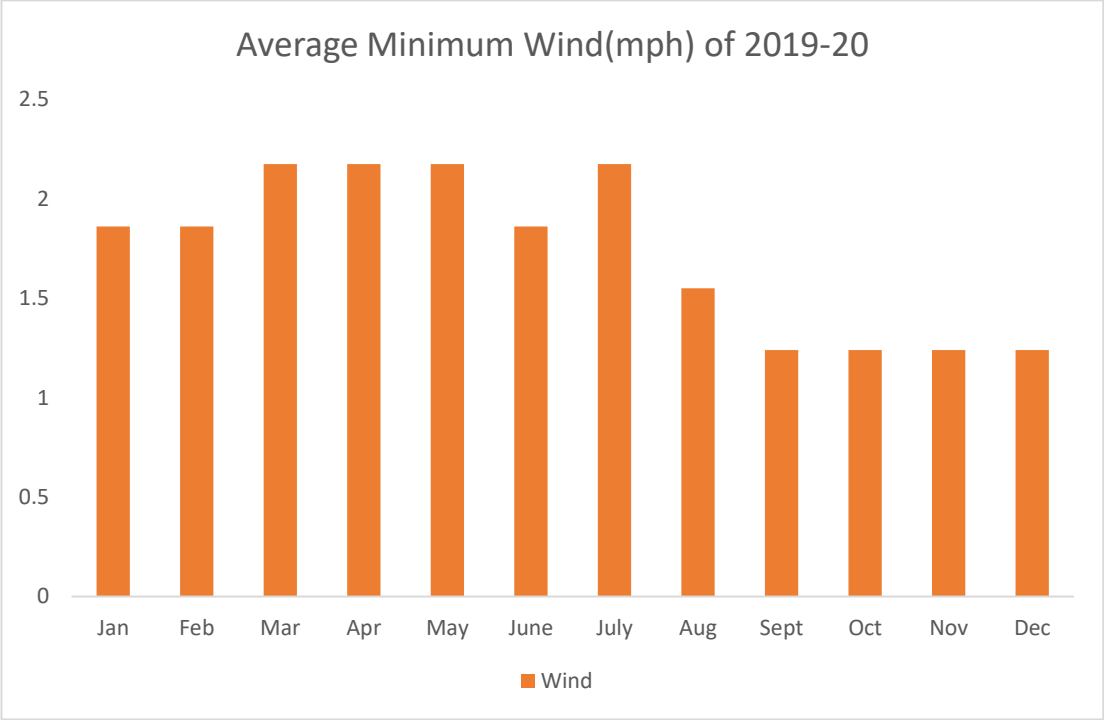


Fig.3.12 Average minimum Wind of 2019-20 of Dibrugarh

3.3 Survey & Collection

- Sporadic collection trips were undertaken to different places of all the seven districts of the study area.
- Forest officials and local people were interviewed to find out the locality of the plants, as well as to generate information about their uses.
- Plant samples were collected both for preparation of herbarium as well as for microscopic study; hence, plant samples were collected at blooming state.
- Information were also collected from reputed herbarium of this region viz. Central National Herbarium, Howrah ("Cal"), Kanjilal Herbarium, Shillong ("ASSAM"), Herbarium of CSIR NEIST, Jorhat and Weed Herbarium, Assam Agricultural University, Jorhat.
- Collected samples were pressed, dried and finally herbarium sheets were prepared by following Standard Herbarium method (Bhattacharya *et al*. 2007). The thick handmade papers available in Jorhat Handmade paper industry were cut into Standard Herbarium sheet size of 42cm X 28cm were used as mounting boards.
- The floral organs are studied under Stereo Zoom Microscope with image analysing software connected to PC.

3.4 Identification

- The species were identified by comparing the characters generated through field and laboratory studies with the Floras and Monographic works.
- Taxonomic authentication of the identity of each taxa were done in the weed herbarium belonging to the Dept. of Agronomy, Assam Agricultural University, Jorhat.

3.5 Compilation

Data recorded *in-situ* at the time of collection as well as data generated during laboratory studies were compiled for each taxon. Illustrations were made by studying the life specimens and with the help of microscopic photographs. The final compilation was made by following the protocols of Assam Science & Technology University.

Results and Discussion

Field survey and herbarium records revealed as many as 8 species of erstwhile Vernonia species in the Upper Brahmaputra Valley Agro-climatic zone of Assam. Study has also revealed that out of explored 8 species, 7 species have undergone nomenclatural changes. The checklist of these species is presented in table-2.

Table 2: Checklist of erstwhile Vernonia species occurred in Upper Brahmaputra Valley Agro-climatic zone of Assam, showing their accepted name, flowering and fruiting time in the study area

SL. No	Accepted Name	Fl. & fr.	Habit	Locality
1	*Acilepis saligna* (DC.)H.Robinson	Aug-May	Perennial herbs, ca 2m tall.	Upper Dehing Reserve Forest,Tinsukia
2	*Acilepis silhetensis* (DC.)H.Robinson,	Aug-Dec.	Perennial herbs or under shrubs, 1-3m tall.	Dilli Reserve Forest, Sivsagar
3	*Baccharoides anthelmintica* (L.) Moench	Aug.-March	Robust annual herb, 50-120cm tall.	Jeypore Rain Forest, Dibrugarh
4	*Cyanthillium cinerium* (L.)H Robinson.	Almost throughout the year.	Annual herb, 20-100cm tall.	Jorhat and Dibrugarh
5	*Decaneuropsis vagans* (DC.) H.Robinson & Skvarla	Sept.-June	Scandent shrubs or liana	Nimati Ghat,Jorhat
6	*Gymnanthemum amygdalinum* (Delile) Sch.Bip. ex Walp	Dec-March	Small shrub 2-5 m in height.	Khanamukh, Sivsagar
7	*Monosis volkameriifolia* (DC.) H.Robinson & Skvarla	Almost throughout the year.	Evergreen small tree, 2-8 m high	Garampani Wildlife Sanctury, Golagaht
8	*Vernonia arborea* Buchanan-Hamilton	Aug.-May	Tree, 5-20m tall	Podumoni Wildlife Sanctury, Tinsukia

4.1. Generic Description :

Herbs, shrubs, sometimes scrambling, or small trees. Leaves alternate, simple. Capitula in terminal panicles, often corymbose, discoid. Involucres oblong or campanulate; phyllaries linear or narrowly ovate in several series, imbricate. Corollas equal, tubular-campaulate,5-toothed,pink or red to dull purple or bluish (colour rarely recorded).Style branches subulate. Receptacle flat, naked or with a few short hairs. Achenes oblong,5-10(-15)-ribbed, terete, tapered at base; pappus deciduous, reddish or dirty white, with inner series of scabrid bristles and incomplete outer series of short bristles or narrow scales.

4.2. Key to the species based on morphological characters:

1.a. Trees or tall shrubs…… (2)

1.b.Scandent shrubs or robust herb……(3)

2.a.Branches reddish brown hairy. Leaves elliptic to oblong.

Cypsela inconspicuously ribbed…….*Vernonia arborea*

2.b. Branches white tomentose. Leaves oblanceolate or obovate.

Cypsela distinctly 10 ribbed……*Monosis volkameriifolia*

(*Vernonia volkameriifolia*)

3.a. Phyllaries acuminate and caspided……. (4)

3.b. Phyllaries usually acute or sometimes sub-acuminate. Leaves variously

ovate or ovate lanceolate ……(5)

4.a. Cypsela pubescent, inconspicuously 10 ribbed, florets 10-15 on each capitulum, lateral veins looped…….*Acilepis saligna* (*Vernonia saligna*)

4.b. Cypsela glabrous very conspicuously 1o ribbed, floret 50-75 in each capitulum.Lateral veins extended to leaf margins…….*Acilepis silhetensis* (*Vernonia silhetensis*)

5.a.Scandent shrub or liana,Capitula 5-10 or hardly 12 flowered……..*Decaneuropsis vagans(Vernonia scandens)*

5.b.Erect herb or shrub,more than 20 flowered……...……..(6)

6.a. Shrubs,1-3 m high,l eaves usually 10-17 cm long, entire, pappus white…….*Gymnenthemum amygdalinum(Vernonia amygdalina*)

6.b.Herbs usually less than 1 m high,leaves shorter than 8 cm, undulate or serrate, pappus fulvous, rarely white……..(7)

7.a. Leaves ovate lanceolate or nearly so, never rhomboid corolla tube, 6-7 mm long, cypsela conspicuously 10 ribbed……*Baccharoides anthelmintica(Vernonia anthelmintica)*

7.b. Leaves, atleast few, rhomboid,corolla tube ca. 3mm long,cypsela ribs inconspicuous……..*Cyanthillium cinerium(Vernonia cinerea)*

4.3 Species Description

Suffrutescent,1-2m; stems ± unbranched except at inflorescence, shortly pubescent. Leaves rather coriaceous, elliptic to narrowly lanceolate,4-11.5 x 0.7.5-3cm, acuminate, narrowed to base, ± sessile, remotely serrulate, finely glandular-punctate, pubescent at least along veins beneath. Inflorescence terminal, paniculate, subcorymbose. Involucre broadly campanulate, 7-10mm diameter; phyllaries ovate to oblong, 3-12 x 1-3mm, acuminate, all ± appressed, pubescent, ciliate. Corollas purplish, 13mm.Achenes 4mm, glabrous; pappus whitish, inner series 8mm,outer series of bristles,1-2mm.

4.4 Genera description after nomenclatural changes:

(i) Decaneuropsis

The genus Decaneuropsis of the Asteraceae, Vernonieae, subtribe Gymnantheminae is recognised as new with the addition of 12 species from

Malaysia and Southeast Asia. *Vernonia cumingiana*, the genus' type species, and 11 other members: Vernonia andamanica, *Vernonia andersonii, Vernonia blanda, Vernonia chingiana, Vernonia craibiana, Vernonia eberhardtii, Vernonia garrettiana, Vernonia gratiosa, Vernonia obovata, Vernonia philippinensis*.The scandent or subscandent habit of Decaneuropsis distinguishes it from the majority of Gymnantheminae. (Robinson & Skvarla,2007)

(ii) Monosis:

Monosis D.C., a South Asian genus, has been revived from synonymy with Vernonia and Gymnanthemum. It has a distinct lophate pollen type as well as leaves with thick petioles, cuneate leaf bases, and spreading secondary veins. The type species, M. wightiana D.C., is included,other six species included in this genus are: M. aplinii, M. parishii, M. shevaroyensis, M. talaumifolia, M. travancorica, and M. volkameriifolia(Robinson & Skvarla,2006)

(iii) Gymnanthemum:

G Cassini established Gymnanthemum in 1817 on the basis of the African G. cupulare Cass. The genus is well-defined, with several generic synonyms in Africa: Decaneurum DC.; Gymnanthemum; Plectreca Rafin., based on Staehelina corymbosa Thunb. ; Keringa Rafin. and Cheliusia Sch.Bip., both based on Gymnanthemum amygdalinum (Del.) Sch.Bip. ex Walp. All of these have smooth involucral bracts with a small to large expanded shield in the distal section, weakly to strongly 10-ribbed achenes, a reduced or absent basal stylar node, a style with pointed sweeping hairs, and distinct, echinate, sublophate pollen(Robinson & Skvarla,2007)

(iv) Baccharoides:

Moench erected the genus Baccharoides in 1794 by transferring Conyza anthelmintica L. to it. It has been completely unknown since then until Robinson revitalised it. According to Punekar and Rao, all Indian species previously classified as Centratherum Cass. and Phyllocephalum Blume should be reclassified as Baccaroides and accordingly they made five combinations viz. *Baccharoides courtallense* (Wight) Punekar and Vasudeva Rao, *Baccharoide indicum* (Less.) Punekar and Vasudeva Rao, *Baccharoide mayurii* (C.E.C.Fisch.)

(v) Acilepis:

With ten identified species, the genus Acilepis D. Don was revived from synonymy under Vernonia. The herbaceous habit, simple hairs on the stems, divided heads, uneven deeply separated cells of the achenes' setulae, almost entirely deciduous pappus, and triporate pollen are all distinguishing features. Many other herbaceous species in Asia identified as *Vernonia* at the time were insufficiently understood to determine their proper placement in relation to Acilepis, including *Vernonia attenuata* DC. and *Vernonia divergens* (Roxb.) Edgew.

(vi) Cyanthillium:

Cyanthillum have an essentially herbaceous habit, herbaceous leaves that are often narrowly petiolate, and involucral bracts that range from being widely to narrowly oval and slightly acuminate, frequently having greenish outer surfaces and purplish borders. Members of the group have different types of T-shaped hairs, according to Jeffrey (1988).

One of the several paleotropical varieties in the *Vernonieae* where the colpus is not obvious is the Cyanthillium pollen type.

4.5 Taxonomic citation

- *Acilepis saligna* (DC.)H.Robinson
- *Acilepis silhetensis* (DC.)H.Robinson,
- *Baccharoides anthelmintica* (L.)Moench
- *Cyanthillium cinerium* (L.)H Robinson
- *Decaneuropsis vagans* (DC.) H.Robinson. & Skvarla
- *Gymnanthemum amygdalinum* (Delile) Sch.Bip. ex Walp.
- *Monosis volkameriifolia* (DC.) H.Robinson. & Skvarla
- *Vernonia arborea* Buchanan-Hamilton.

4.6 Morphological Description of the species:

(a) ***Acilepis saligna*** (DC.)H.Robinson,Proc.Biol.Soc.Washington 112(1):226.1999

Synonym: *Vernonia saligna* DC.,Prodr.5:33.1836;Hook.f.,Fl.Brit.3:235.1881.

Habit :	Perennial herbs, ca 2m tall.
Stem :	Erect; branches inconspicuously ribbed, sericeous or (glandular) pubescent
Leaves :	Alternate, lanceolate or elliptic-lanceolate, 10-15 x 3-6 cm, scabrous with whip-shaped hairs and capitates glands; lateral veins 6-10 pairs.
Margins :	Serrate
Apex :	Acute or acuminate
Base :	Cuneate
Texture :	Sub-coriaceous
Petiole :	ca 0.6cm long
Inflorescence :	Terminal or axillary, panicles.
Capitula :	Campanulate, peduncled, 6-7mm long, pedunculate
Receptacle :	Flat, hairy, 2-2.5mm in diam..
Involucres :	Campanulate, 6-7mm long, 3.5-4.5mm in diam, herbaceous, 5-6 seriate.
Phyllaries :	Light green or purple, lanceolate to oblong-lanceolate, margins piliferous, outer surface arachnoids with capitate glands; outer and mille ones ovate, apex acuminate or cuspidate; inner ones ovate-lanceolate to oblong, apex rounded or apiculate
Floret :	10-15
Corolla :	Funnelform, purple; puberulous-glandular; tube 6-7mm long; lobes 2-3mm long
Anther :	2.5-3mm long, purple, apical appendage acute, base obtuse.
Style:	Purple, 5-7mm long; branches 1.5-2mm long
Cypsela :	Sub-terete, 3-3.5mm long, 10 ribbed, pubescent with twin hairs and capitate glands.
Pappus :	Persistent, in 1 series, reddish or white bristles, 6-7mm long.

Flowering & Fruiting : Oct. to Jan.

Distribution: India: NE India, E. Himalaya, W. Ghats, Karnataka.

Myanmar, Thailand, Laos, China (Yunnan), Nepal, Bhutan, Bangladesh and Vietnam.

Ecology: up to 1400m alt. in Thailand.

Uses:

- The plant is good to cure respiratory tract infections and gynaecological complications(Joyce Jepkorir Kiplimo,2016)
- It has been used by the people of Yi nationality of China, Vietnam and Thailand for the treatment of sore throat, cough, tuberculosis, and uterus prolapsed. (Yue Huang *et al.*2003)

Chemical Constituents:

- Major chemical constituents were investigated by Yue Huang *et al.*2003 which are 8,3-dihydroxy-5, 6, 7, 4-tetramethoxy-flavone (1), together with other five flavonoids including 5, 3-dihydroxy-6, 7, 4-trimethoxy flavone (2),6,7-di-methoxy kaempferol-3--O-glucoside (3), 6-hy-droxy kaempferol-7--O-glucoside (4), quertage-tin-5--O-glucoside (5), luteolin-7--O-glucoside (6) in the chloroform extract of dried leaves of *Vernonia saligna.*
- Moreover the whole plant yielded lupeol palmitate, a glycoside and an acetate α-amyrin, α-amyrin palmitate (α-amyrin , α-amyrin axcetate , friedelin (Joyce Jepkorir Kiplimo,2016)

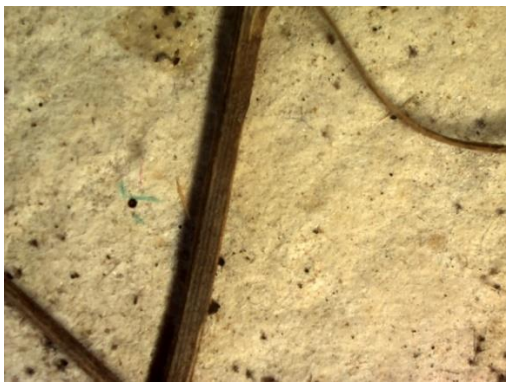
Specimen examined: Ananyaa Khaund 02 ,Upper Dihing Reserve Forest,Tinsukia (15.01.2022)

Pappus

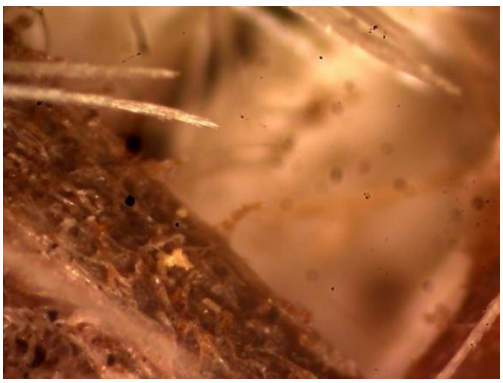
Leaf showing venation pattern

Cypsela

Phyllaries



Stem



Stem hairs

(b) *Acilepis silhetensis* (DC.)H.Robinson,Proc.Biol.Soc.Washington 112(1):227.1999

Synonym: *Vernonia silhetensis* (DC.) Kerr.,Fl.Siam.2:243.1936

Habit : Perennial herbs or undershrubs, 1-3m tall.

Stem : Erect, sparingly branched; branches inconspicuously ribbed, pilose

Leaves : Alternate, elliptic to elliptic-lanceolate or oblanceolate, 7-12 x 2-4 cm, scabrous with whip-shaped hairs and capitates glands; lateral veins 5-10 pairs.

Margin : Remotely serrate

Apex : Acute or acuminate

Base : Attenuate

Texture : Sub-coriaceous

Petiole : 0.5 to 1cm long.

Inflorescence : Terminal, corymbose panicles or solitary

Capitula : Campanulate, peduncled, 15-20mm long.

Receptacle : Flat, hairy, 6-10mm in diam.

Involucres : Campanulate, 11-18mm long, 10-15mm in diam, herbaceous, 6-7 seriate

Phyllaries : Deep purple or green, lanceolate to oblong-lanceolate, apex acuminate, margins piliferous, outer surface arachnoids without glands; outer and mille ones ovate

Floret : 50-75

Corolla : Funnel form, purple; tube 8-12mm long; lobes 3.5-5mm long.

Anther : 3.5-4.5mm long, apical appendage acute, base obtuse.

Style : Purple, 10-12mm long; branches 3.5-4.5mm long

Cypsela : Sub-terete, 4-5mm long, 10 ribbed, glandular

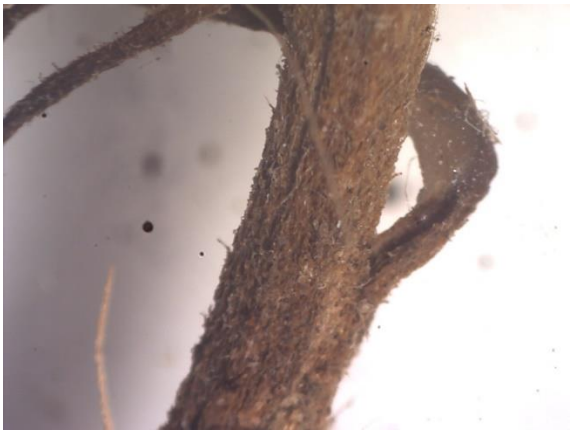
Pappus : Persistent, in 1 series of reddish bristles, 6.5-8mm long

Flowering & Fruiting: Aug.-Dec.

Distribution: India: NE India (Meghalaya, Manipur, Sikkim); West Bengal, Madhya Pradesh.
Bhutan, Bangladesh, Myanmar, Laos, Thailand and China

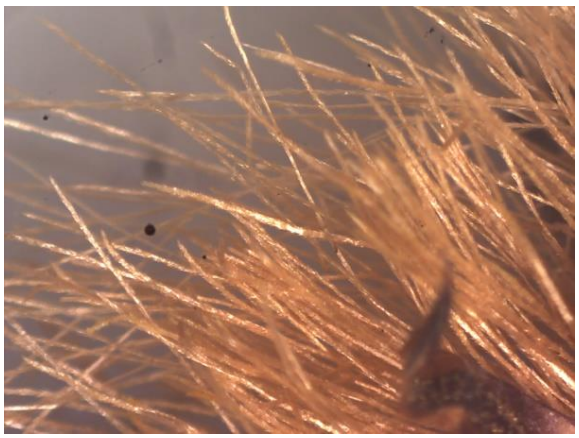
Specimen examined: I.C Barua 4131 (25.11.2007) Dilli Reserve Forest, AAUWH

Phyllaries with Pappus



Stem

Cypsela



Pappus

Leaf showing venation

(c) *Baccharoides anthelmintica* (L.)Moench, 578,1794

Synonym*: Vernonia anthelmintica* (Linn.)Willd.,Sp.Pl.3:1634.1803

Habit : Robust annual herb, 50-120cm tall.

Stem : Erect. Branches conspicuously ribbed, glandular-pubescent.

Leaves : Alternate, ovate-lanceolate, elliptic-lanceolate or oblancerlate, 1.5-4.5 x 1.0-2.5 cm, pubescent with filiform hairs and capitate glands on adaxial surface; lateral veins 8-11 pairs.

Margins : Coarsely serrate

Apex : Acute or acuminate

Base : Attenuate.

Texture : Charteceous

Petiole : 0.5-1.0cm long

Inflorescence : Terminal or axillary, sub-corymbose

Capitula : Many, campanulate , 15-20mm in diam , peduncles 5-15mm long.

Receptacle : Flat or rather concave, areolate.

Involucres : Campanulate or hemispheric, 3(-4) seriate.

Phyllaries : Green, subequal, 10-12mm long; outer ones ovate-lanceolate, sparsely puberulous and glandular, tips leafy and slightly patent; middle ones oblong-linear, acute; inner ones oblong, acute.

Floret : 40-50

Corolla : Funnel form, purple; tube 6-7mm long; lobes 3-5m long, lanceolate.

Anther : Ca 2.5mm long, apical appendage acute.

Style : Purple

Cypsela : Cylindric, black, 4-5mm long, conspicuously 10-ribbed, pubescent and glandular

Pappus : Reddish, in 2 series of bristles, inner series 5-8mm long, rigid, persistent; outer ones 1-2mm long, flattened, shining, deciduous.

Flowering & Fruiting: Aug.-March

Distribution: India: Throughout India, ascending to 1700m in Himalaya.

Uses:

- Afghanistan, Nepal, Sri Lanka, China, Malay Archipelago and Laos. *Vernonia anthelmintica* is used for the management of several disorders related to skin, central nervous system, kidney, gynaecology, gastrointestinal, metabolism, and general health (Dogra *et al.*, 2020)
- *Vernonia anthelmintica* act as a promising source for drug development (Dogra *et al.*, 2020)
- *Vernonia anthelmintica* has been utilized since ancient times for its nutritional and medicinal value (Khokhar *et al*., 1995; Mukherjee *et al*., 2000, ; Muslim and Sikander, 2010; Parekh and Chanda, 2008)
- *Vernonia anthelmintica* has been widely used to treat diabetes, gastrointestinal problems, and skin ailments etc. (Dogra *et al.*, 2020)
- The fruits extract of *Vernonia anthelmintica* L. is used for vitiligo and initially recorded in "Yao Yong Zong Ku" around 300 years ago. (Tian G. *et al.* 2004)
- The chalcone compounds of the plant play an important role in the treatment since they may activate tyrosinase and improve melanin production (Tian G. *et al.* 2004)
- According to Ayurveda, seeds are hot, acrid, astringent, anthelmintic; cure ulcers, used in treatment of vata and kapha (Manvar *et al*. 2012)
- According to Unani system of medicine, the seeds are anthelmintic, purg ative; used for asthma, kidney troubles, hiccough, inflammatory swellings , to remove blood from the liver, sores and itching of the eyes (Manvar *et al*. 2012)
- The powdered seeds are applied externally in paralysis of the legs at Mundas of Chota Nagpur(Manvar *et al*. 2012)
- The juice of the leaf is given to cure phlegmatic discharges from the nostrils(Manvar *et al*. 2012)
- The seeds of *V. anthelmintica* exhibited suppression of Rh-incompatibility of female during pregnancy (Manvar *et al*. 2012)

- The seeds of *Vernonia anthelmintica* is used as a potent wormicidal agent (Jahan *et al*. 2014)
- Leaves and fruits of Vernonia anthelmintica have been reported to have larvicidal properties against malaria vector.(Hellert *et al*.,2015)

Chemical Constituents

- Phytochemical studies have revealed that *V. anthelmintica* contains fatty acids, steroids, flavonoids, sesquiterpene lactones, carbohydrates, and terpenes (Paydar *et al*., 2013; Srivastava *et al*., 2014)
- Phytochemical studies of *V. anthelmintica* have revealed the presence of 193 chemical constituents, including phenolic acids (11), chalcones (6), flavonoids (33), terpenes (42), fatty acids (33), steroids (48) and miscellaneous (20) compounds. (Fatima et al., 2013; Huo et al., 2010; Sanyal et al., 1970)
- Achenes of *Vernonia anthelmintica* contain fixed oil (18.89%), brassicasterol, stigmasterol, resin (2%), myristic acid (7.4), palmitic acid (7%), stearic acid (5.9%), oleic acid (5.7%), linoleic acid (9.6%), vernolic (epoxyoleic) acid (62.4%) and methyl vernolate)(Desai. T.R *et al*. 2012)
- Leaf of *Vernonia anthelmintica* contains abscisic acid, centratherin and germacranolides were isolated from the leaves and stem(Desai. T.R *et al*. 2012)
- The highly oxygenated stigmastane-type steroids vernoanthelcin A–I; stigmastane-type steroidal glycosides vernoantheloside A and B were isolated from the aerial parts of *V. anthelmintica* (Desai. T.R *et al*. 2012)
- Methanol extract (75%) of *Vernonia anthelmintica* was found to be potent inhibitors of lipid peroxide formation and scavengers of hydroxyl and superoxide radicals invitro (Desai. T.R *et al*. 2012)

- The chloroform fraction of *Vernonia anthelmintica* demonstrated significant antioxidant activity with DPPH (1 , 1-Diphenyl-2-
  picrylhydrazyl), ORAC (oxygen radical absorbance capacity), and FR AP (Ferric Reducing/Antioxidant Power) (Desai. T.R *et al*. 2012)
- Jahan *et al*.(2010) studied the medicinal plants of Pakisthan and found that *Vernonia anthelmintica* seeds' methanol extract was tested against strains of the bacteria *Pseudomonas aeruginosa, Yersinia aldovae, Citrobacter, Shigella flexneri, Escherichia coli,* and *Staphylococcus aureus*. Saccharomyces cerevisiae, *Candida albicans, Aspergillus parasiticus, Macrophomina, Fusarium solani, Trichophyton rubrum*, and *Trichophyton occidentalis* were also tested for antifungal activity. Except for *Yersinia aldovae,* the extracts demonstrated antibacterial activity against all strains tested. The antifungal assay, on the other hand, revealed only inhibitory activity against the dermatophyte *Trichophyton rubrum* in their investigation.

Specimens examined: I.C. Barua 4139 (25-11-2007) Joypore Reserve Forest (AAUWH)

Fig. Phyllaries and pappus

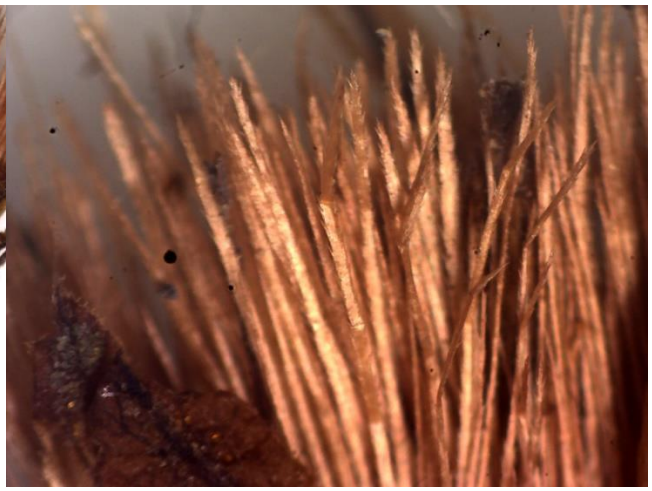


Fig. Pappus

Stem

Pappus hairs

(d) *Cyanthillium cinerium* (L.) H Rob.,Proc.Biol.Soc.Wash 103 252 1990

Synonym : Vernonia cinerea

(Linn.)Less.Linnaea.4:291.1829;Hook.f.,Fl.Brit.India.3:233.1881;Uniyal in Hajra *et al.*, Flora of India13:367,1995.

Habit : Annual herb, 20-100cm tall.

Stem : Erect; young branches conspicuously ribbed, sericeous, fulvous pubescent to grayish pubescent, glandular.

Leaves : Alternate, lanceolate or ovate to broadly ovate, 3-8 x 2-5 cm; upper surface sericeous, without gland; lower surface fulvous-puberulous to villous or sericeous with cylindrical hairs, T-shaped hairs and capitate glands; lateral veins 5-7 pairs.

Margins: Undulate to repent -serrate or almost entire.

Apex : Acute to acuminate or obtuse.

Base : Attenuate

Texture : Charteceous

Petiole : 0.5 to 2cm long.

Inflorescence : Terminal or axillary, corymbose panicles.

Capitula : Campanulate, peduncled, 5-6 mm long.

Receptacle : Flat, glabrous, 2.0-2.5 mm in diam.

Involucres : Campanulate, 4.0-4.5 mm long, 2-3 mm in diam. , 3-4 seriate

Phyllaries : Green with purple apex, sericeous, glandular, lanceolate to ovate-lanceolate, apex acute to acuminate, margins piliferous.

Florets : 18-20 (-30)

Corolla : Funnel form, puberulous -glandular, purple to white; tube 3.0-3.5 mm long; lobes ca 1 mm long.

Anther: ca. 0.6mm long, apical appendage acute, base obtuse.

Style: Purple, ca. 3mm long; branches ca. 0.5mm long.

Cypsela: Clavate-terete, 1.5-1.8 mm long, ribs inconspicuous, covered with dense silky twin hairs and capitates glands

Pappus: Persistent, in 2 series of white or fulvous bristles, inner series 3.0-3.5mm long, outer ones shorter.

Flowering & Fruiting : Throughout the year

Distribution: Throughout tropics and subtropics

Uses:

- *Vernonia cinerea* (Asteraceae) is traditionally used to treat inflammation, diarrhoea, cough, smoking cessation, asthma, Parkinson's disease and leprosy.(Singh *et al*.2014)
- The plant has immunmodulatory and nephroprotective actions[Bhandari *et al*.(2014)]
- The leaves are useful in the treatment of conjunctivitis and tumours[Singh *et al*.(2014)]
- The seeds are useful in alleviation of worm infestation, psoriasis and leukoderma (Bhandari *et al*.2014)
- The plant is used for the treatment of intermittent fever, filariasis, blisters, boils and vaginal discharges (Mubo A Sonibare *et al*. 2016)
- Young leaves of the plant are used for the treatment of tonsillitis (Mubo A Sonibare *et al*. 2016)
- Jain and Puri (1984) discussed that *Vernonia cinerea* is a herbaceous species that has been used ethno pharmacologically in South America, Africa, and Asia to cure many diseases and ailments such as malaria.
- Alara *et al*.(2008) in their study examined the effects of the Soxhlet extraction factors of time, feed-to-solvent ratio, and ethanol concentration were examined in relation to the recoveries of extract, TPC, and TFC from *Vernonia cinerea* leaves and concluded that the leaves of *Vernonia cinerea* exhibit strong antioxidant activity in relation to ascorbic acid. Therefore, the *Vernonia cinerea* leaf extract has the potential to be used as a natural antioxidant.

- Latha *et al*. (2009) in their study discovered that *Vernonia cinerea* has no apparent toxicity and can be used as an antimicrobial agent in known dosages, particularly in rural communities where conventional drugs are either too expensive or unavailable.
- Leelarungrayub *et al*.(2010) study showed that *Vernonia cinerea* supplementation can be used to lower the smoking rate. The effects of *Vernonia cinerea* supplementation and exercise on oxidative stress and end release are relevant to smoking cessation. Oxidative stress levels may be linked to the decline in smoking rates. Exercise and *Vernonia cinerea* supplementation both have the potential to treat nicotine addiction.
- Latha *et al*., (2011)conducted a study and found the effectiveness of methanol extracts of aerial parts of *Vernonia cinerea* against Pseudomonas aeruginosa, a common opportunistic pathogen in hospital infections, was examined. The methods of disc diffusion and broth dilution were employed. Against the studied pathogen, the extract exhibited dose-dependent antibiotic activity.
- Haque *et al*.(2012) in their study discussed that phytochemical screening of the plant extract of *V.cinerea* revealed the presence of several bioactive compounds such as glycosides, triterpinoids, and esters, which may be responsible for the plant's versatile medicinal properties. In the n-hexane portion, NMR data revealed the presence of Lupeol, 12-oleanen-3-ol-3ß-acetate, Stigmasterol, and ß-sitosterol.
- Gaikwad *et al. (*2012) in their study concluded that Triterpenes such -amyrin, -amyrin, and lupeol were found in extracts of the aerial portions of *Vernonia cinerea*, according to studies on their chemical makeup.
- Dogra & Kumar (2014) found that *Vernonia cinerea* has a wide range of biological activities; nevertheless, traditional claims such as the use of the plant in the treatment of ailments like psychoneurosis, menstruation, elephantiasis, haematological, eye, and skin disorders etc.
- Lakshmi Prabha (2015)in her study discussed that the plant *Vernonia cinerea* possesses properties that include antioxidant, antitumor, antibacterial, antimicrobial, anti-anthelmintic, and anti-hyperglycaemic .

Chemical Constituents

- Vernonia cinerea contains vernolide-A and vernolide-B (two novel sesquiterpene lactones); β-amyrin, lupeol and their acetates; and β-

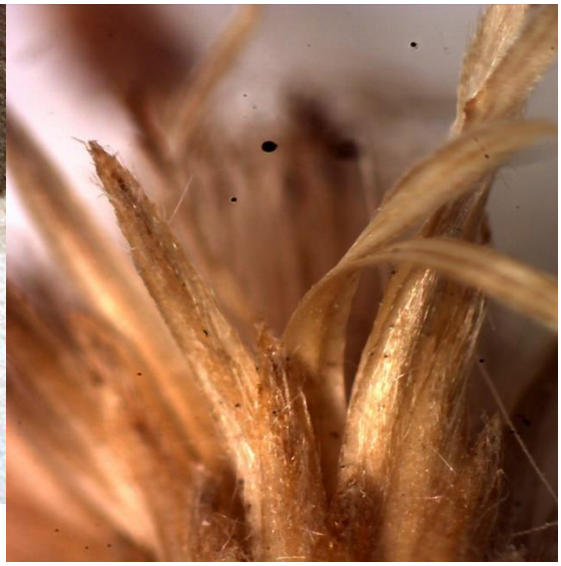
sitosterol, stigmasterol, α-spinasterol and phenolic resin in the whole plant(Singh *et al*. 2014

Specimen examined: Ananyaa Khaund 06 (25-05-2022) ,Jorhat; Ananyaa Khaund 10, Dibrugarh (28-05-2022),

Phyllaries with pappus

Cypsela

Leaf showing foliar venation



Pappus hair

Stem

Attachment of leaf to the stem

(e) Decaneuropsis vagans* (DC.) H.Rob. & Skvarla *Proc. Biol. Soc. Wash. 120(3): 365. 2007

Synonym: Vernonia vagans Wall. Ex. DC.,Prodr. 5:32,1836.

Habit : Scandent shrubs or liana,

Stem : Slender and climbing. Bark thin, yellowish. Young branches terete, minutely grooved, brownish pubescent

Leaves : Alternate, elliptic-obovate or ovate-lanceolate, 10-18 x 5-8 cm, glabrous above, sparsely pubescent beneath, glandular on both the surfaces. Lateral nerves 5-6 pairs

Margins : Entire

Apex : Acute or acuminate

Base : Long attenuate to cuneate.

Texture : Charteceous

Petiole : Slender, 2-5mm long.

Inflorescence : Terminal, paniculate

Capitula : Numerous, campanulate, peduncled, 9-10mm long

Receptacles : Flat, 1.5-2mm in diam., glabrous.

Involucres : Narrowly campanulate or slightly oblong-cylindrical, 3-4mm in diam., many seriate.

Phyllaries : Ovate to linear-lanceolate, 1-7.5 x 1-3mm, acute or obtuse, scarious, glandular pubescent on upper parts, short ciliate on margins; outer ones ovate-acute; inner ones ca. 6mm long

Floret : 5-10(-12)

Corolla : Funnel form, purple, glandular; lobes 5,

Anther : 3-3.5mm long, apical appendage acute, base acute

Style : Purple, 5-7mm long, branches 2, 3-4mm long

Cypsela : Glabrous, 10 ribbed, ca. 7mm long

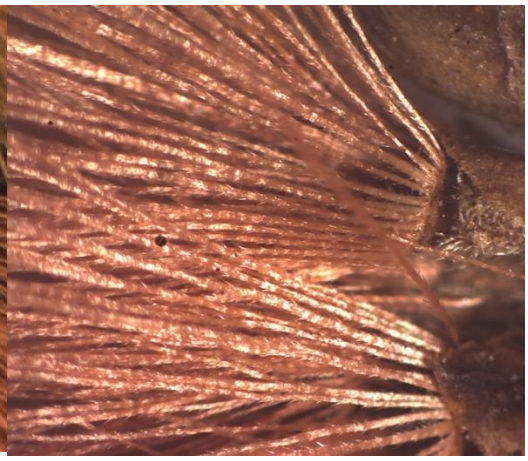
Pappus : Reddish, inner series ca. 7mm long; outer shorter.

Flowering & Fruiting: Sept.-June.

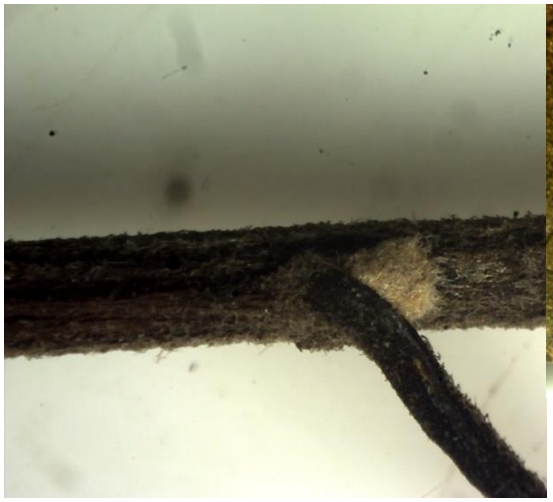
Distribution*:* India: E. Himalaya, NE India (Sikkim, Arunachal Pradesh, Assam and Meghalaya, West Bengal.Bhutan, Bangladesh, Myanmar, Indo-china, Thailand, Vietnam and China.

Specimen examined: I.C. Barua 4089 (13-12-2005) Nimati Ghat, Jorhat (AAUWH)

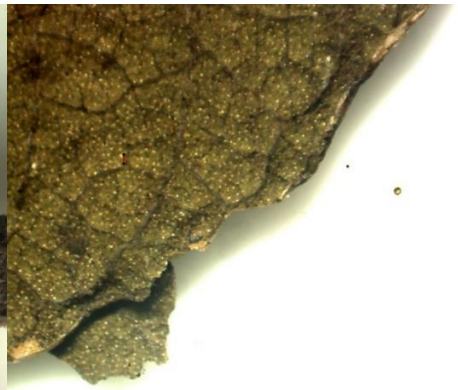
Phyllaries and Pappus



Pappus

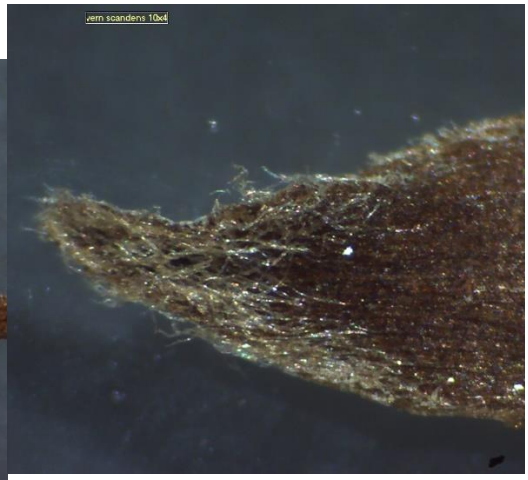


Stem



Leaf margin with venation

Cypsela



Pappus hairs

***(f)Gymnanthemum amygdalinum* (Delile) Sch.Bip. ex Walp. in Repert. Bot. Syst. (Walpers) 2:948.1843**

Synonym: Vernonia amygdalina Delile, Cent. Pl. Afr. Voy. Meroe:41.1826 Bhattacharjee *et al*. Zoo's Print,28(5):19.2013

Habit : Shrubs, 1.5-3m high.

Stem : Moderate to densely branched, terete with solid pith, sometimes angular above, striate, almost glabrous below and puberulous above.

Leaves : Alternate, highly variable in shape and size, lanceolate-oblanceolate, some ovate.

Inflorescence : Terminal, densely corymbiform with small bracteoles of 0.1 cm 0.2 cm long, with short peduncle.

Capitula : 11-35 flowered, campanulate 0.2-0.5 cm wide, on pedicles 0.2-0.5 cm long, small creamy white.

Involucre : Involucre with 25-30 phyllaries in 4-5 gradate series.

Phyllaries : Ovate-elliptic or oblong-obtuse or subacute, 0.4-0.6 cm long, coriaceous to subcoreaceous, pale green with darker spots near tip, glabrous or ciliolate.

Corolla : Gradually narrowed below, throat very deeply cut, lobes with glands or spicules on outer surface, white.

Androecium : 4.5-5 mm long, with 5 epipetalous stamens, syngenecious, anther linear to linear-lanceolate

Gynoecium : 11-14.5 mm long, ovary oblong-elliptic, 2-2.5x0.5-0.9 mm; style 8-9.5 mm long with 2 coiled or decurved style branches at apex and a small basal node at base with stout pointed sweeping hairs on branches.

Cypsela : Oblong-elliptic, 3-4x0.5-1mm,with minute glands and bristly hairs.

Pappus : Persistent capillary bristles with broadened tips, sub uniseriate

Fl. & Fr.: December-March

Distribution:

Africa,Yemen,Ethiopa,Uganda,Kenya,Brazil,India,Zimbabwe,Mauritiana,Angola, Benin,Senegal

India: Madhya Pradesh,Odisha,West Bengal,Assam

Uses:

- The organic fraction extracts of the plant is shown to possess cytotoxic effects towards human carcinoma cells of the nasopharynx (Forambi and Owoeye,2011).
- It is effective against amoebic dysentery, gastrointestinal disorders,and has antimicrobial and ant parasitic activities (Forambi and Owoeye,2011).
- The seed, commonly known as bitter kola, is a masticatory and is a major kola substitute offered to guests at home and shared at social ceremonies(Forambi and Owoeye,2011).
- The seeds are used in folk medicine and in many herbal preparations for the treatment of ailments such as laryngitis, liver disorders, and bronchitis (Forambi and Owoeye,2011).
- The leaves are used as green leafy vegetable and may be consumed eitheras a vegetable (leaves are macerated in soups) or aqueous extracts used as tonics for the treatment of various illnesses (Forambi and Owoeye,2011).
- Many herbalists and native doctors in Africa recommend its aqueous extracts for their patients as treatment for varieties of ailments ranging from emesis, nau-sea, diabetes, loss of appetite, dysentery and other gastrointestinal tract problems to sexually trans-mitted diseases and diabetes mellitus among others (Forambi and Owoeye,2011).
- The leaves can be taken as an appetizer and the water extract as a digestive tonic (Forambi and Owoeye,2011).
- In Cameroon the processed leaves are cooked with meat and/or prawns mixed with ground peanuts to make a famous dish called ‘ndole’(Joshi *et al*. 2019)

- Leaf decoctions are used to treat fever, malaria, diarrhoea, dysentery, hepatitis and cough, as alaxative and as a fertility inducer (Joshi *et al*. 2019)
- They are also used as a medicine for scabies, headache and stomach-ache (Joshi *et al*. 2019)
- Root extracts are also used as treatment against malaria and gastrointestinal disorders (Joshi *et al*. 2019)
- Otshudi *et al*.(1999) found that *V. amygdalina* had antimicrobial activity against all tested microorganisms with the exception of *Serratia marcescens, Escherichia coli,* and *Candida albicans*.
- Hamill *et al*., (2000). in their study also discussed the widespread use of *Vernonia amygdalina* as a medicine in African nations to treat gastrointestinal disorders, fever, helminth infections, and malaria.
- Kambizi and Afolayan (2001)discussed the antibacterial efficacy of solvent extracts of the aerial portions of *Vernonia amygdalina* against gram-positive and gram-negative bacteria examined in several investigations utilising methanol, ethanol, and water methanol and acetone.
- Akinpelu(1999) and Suleiman *et al*., (2008) found that *Vernonia amygdalina* have antifungal activity against Candida albicans, as well as fungi of the genus Fusarium, which cause superficial and systemic human infections, as well as food contamination due to mycotoxins produced respectively.
- Oboh and Masodje(2009) in their study analyzed the protein, ash, mineral, and antibacterial characteristics of *Vernonia amygdalina* leaves. Fresh *Vernonia amygdalina* leaves exhibited a high water content, a low protein and ash content, and a moderate amount of phosphorus and noticeable amounts of the other substances . Phosphorus, selenium, iron, and zinc appear to make just a small contribution to the RDAs of the elements investigated *Staphylococcus aureus* and *Escherichia coli* growth was prevented by the leaves' cold aqueous extract.

Specimen examined: Ananyaa Khaund 08 (20.08.2022) Khanamukh, Sivsagar (AAUWH)

(g) Monosis volkameriifolia* (DC.) H.Rob. & Skvarla *Proc. Biol. Soc. Wash. 119(4): 606. 2006.

Synonym: Vernonia volkamerifolia DCandolle, *Prodr. (DC.) 5: 32 32 1836*; Hook.f., Fl. Brit. India 3:240. 1881; Uniyal in Hajra *et al*., Flora of India 13:393. 1995

Habit : Evergreen small tree, 2-8 m high

Stem : Erect, bark grey. Young branches inconspicuously ribbed, white tomentose

Leaves : Alternate, oblanceolate or obovate, 10-50 x 5-20 cm, glabrous above, sparsely pubescent beneath.

Margins : Undulate to irregularly serrate

Apex : Acute (or acuminate)

Base : Long attenuate to cuneate

Texture : More or less coriaceous.

Petiole : 0.5-2.5cm long

Inflorescence : Terminal, thyrsoid-paniculate

Capitula : Numerous, campanulate, shortly peduncled of sub-sessile, 9-10mm long

Receptacle : Flat, 1.5-2mm in diam., glabrous

Involucres : Narrowly campanulate or slightly oblong-cylindrical, 3-4mm in diam, 4-5 seriate.

Phyllaries : Ovate to oblong, 1-7.5 x 1-3mm, rounded or sub-acute, sparsely pubescent; middle ones ovate=acute; inner ones ovate or lanceolate, acute.

Floret : 4-6(-8)

Corolla : Funnel form, 10-12mm, glandular; lobes 5, smooth or papillose at apex, (White to-) mauve

Anther : 3-3.5mm long, apical appendage acute, base acute

Style : Purple, 5-7mm long, branches 2, 3-4mm long

Cypsela : Oblong-turbinate, 3.5-6.5mm, 10 ribbed, covered with dense twin hairs and capitates glands.

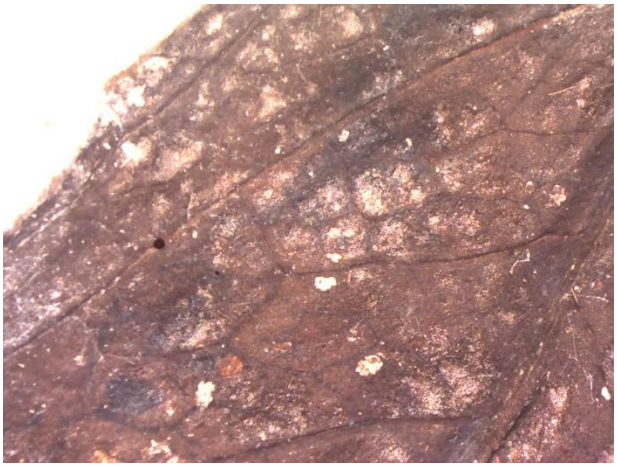
Pappus : Whitish, inner series 7-10mm at maturity, outer shorter, mostly 1-3mm.

Flowering & Fruiting : Almost throughout the year.

Distribution: India: E. Himalaya, NE India (Sikkim, Arunachal Pradesh, Assam and Meghalaya, up to 1400m alt.), West Bengal,Bhutan, Bangladesh, Myanmar, Indo-china, Thailand, Vietnam and China.

Specimen examined: I.C. Barua 4069 (18-12-2004) Garampani Reserve Forest, Golaghat.

Pappus and Phyllaries



Leaf showing venation

Pappus

Hairy stem

***(h) Vernonia arborea* Buch-Ham, Trans. Linn. Soc. London 14:218, 1824: Hook.f., Fl. Brit. India. 3:239, 1881; Uniyal in Hajra et al., Flora of India 13:359, 1995**

Synonym: *Gymnanthemum arboreum* Buch.-Ham. In Trans.Linn. Soc. London 14:218. 1825; Hook. f.,Fl. Brit. Ind. 3:239. 1881.

Habit: Tree, 5-20m tall.

Stem: Young branches inconspicuously ribbed, ferruginous pubescent.

Leaves: Alternate, elliptic to oblong, 8-20 x 4-10 cm, puberulous with filiform hairs and capitate glands; lateral veins 10-15 pairs.

Margins: Entire

Apex: Acuminate or caudate

Base: Cuneate or oblique.

Texture: Coriaceous.

Petiole: 0.5-3.0cm long

Inflorescence : Terminal or axillary, thyrsoid-paniculate

Capitula: Narrowly campanulate, shortly peduncled.

Receptacle: Flat, glabrous.

Involucres: Narrowly campanulate or slightly oblong-cylindrical, 2-3mm long, 3-4 seriate.

Phyllaries: Green or purple, sparsely puberulous without gland, apex obtuse, margins piliferous; outer ones ovate; inner ones ovate-lanceolate or oblong.

Floret: 3-6.

Corolla: Funnelform, glandular; tube 6-7mm long; lobes ca 2mm long, purple to white.

Anther: Ca 2.5mm long, apical appendage acute.

Style: Purple.

Cypsela : Turbinate, ca 2mm long, 3-4 angled, inconspicuously ribbed, covered with dense twin hairs and capitates glands.

Pappus: Persistent, in 2 series of bristles, inner series 6-7mm long, outer ones shorter.

Pollen: Sub achinolophate, 3-colporate, with micropancta.

Flowering & Fruiting: July to February / Sept.-March

Distribution: India: Assam, Nagaland, Manipur, Meghalaya, Karnataka, Tamil Nadu, Kerala, Andaman's.

Pakistan, Nepal, Bangladesh, Myanmar, Thailand, Sri Lanka, China, Malay Archipelago, New Guinea and Philippines.

Uses:

- The plant has many medicinal properties *viz*., leaf juice is used to treat worms, infusion of roots or decoction of bark in fever. (BK Manjunatha *et al*. 2005)
- In Southern Sumatra, the bark is chewed at the first sign of sprue(BK Manjunatha *et al*. 2005)
- It is chewed as a substitute for pan by Nagas. (BK Manjunatha *et al*. 2005)
- This plant contains sesquiterpene 'zaluzanin D', which is a potent antifungal agent (BK Manjunatha *et al.* 2005)
- Two types of drug formulations were prepared from each of the extracts. For topical administration, 5% w/w ointment was prepared in 2% sodium alginate. For oral administration, 30 mg/ml of aqueous and methanol suspensions of leaf extracts were prepared in 1% gum tragacanth. (BK Manjunatha *et al*. 2005)
- Pradhan *et al.*(2009) found that the wound healing capacity of *Vernonia arborea* may be credited to the phyto constituents present in it, which may be due to their individual or additive effect that speeds up the healing process. They also suggested for further studies in which the methanol extract would be subjected to further formation and purification in order to identify and isolate the active compounds responsible for pharmacological activities.

Discussion

The study has enumerated as many as 8 numbers of species belonging to the erstwhile genus *Vernonia* of the family Asteraceae in Upper Brahmaputra Valley zone, out of which two species are found to be cultivated for medicinal purposes in restricted jurisdiction and two species were falcultative weed in upland ecosystems. The taxonomy of species under *Vernonia* sensu lato has undergone several major changes during the last decade and so, the genus has undergone several splits.Accordingly out of the explored 8 species in the UBV zone of Assam, two species got new name under Acelepis (*Acelepis saligna, Acelepis silhetensis)* and one each under *Baccharoides (Baccharoides anthelmintica), Cyanthilliu(Cyanthillium cinerium),Decaneuropsis(Decaneuropsis vagans),Gymnanthemum(Gymnanthemum amygdalinum), Monosis(Monosis volkameriifolia),* leaving *Vernonia arborea* in the genus *Vernonia.*

The morphology of each of the species studied thoroughly and their flowering and fruiting time and a note on its habitat ecology are provided for understanding the characteristic of the taxa. In addition the distribution of the species in India and the world is reviewed to depict the range of phytogeographical distribution. From this review it is seen that only Cyanthillium cinerium has cosmopolitan distribution in tropics and sub tropics as a weed of cultivated and other disturb lands and rest of the species are restricted to paleo tropical regions more specifically in tropical and sub tropical Asia and only *Gymnanthemum amygdalinum* has African origin.

From the study it is understood that within the family Asteraceae, more particularly the genus Vernonia sensu lato cypsela, phyllaries and pappus play an important role in delimiting taxa as these organs are persistent. And therefore emphasis was given to illustrate cypsela, phyllaries and pappus of the studied species elaborately (Tab. 3) All of these have given rather weightage in constructing the key for identification, and that found to be an effective effort. Use of each of the species are also reviewed.

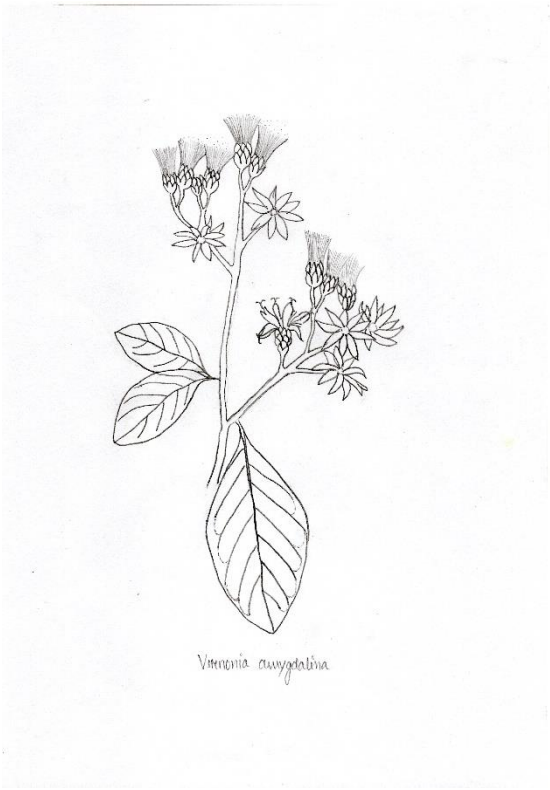
Table 3. Comparative study of Cypsela, Phyllaries and Pappus of the studied species.

Species	Cypsela	Phyllaries	Pappus
Acilepis saligna	Sub-terete, 3-3.5mm long, 10 ribbed, pubescent with twin hairs and capitate glands.	Reddish purple in upper part, 4 or 5 seriate ovate or oblong, scabrid sparsely tomentose ciliate, apex obtuse and mucronulate.	Persistent, in 1 series, reddish or white bristles, 6-7mm long.
Acilepis silhetensis	Sub-terete, 4-5mm long, 10 ribbed, glandular	Deep purple or green, lanceolate to oblong-lanceolate, apex acuminate, margins piliferous, outer surface arachnoids without glands; outer and mille ones ovate	Persistent, in 1 series of reddish bristles, 6.5-8mm long
Baccharoides anthelmintica	Cylindric, black, 4-5mm long, conspicuously 10-ribbed, pubescent and glandular	Green, subequal, 10-12mm long; outer ones ovate-lanceolate, sparsely puberulous and glandular, tips leafy and slightly patent; middle ones oblong-linear, acute; inner ones oblong, acute	Reddish, in 2 series of bristles, inner series 5-8mm long, rigid, persistent; outer ones 1-2mm long, flattened, shining, deciduous.
Cyanthillium cinerium	Clavate-terete, 1.5-1.8 mm long, ribs inconspicuous, covered with dense silky twin hairs and capitates glands	Green with purple apex, sericeous, glandular, lanceolate to ovate-lanceolate, apex acute to acuminate, margins piliferous.	Persistent, in 2 series of white or fulvous bristles, inner series 3.0-3.5mm long,

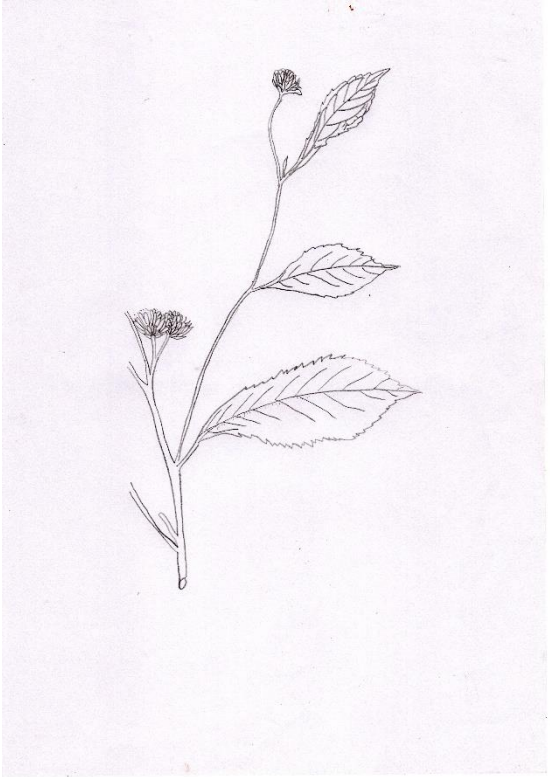
			outer ones shorter
Decaneuropsis v agans	Glabrous, 10 ribbed, ca. 7mm long	Ovate to linear-lanceolate, 1-7.5 x 1-3mm, acute or obtuse, scarious, glandular pubescent on upper parts, short ciliate on margins; outer ones ovate-acute; inner ones ca. 6mm long	Reddish, inner series ca. 7mm long; outer shorter.
Gymnanthemum amygdalinum	Oblong,elli ptic, 34x0.51m m, with minute glands and bristly hairs.	Ovate-elliptic or oblong-obtuse or subacute, 0.4-0.6 cm long, coriaceous to subcoreaceous, pale green with darker spots near tip, glabrous or ciliolate.	Persistent capillary bristles with broadened tips, sub uniseriate
Monosis volkameriifolia	Oblong-turbinate, 3.5-6.5mm, 10 ribbed, covered with dense twin hairs and capitates glands.	Ovate to oblong, 1-7.5 x 1-3mm, rounded or sub-acute, sparsely pubescent; middle ones ovate=acute; inner ones ovate or lanceolate, acute.	Whitish, inner series 7-10mm at maturity, outer shorter, mostly 1-3mm.
Vernonia arborea	Turbinate, ca 2mm long, 3-4 angled, inconspicuously ribbed, covered with dense twin hairs and capitates glands	Green or purple, sparsely puberulous without gland, apex obtuse, margins piliferous; outer ones ovate; inner ones ovate-lanceolate or oblong	Persistent, in 2 series of bristles, inner series 6-7mm long, outer ones shorter

Habit Sketch of *Decaneuropsis vagans*

Habit Sketch of *Acilepis saligna*



Habit Sketch of *Gymnanthemum amygdalinum*



Habit Sketch of *Baccharoides anthelmintica*

Plate 8: Handmade illustration

At Dikhowmukh, Sivsagar with guide and local people

Vernonia arborea

At Khanamukh,Sivsagar with a local person

At Golaghat

Gymnanthemum amygdalinum

Bccharoides anthelmintica

Plate 9: Pictures taken during species collection at different regions of UBV Zone.

SUMMARY AND CONCLUSION

Due to their capacity to produce secondary metabolites that may have biological effects, plants have long been important in the development of medicine. Plants were employed in traditional medicine in a variety of ways to cure a wide range of diseases. The majority of traditional and folk medicine, which is based primarily on plant cures, is still used by more than 80% of the world's population, according to the World Health Organization. Commonly more inexpensive, more readily available, and less likely to result in adverse effects than their synthetic counterparts are plant-based drugs that are utilised in mainstream treatment. Numerous fascinating chemicals have been discovered as a result of current analyses of traditional medicinal plants using more advanced technologies**.** One of the largest families of flowering plants, the Asteraceae has approximately 1600 genera and 25,000 species worldwide. It is also referred to as the sunflower family. Along with some well-known species including chicory, sunflower, lettuce, coreopsis, dahlias, and daisies, it also contains a number of plants of medicinal value like wormwood, chamomile, and dandelion

Eight species, which have been collectively renamed into seven genera during the last deacde, have been studied in relation to *Vernonia* (sensu lato) in the UBV zone of Assam. Discussed are their current nomenclature, intricate morphology, flowering and fruiting intervals, habitat ecology, and phyto-geographic distribution. A key for identification that focuses a lot of emphasis on the cypsela, phyllaries, and pappus characteristics is created for quick taxon recognition in the field. Freehand illustrations and high-resolution photos support taxonomic descriptions.

Future Line of Work:

1. Taxonomic enumeration, followed by population estimation of each of the taxa present in entire North East India for their exploitation.

2. Adoption of conservation strategies both in-situ and ex-situ condition.

3. Electronic documentation with up to date information.

4. Validation of ethno biological information and value addition for commercial exploitation of these resources under the erstwhile genus *Vernonia* of North East India.

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