

Morphological and Anatomical Study of *Bidens pilosa* var. *minor* (Blume.) Sher. From Tribe Heliantheae

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Abstract

In this research, morphology and anatomy of *Bidens pilosa* var. *minor* (Blume) Sher. of tribe Heliantheae belonging to the family Asteraceae were studied, photomicrographed and described. The plant is annual erect herb. Leaves are trifoliolate compound and the florets of rays and disc in a head are bisexual and monoecious heads are also found. In anatomical characters, although endodermis are inconspicuous only in roots, it is conspicuous in stem and root. The stomata types are anomocytic and vascular bundles are bicollateral, open and covered by one-layer of bundle sheath. The resulting characters are valuable for the identification of study species for further researchers.

Key words – Asteraceae, endodermis, vascular bundles, bicollateral

Introduction

Asteraceae also called Sunflower family is one of the most important economic family and the second largest of flowering plant families. It consists of several tribes. Its flowers have two types of florets. Disc florets are in the center of head and ray florets in the outer. Many plants of Asteraceae family are economically important as weed, ornamentals, medicinal, green vegetables and poisonous plants.

Commercially the flowers of this Asteraceae family are very famous of their colourful florets and beautiful petals. Several plants of this family are commonly cultivated for ornamental purpose in the gardens plots and field. The studied species of this Asteraceae family are native of America, Africa, India and all warmer countries (Grierson 1980).

The study species is widely distributed in Pyin Oo Lwin of Mandalay Region. Asteraceae are the largest family of flowering plants and contains 900 genera and 13,000 species and contain the many species of medicinal value (Trease and Evan 1978).

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The Asteraceae consists of about 1000 genera and about 8000 species. Moreover, this family was subdivided into 11 tribe – Vernoniae, Eupatorieae, Asteroideae, Inuloideae, Helianthoideae, Antemideae, Seneciodeae, Calendulaceae, Cynoroideae, Mutisiaceae, Cichoriaceae and it was also organized with subtribes in each tribe (Hooker 1881).

In best-known family of flowering plants, the Asteraceae was organized into 3 subfamilies: (1) the Brandesiodieae with a single tribe, (2) the Cichorioideae with 6 tribes, and (3) the Asteroideae with 7 tribes. The tribe of Brandesiodieae is Brandesieae. The tribes of Cichorioideae are Mutisieae, Cardueae, Lactuceae, Vernoniae, Liabeae and Arctotideae. The tribes of Asteroideae are Inuleae, Canenduleae, Astereae, Anthemideae, Senecineae, Heliantheae and Eupatorieae. And then the tribe Heliantheae includes 18 subtribes, 300 genera and 3,330 species (Heywood *etal.* 1978).

Bidens pilosa var. *minor* (Blume.) Sher. is known as “kuei chen sao” in China and as “Rumput juala in Malaysia. In China a decotion of the leaves mixed with rice wine is used to relieve shock after accident and to treat lung troubles. It is also applied as styptic and in alternative (Wiar 2000).

The main objective of this present study is to record morphological and anatomical characters of studied species, and to get anatomical information that can fulfill the need of systematic studies on tribe Heliantheae.

Materials and Methods

The species of *Bidens pilosa* var. *minor* (Blume) Sher. was collected from Pyin Oo Lwin Township of Mandalay region. Field notes were made of precise location and of habitat type. They were recorded and photographed in the field trip. After the collection, the vegetative and floral parts of fresh specimens were studied, measured and identified by using literature (Hooker 1881; Heywood 1978; Grierson 1980; Cronquist 1981) based on the earlier record in Department of Botany, University of Mandalay. Some of collected specimens were dried and pressed to make herbarium sheet.

The collected specimens were preserved in 50% solution of ethyl alcohol for further morphological and anatomical study.

For anatomical studies, the fresh and preserved specimens were examined by preparing free-hand section. These plant parts were cut by using a new razor blade to obtain thin sections (about 0.5 – 1 mm in thickness) for microscopic study. These plant sections were cleared in chloral hydrate solution on a glass slide and stained with saffranin solution and temporarily mounted in dilute glycerin solution.

Maceration of leaves, stems and roots were made by boiling the materials in equal volume of 50% acetic acid and 50% hydrogen peroxide according to the method of Jaffery (1917) as cited in plant microtechnique (Johansen, 1940). The plant section and macerated components of plant parts were fixed in standard F.A.A solution (90ml of 50% or 70% of ethyl alcohol, 5ml of glacial acetic acid and 5ml of formalin employed by Johnson (1940). The plant section and macerated components of plant parts were measured by the microscope with an ocular micrometer which was then calibrated against at a stage micrometer. After calibrating, an ocular micrometer was used to determine the size of a cell in terms of length, breadth and diameter by the formula. Photomicrographic plates of the free-hand sections were also prepared by the use of a microscope with digital camera and presented in this research.

Results

Morphological studies

***Bidens pilosa* var. *minor* (Blume) Sher., Bot. Gaz. 70. 1925**

B. sundaica var. *minor* Blume, Bijdr. 914. 1826.

B. chinensis auct. non. Willd: Moon, Cat. 57. 1824.

B. pilosa L., Enum. Pl. Zeyl. 165. 1860, sensu Thw.

Family name : Asteraceae

Myanmar name : Ta-sae-ut

English name : Spanish-needle

Annual suffrutescent herbs; stems tetragonous; glabrous. Leaves ternately divided into tri to pentapinnate compound, opposite and decussate, petiolate, the petioles 2.0-5.0 cm long, leaflet ovate to oblong-ovate, the terminal leaflets ovate-lanceolate, 4.0-6.0 cm by 2.0-3.0 cm, lateral one 2.0-5.0 cm by 1.0-3.0 cm, petiolules of terminal leaflets 1.0-2.5 cm long, lateral ones 0.5-1.0 cm long, acute or shortly acuminate at the apex, serratedentate along the margin, abruptly attenuate at the bases, glabrous on both surfaces.

Capitula terminal or axillary, usually numerous in loose dichotomously branched panicels, heterogamous, radiate, 1.0-2.0 cm across, pedunculate, the peduncles slender, glabrous; involucre 2-seriate, campanulate, the outer phyllaries 8-10 in number, spatulate, herbaceous, 3.0-5.0 mm by 1.0-2.0 mm, the inner ones oblong-lanceolate, 2.0-4.0 mm by 1.0-1.5 mm, membranous; receptacles flat, paleaceous, the paleae linear, 3.0-5.0 mm long, membranous. Ray florets 5-6 in number, neuter, ligulate, ligules flabelliform, 5.0-10.0 mm by 4.0-6.0 mm, 2-3-lobed, white, basal tube 1.0-1.5 mm long, short; ovaries more or less compressed, oblongoid, 1.5 mm long, sterile, style exserted; stylar arms acute at tip. Disc florets numerous, tubular, bisexual, yellow, the corolla tube infundibuliform with 5-deltoid lobes, 1.0-1.5 mm long, the basal tube 2.0-3.0 mm long; stamens 5, exserted, the anther base sagittate, the apical appendage acute; ovaries 1.0-2.0 mm long, linear-oblong, pappose. Achenes tetragonous, oblongoid, black, 6.0-10.0 mm long, pubescent. Pappus 2-4, whitish, retrose barbed. (Figure 1)

Flowering period : July to March

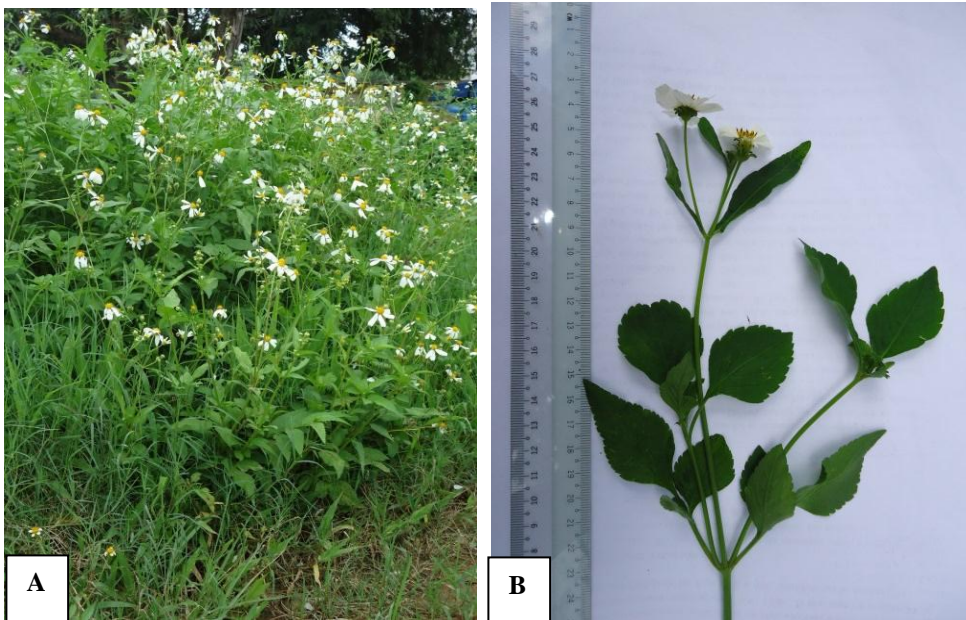


Figure 1 *Bidens pilosa* var. *minor* (Blume) Sher.
A. Habit B. Inflorescence

Anatomical Studies

Internal Structure of the leaf of *Bidens pilosa* var. *minor* (Blume) Sher. Lamina

In transverse section, the lamina of *B. pilosa* var. *minor* (Blume) Sher. (Figure 2, A) studied is 40.0-125.0 μm in thickness. Typically dorsiventral, venation reticulate. Distinguishable into dermal, ground and vascular tissue systems.

Dermal Tissue System: Composed of epidermal cells, guards cells of the stomata and trichomes.

In surface view epidermal cells parenchymatous, compactly arranged anticlinal walls of upper epidermal cells thick and slightly wavy, cells 25-100 μm in length, 18.75-52.5 μm in breadth; irregularly arranged cell walls of lower epidermal cells thin and more wavier, cells 56.25-150.0 μm in length, 35.0-81.25 μm in breadth; stomata anomocytic type, more abundant on abaxial surface; stomata at adaxial surface 7.5-18.75 μm in length, 2.5-7.5 μm in breadth, guard cells 22.5-31.25 μm in length, 5.0-12.5 μm in breadth; stomata at abaxial surface 13.75-25.0 μm in length, 5.0-12.5 μm in breadth, guard cells 25.0-40.0 μm in length, 5.0-12.5 μm in breadth; trichomes present on both surfaces, multiseriate, 50.0-212.5 μm in length, 8.75-18.75 μm in breadth.

In transverse section, both upper and lower epidermis one-layered, the upper cells 15.0-75.0 μm in length, 12.5-32.5 μm in breadth, compact, oval or barrel-shaped, the anticlinal wall straight, outer and inner walls convex; cuticle on both sides, 1.25-3.75 μm in thick; the lower epidermal cells 10.0-33.75 μm in length, 10.0-31.25 μm in breadth, outer and inner walls convex.

Ground Tissue System: Mesophyll differentiated into palisade and spongy parenchyma; palisade parenchyma present at adaxial side, one-layered, cells vertically elongated, 25.0-87.5 μm in length, 12.5-25.0 μm in breadth, chloroplast abundant; spongy parenchyma present at abaxial side, 3- to 5-layered, the layers 15.0-25.0 μm in thick, cells oval or rounded or irregular in shape, 10.0-37.5 μm in length, 8.75-31.25 μm in breadth, intercellular space rare, chloroplast abundant.

Vascular Tissue System: The vascular bundles embedded in ground tissue, bicollateral type, oval-shaped, 12.5-81.25 μm in horizontal diameter, 31.25-100.0 μm in vertical diameter; bundle sheath one-layered, parenchymatous,

cells barrel or oval-shaped, 16.25-50.0 μm in length, 12.5-31.25 μm in breadth, cell walls thin; xylem on the adaxial side and phloem on the abaxial side; phloem 3- to 5-layered, the layers 6.25-12.5 μm in thick, cells 2.5-18.75 μm in length, 2.5-12.5 μm in breadth, phloem composed of, sieve-tubes, companion cells, phloem parenchyma and phloem fibers; xylem cells 1 to 5 radial rows, 1-to 4-celled in each row, the cells 6.25-18.75 μm in length, 3.75-42.5 μm in breadth, xylem composed of vessels, tracheids, fibers and xylem parenchyma; bundle sheath extension parenchymatous above the abaxial epidermis, one-layered, cells oval-shaped, 12.5-40.0 μm in length, 12.5-31.25 μm in breadth.

Midrib

In transverse section, the midrib of *B. pilosa* var. *minor* (Blume) Sher. (Figure 2, B) studied is oval or shield-shaped in outline, semicircular at the abaxial side and prominent ridges at adaxial side, 100.0-200.0 μm in tangential diameter, 100.0-235.0 μm in radial diameter. Distinguishable into dermal, ground and vascular tissue systems.

Dermal Tissue System: Composed of epidermal cells and trichomes.

In transverse section; both upper and lower epidermis one-layered, the cells barrel or oval-shaped; upper epidermal cells 8.75-93.75 μm in length, 8.75-62.5 μm in breadth, anticlinal walls straight, outer and inner walls convex; lower epidermal cells 12.5-56.25 μm in length, 12.5-43.75 μm in breadth; cuticle 2.5-6.25 μm in thick; non-glandular trichomes 312.5-937.5 μm in length, 62.5-150.0 μm in breadth, multicellular.

Ground Tissue System: Consists of outer collenchymatous and inner parenchymatous cells as main mass of ground tissue. Outer collenchymatous layers below the adaxial and above abaxial epidermis; those at adaxial side 2- to 6- layered, the layers 22.5-37.5 μm in thick, the cells 12.5-43.75 μm in length, 15.0-43.75 μm in breadth, polygonal; those at abaxial side 1- to 2- layered, the layers 25.0-37.5 μm in thick, the cells 12.5-62.5 μm in length, 12.5-58.75 μm in breadth, polygonal; inner parenchymatous layers below adaxial and above the abaxial collenchymatous layers; those at adaxial side 6- to 9- layered, the layers 25.0-62.5 μm in thick, the cells 22.5-131.25 μm in length, 18.75-125.0 μm in breadth, rounded or oval or polygonal, intercellular space small; those at

abaxial side 3 to 5 layered, the layers 37.5-68.75 μm in thick, the cells 18.75-137.5 μm in length, 18.75-93.75 μm in breadth, rounded or oval shaped, intercellular space present.

Vascular Tissue System: Occurred in 4 to 9 groups of farcically in crescent shape of bicollateral type and open vascular bundle, the middle large, peripheral bundles small, the bundles 50.0-450.0 μm in tangential diameter, 60.0-400.0 μm in radial diameter, oval in shape; phloem present on both side of xylem, phloem 2- to 8- layered, the layers 6.25-25.0 μm in thick, cells 2.5-33.75 μm in length, 2.5-25.0 μm in breadth, irregular in shape, phloem composed of sieve-tubes elements, companion cells, phloem parenchyma and phloem fibers; vascular cambium developed between xylem and phloem, 2- to 3-layered, the layers 8.75-18.75 μm in thick, cells rectangular, radially flattened, thin-walled, 8.75-21.25 μm in length, 6.25-20.0 μm in breadth; xylem cells 2 to 10 radial rows, 1- to 9-celled in each row, the cells 6.25-37.5 μm in length, 3.75-31.25 μm in breadth, xylem composed of vessel elements, tracheids, fibers and xylem parenchyma.

Petiole

In transverse section, the petiole of *B. pilosa* var. *minor* (Blume) Sher. (Figure 2, C) studied is semicircular at the abaxial side and straight at the adaxial side, 181.25-325.0 μm in tangential diameter, 150.0-200.0 μm in radial diameter. Distinguishable into dermal, ground and vascular tissue systems.

Dermal Tissue System: Composed of epidermal cells and trichomes.

In transverse section, both upper and lower epidermis one-layered, the cells barrel or oval-shaped or rounded; upper epidermal cells 8.75-37.5 μm in length, 8.75-31.25 μm in breadth, anticlinal walls straight, outer and inner walls convex; lower epidermal cells 10.0-56.25 μm in length, 8.75-40.0 μm in breadth, anticlinal walls straight, outer and inner walls convex; cuticle present on both surfaces, 2.5-6.25 μm in thick; non-glandular trichomes 110.0-250.0 μm in length, 20.0-40.0 μm in breadth.

Ground Tissue System: Composed of outer collenchymatous cells and inner parenchymatous cells as main mass of ground tissue. Outer collenchymatous layers below the adaxial and above abaxial epidermis; those at adaxial side, 1 to 3-layered, the layers 15.0-40.0 μm in thick, the cells

15.0-62.5 μm in length, 10.0-68.75 μm in breadth, polygonal; those at abaxial side, 1- to 2-layered, the layers 22.5-37.5 μm in thick, the cells 12.5-51.25 μm in length, 7.5-45.0 μm in breadth, polygonal; inner parenchymatous layers below adaxial and above the abaxial collenchymatous layers; those at adaxial side 5- to 8-layered, the layers 6.25-10.0 μm in thick, the cells 25.0-225.0 μm in length, 31.25-175.0 μm in breadth, rounded or oval-shaped; those at abaxial side 3- to 5-layered, the layers 43.75-75.0 μm in thick, the cells 22.5-150.0 μm in length, 25.0-131.25 μm in breadth, rounded or oval-shaped; intercellular space present on both side.

Vascular Tissue System : Occurred in 6 to 12 groups of farcically arranged in crescent shaped of bicollateral type and open vascular bundle, the middle bundle large, peripheral bundles small, the bundle 11.25-93.75 μm in tangential diameter, 12.5-112.5 μm in radial diameter, oval-shaped; phloem lying on both side of xylem, phloem 2 to 10 layered, the layers 6.25-18.75 μm in thick, cells 2.5-31.25 μm in length, 22.5-18.75 μm in breadth, phloem composed of sieve-tubes elements, companion cells, phloem parenchyma and phloem fibers; vascular cambium developed between xylem and phloem, 2- to 4-layered, the layers 6.25-12.5 μm in thick, the cells rectangular, radially flattened, thin-walled, 12.5-27.5 μm in length, 7.5-22.5 μm in breadth; xylem arranged in 2 to 8 radial rows, 2- to 8-celled in each row, the cells 12.5-37.5 μm in length, 7.5-35.0 μm in breadth, xylem composed of vessel elements, tracheids, fibers and xylem parenchyma.

Internal Structure of the Stem of *Bidens pilosa* var. *minor* (Blume) Sher.

In transverse section, the stem of *B. pilosa* var. *minor* (Blume) Sher. (Figure 2, D) studied is polygonal or tetragonal shape in outline, 2125.0-3687.5 μm in tangential diameter, 2062.5-3437.5 μm in radial diameter. Distinguishable into dermal, ground and vascular tissue systems.

Dermal Tissue System: Composed of epidermal cells and trichomes.

In transverse section, epidermis one-layered, parenchymatous, the cells rectangular or barrel in shape, 13.75-43.75 μm in length, 6.25-35.0 μm in breadth, the lateral walls straight, both outer and inner walls convex; non-

glandular trichomes 450.0-850.0 μm in length, 30.0-75.0 μm in breadth, elongated multicellular.

Ground Tissue System: Composed of cortex, endodermis, pericycle and pith. The cortex differentiated into outer collenchymatous tissue and inner parenchymatous tissue. Collenchymatous cells forming a discontinuous sheath, cells 1- to 5-layered, the layers 8.75-18.75 μm in thick, the cells polygonal or oval in shape, 5.0-27.5 μm in tangential diameter, 5.0-12.5 μm in radial diameter, thickening angular. Parenchymatous cells occur in continuous cylinder, 3- to 5-layered, the layers 10.0-37.5 μm in thick, the cells rounded or oval-shape, 15.0-56.25 μm in length, 12.5-53.75 μm in breadth, intercellular space present. Endodermis one-layered, the cells 10.0-56.25 μm in length, 15.0-37.5 μm in breadth, compact and continuous, parenchymatous, barrel-shaped, thin-walled. Pericyclic sclerenchymatous forming discontinuous crescent-shaped, the cells 1- to 6- layered, the layers 10.0-18.75 μm in thick, irregularly polygonal in shape, 6.25-31.25 μm in length, 3.75-25.0 μm in breadth. Pith cellular large, 1000.0-2125 μm in diameter, the cells 20.0-75.0 μm in length, 17.5-68.75 μm in breadth, parenchymatous, thin-walled, oval or rounded or polygonal in shape, intercellular space present.

Vascular Tissue System: Vascular bundles arranged in a discontinuous circular ring, collateral type, about 16-23 bundles, the bundles 100.0-300.0 μm in tangential diameter, 100.0-275.0 μm in radial diameter; phloem outer and xylem inner; phloem 4- to 6-layered, the layers 5.0-10.0 μm in thick, the cells 3.75-22.5 μm in length, 3.75-15.0 μm in breadth, small, oval or irregular in shape, phloem composed of sieve-tube elements, companion cells, phloem parenchyma and phloem fibers; vascular cambium developed between the xylem and phloem, 3-to 5- layered, the layers 6.25-11.25 μm in thick, cells rectangular, radially flattened, thin-walled, 12.5-27.5 μm in length, 5.0-18.75 μm in breadth; xylem arranged in 1 to 5 radial rows, 1- to 5- celled in each row, the cells 15.0-56.25 μm in length, 6.25-50.0 μm in breadth, rounded or polygonal in shape, xylem composed of vessel elements, tracheids, fibers and xylem parenchyma.

Internal Structure of the Root of *Bidens pilosa* var. *minor* (Blume) Sher.

In transverse section, the root of *B. pilosa* var. *minor* (Blume) Sher. (Figure 2, E) studied is circular in outline, 1162.5-1750.0 μm in diameter. Distinguishable into dermal, ground and vascular tissue systems.

Dermal Tissue System: The root epiblimma parenchymatous cell, one-layered, the cells 31.25-75.0 μm in length, 10.0-40.0 μm in breadth, irregularly rectangular in shape.

Ground Tissue System: Composed of cortex and pericycle. Cortex 3- to 4-layered, the layers 31.25-50.0 μm in thick, parenchymatous, oval or barrel or irregular in shape, cells 18.75-75.0 μm in length, 12.5-56.25 μm in breadth. Pericyclic sclerenchymatous, continuous, 3-to 5-layered, the layers 12.5-25.0 μm in thick, cells 6.25-50.0 μm in length, 25.0-31.25 μm in breadth, polygonal or oval or irregular-shaped.

Vascular Tissue System: Vascular bundles occurs as continuous ring, collateral type, vascular cylinder polyarch, the bundles 875.0-1875.0 μm in diameter; phloem distributed at the periphery of the xylem, 5-to 8-layered, the layers 8.75-18.75 μm in thick, the cells 2.5-43.75 μm in length, 3.75-18.75 μm in breadth; xylem arranged as a continuous cylinder and in the form of radiate group, 625.0-1312.5 μm in diameter, cells polygonal or rounded, 16.25-75.0 μm in length, 12.5-56.25 μm in breadth; phloem composed of sieve-tube elements, companion cells, phloem parenchyma and phloem fiber; xylem composed of vessel elements, tracheids, fibers and xylem parenchyma.

Discussion

Morphological and anatomical study of the species *Bidens pilosa* var. *minor* (Blume.) Sher. was investigated in this research. *Bidens pilosa* var. *minor* (Blume) Sher., is belonging to the tribe Heliantheae of Family Asteraceae. According to Singh (1957). Asteraceae is subdivided into three groups. All florets of Disciflorae group are regular. Zygomorphic ligulateflorets are found in Liguliflorae group and latex is only in its group. Inner tubular florets and outer ligular florets are found in Radiate group.

According to Bogor (1999) constituents of essential oils are also called sesquiterpens. It has a broad range of biological activities. According to Sharma (1993) Asteraceae family is organised with 13 tribes. They are

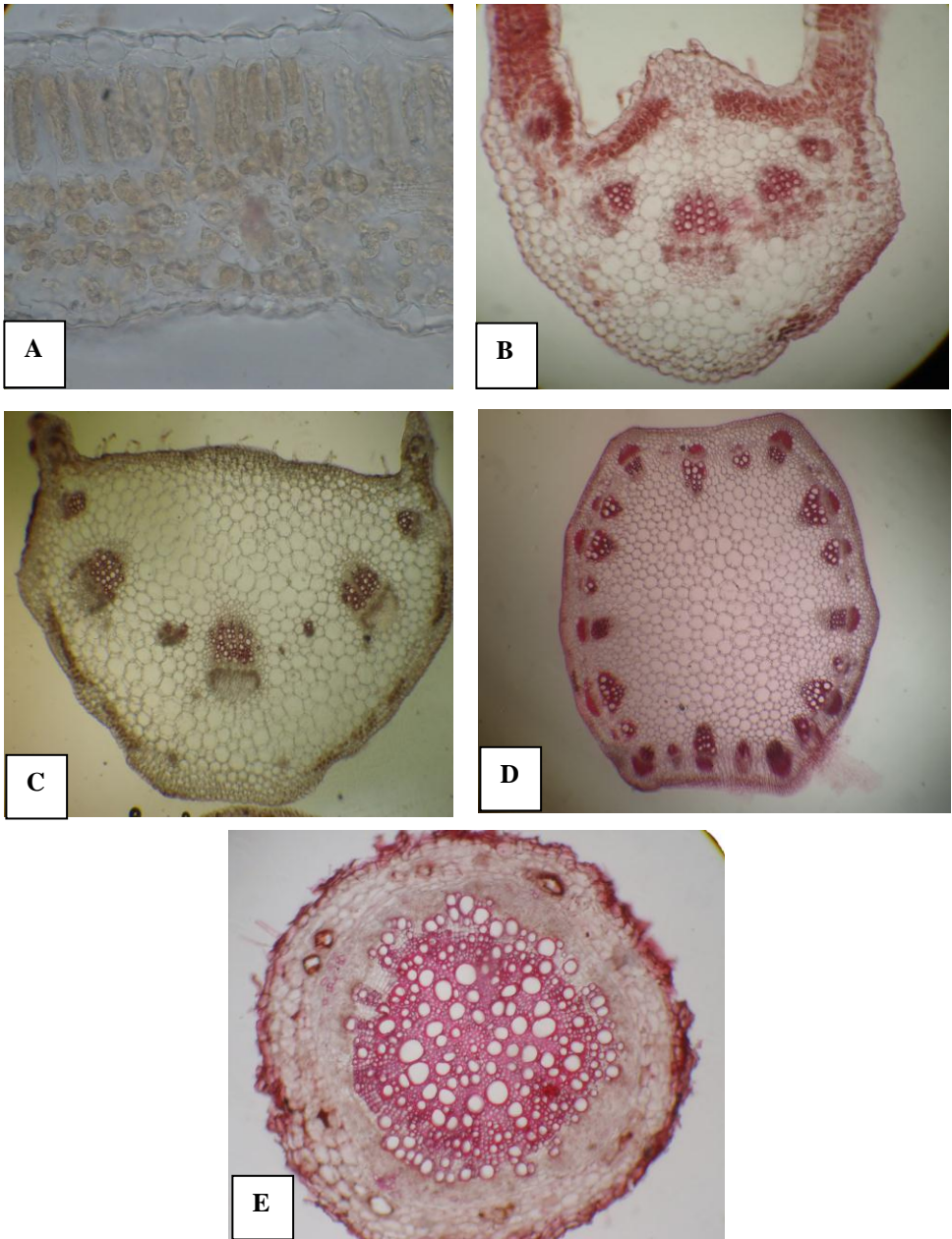


Figure 2. *Bidens pilosa* var. *minor* (Blume) Sher
A. Lamina B. Midrib C. Petiole D. Stem E. Root

Heliantheae, Astereae, Anthemideae, Arctoideae, Inuleae, Senecineae, Calenduleae, Eupatorieae, Vernoniaeae, Cynureae, Mutisieae, Liabeae and Lactuceae. Asteraceae had been also divided into 12 tribes by Grierson (1980). Hundley and Chit Ko Ko (1987) stated that 256 species and 98 genera are established in Myanmar

Kress *et al* (2003) described that 309 species belonging to 128 genera had been found in Myanmar. Naw Wah Wah Hpaw (1972) had investigated on tribe Heliantheae in Myanmar. 27 species from 20 genera of tribe Heliantheae had been observed by many researchers in Myanmar beside several tribes. Many researchers had studied on taxonomic revision on family Asteraceae from upper Myanmar.

According to Shirma (1993) the plants of Compositae are annual or perennial herbs. But some are shrub and only a few are trees and even climbers are found. Plants are herbaceous and sap watery or milky is present. Leaves are usually alternate, sometimes opposite and rarely whorled. Mostly simple leaves are present. It is needle-like and margins are pinnately or palmately lobed or divided. Each floret is subtended by a receptacular bract called pale. The receptacle is subtended by an involucre of bracts called phyllaries. The capitulum may be heterogamous or homogamous and bisexual or unisexual or even neutral. Calyx are represented by pappus of bristles and awns or scales or absent. Corolla are 5 and gamopetalous. Stamens are 5, epipetalous and alternating with corolla lobes. Anthers are united into a tube around the style and filaments are free and syngenesious. Carpels are 2 and syncarpous. Ovary inferior, unilocular, one ovule, anatropous and basal placentation. Styles are one and 2-branched. Stigmas are diverse form. Fruits are cypsela and are crowned by the persistent pappus. Seed is one per fruit. It has straight embryo and not endosperm.

Heywood *et al* (1978) reported that the plants of tribe Heliantheae are herbs, sub shrubs or shrubs and rarely tree like. Leaves are opposite or alternate. Capitula are radiate. Phyllaries are 1- to 2-multiseriate and are free. Receptacle are glabrous or paleaceous. Corolla lobes are short. Corolla are yellow but sometimes purple. Anthers are obtuse to acute and not tailed. Style arms are truncate or appendiculate. Pappus consists of awns or scales.

In this study *Bidens pilosa* var. *minor* (Blume.) Sher. is annual suffrutescent herbs. This character agrees with that of small (1933), Bogor (1999), Wiart (2000), Bogor (2002) but Wiart (2000) stated that it is also

cosmopolitan annual herb and are pantropical erect herb in *Bidens pilosa* var. *minor* (Blume) Sher..

It was observed that all leaves are simple but leaves of *Bidens pilosa* var. *minor* (Blume.) Sher. are tri to pentapinnate compounds, opposite and decussate. This finding agrees with that of Bogor (1999), Wiart (2000), Small (1933) and Bogor (2002).

According to study, leaf-segments of *Bidens pilosa* var. *minor* (Blume.) Sher. is ovate to oblong-ovate or ovate-lanceolate; laminae are linear-lanceolate; leaf margins are crenate-serrate; leaf tips are acute or shortly acuminate. The characters agree with that of Bogor (2002), Wiart (2000) and Small (1933), Bogor (1999).

The characters of leaf base are attenuated in *Bidens pilosa* var. *minor* (Blume.) Sher. This disagrees with that of Bogor (2002), Wiart (2000), Bogor (1999), Small (1933).

In the present study, the inflorescences of species are axillary or terminal. This finding agrees with Wiart (2000) and Bogor (2002). Moreover *Bidens pilosa* var. *minor* (Blume.) Sher. are solitary capitula mentioned by Bogor (1999).

In the present study the involucre of *Bidens pilosa* var. *minor* (Blume.) Sher. is regarded to be ovoid or oblong. This character agrees with that of Wiart (2000), Small (1933), Bogor (2002) and Bogor (1999).

According to study, receptacles of *Bidens pilosa* var. *minor* (Blume.) Sher. is flat and are convex. This finding agrees with Hooker (1881) and Bogor (2002).

In the present study the ray florets of *Bidens pilosa* var. *minor* (Blume.) Sher. is 5 to 6 in number per head, 2-to 3-lobed at apex, white and neuter. Although this finding agrees with Small (1933), Hooker (1881), Bogor (2002) and Bogor (1999), they mentioned that ray florets of *Bidens pilosa* var. *minor* (Blume.) Sher. is absent or 4 to 8 in number and white to yellow or pinkish. This characters agree with that of Bogor (2002).

In this study style of all species are exerted but style arms are acute at tip and ovary are more or less compressed, oblongoid in *Bidens pilosa* var. *minor* (Blume.) Sher.; style arms are linear and ovary are triquetrous. This character differs from literature.

According to study, disc florets of *Bidens pilosa* Sher. is numerous per head, yellow to orange and 5-deltoid lobed, anther bases are sagittate and apical appendages are acute. This finding agrees with Small (1933), Bogor (2002) and Bogor (1999).

In present study, achene of *Bidens pilosa* var. *minor* (Blume.) Sher. is tetragonou, oblongoid, black and bubescent. This character differs from the characters of Bogor (2002), Small (1933) Wiart (2000).

According to the study, the pappus of *Bidens pilosa* var. *minor* (Blume.) Sher. are 2-to 4-barbed spine retrorsely. This finding agree with Bogor (1999), Wiart (2000), Small (1933), Bogor (2002) but Small and Bogor reported that pappus are short, 2-4 and very unequal awns in *Bidens pilosa* var. *minor* (Blume) Sher..

In this study, several distinctive anatomical features of laminae, midribs, petioles, stems and roots of four species were observed. The leaves of all species are dorsiventral type. This finding agrees with Metcalfe and Chalk (1950).

In transverse section thickness of all species are varied in size. The epidermis of laminae are composed of three types of cells. They are epidermal cells, guard cells of stomata and trichomes. The epidermal cells are one-layered and parenchymatous. In Textbook of Forest Taxonomy, Cronquist (1981) stated that sclerefication of the walls of epidermal cells is a feature of taxonomic importance in tribe of Compositae family (Singh, Nayar & Roy 1994).

In surface view of lamina, all species of stomata are anomocytic type. The stomata are found on both surface and are more abundant on lower surface but epidermal parenchyma cells of lower surface are wavier than upper surface of epidermal parenchyma cells. This type of stomata agrees with Metcalfe and Chalk (1950).

Metcalf and Chalk (1950) stated that non-glandular multiseriate trichomes are found in all species. This type of trichomes agrees with that of Metcalfe and Chalk (1950).

The ground tissue of lamina of all species is differentiated into palisade and spongy parenchyma. Chloroplasts are abundant in palisade and spongy parenchyma. Vascular bundles of all observed species are round or oval in shape and are collateral type. Phloem is present at abaxial side and xylem is present at adaxial side. Bundle sheaths are distinct and are one-

layered with parenchymatous cells. Bundle sheath extension exists above and below epidermis cells and is parenchymatous. This finding agrees with Pandey and Chadh (1993) who reported that the bundles remain surrounded by a row of colourless parenchymatous cells. The row is called bundle sheath or border parenchyma due to which the bundle is not direct contact with mesophyll cells. Parenchyma as well as a few collenchymatous cells occur on outer and inner sides of bundle and spread upto upper and lower epidermis. These cells are known as bundle sheath extension. Metcalfe and Chalk (1950) examined that vascular bundles of veins of Compositae family are distinct with sheath of parenchyma.

The epidermis cells of midrib, petiole and stem are one-layered and parenchymatous cells with non-glandular trichomes. The ground tissue of midrib of all species is composed of collenchymatous and parenchymatous. Collenchymatous cells are found on both sides of epidermis. Parenchymatous cells are found on both sides of epidermis. Parenchymatous cells are also found between epidermis and vascular strand. Vascular bundles of midrib are bicollateral type and open vascular bundles. Moreover vascular bundles are arranged farcically into 4 to 9 groups in *Bidens pilosa* var. *minor* (Blume.) Sher..

In transverse section, the shape of petioles of *Biden pilosa* var. *minor* (Blume.) Sher.. The ground tissue of petioles of all species is differentiated into collenchymatous and parenchymatous. The vascular bundles of petioles of all study species are bicollateral type and open vascular bundle. Vascular bundles of petioles of *Bidens pilosa* var. *minor* (Blume.) Sher..

According to Metcalfe and Chalk (1950) vascular bundles of petioles of Compositae family have a simple arc of separated bundles but a few bundles are a flattened crescent shape. Moreover vascular bundles of petiole are an arc of phloem around the inner edge of the xylem. Esau (1965) stated that vascular bundles of the petiole may be collateral, bicollateral or concentric. The bundles may be numerous and arranged in several superposed arcs of they may be scattered. Other arrangements are found in petioles with numerous vascular strands. According to the present study, the transverse section of stem is polygonal or tetragonal in shape in *Bidens pilosa* var. *minor* (Blume.) Sher.. In the ground tissue of stem of all observed species cortex is composed of outer collenchymatous and inner parenchymatous layer but discontinuous collenchymatous sheath are found

in stem of *Bidens pilosa* var. *minor* (Blume.) Sher. Endodermis is the inner most layer of cortex and conspicuous in all stem of observed species.

Pericycle is composed of discontinuous sclerenchymatous sheath occurred at the outer boundary of phloem groups of vascular bundles. Pith is composed of many layers of parenchymatous cells occurred at the central part of stem. Vascular bundles of stems of all studied species are collateral type and are varied in number of bundles. Vascular bundles of stem are organized into 16 to 23 bundles in *Bidens pilosa* var. *minor* (Blume.) Sher.. According to Metcalfe and Chalk (1950) herbaceous stems of Compositae family have a single ring of collateral vascular bundles but bundles are closely placed or even forming a woody cylinder in the shrubby. Pandey and Chadha (1993) mentioned that endodermis is conspicuously existent in the stems of herbaceous angiosperm, in aquatic plants, in creepers and rhizomes. But endodermis is absent in woody stem of dicotyledons and gymnosperms, and leaves of angiosperms.

Pandey and Chadha (1993) also mentioned that pericycle is absent in the roots of some aquatic plants and in parasitic angiosperm. In the root of higher plants, pericycle develops uniformly, pith is absent in many dicotyledonous root but it is found well developed in Monocot roots.

References

- Bogor. 2002. Plant Resources of South-East Asia 12 (2) Medicinal and Poisonous plants – 2, Prosea Foundation.
- Bogor. 2002. Plant Resources of South – East Asia 14. Vegetable oils and Fat, Prosea Foundation
- Bogor. 1999. Plant Resources of South – East Asia 12 (1). Medicinal and Poisonous Plants – 1, Prosea Foundation
- Backer. C.A. and R.C. Bakhuizen Van Den Brink. 1965. Flora of Java vol. II. Rijksherbarium, Leyden, N.V.P. Noordhoff, Ltd.
- Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
- Esau, K. 1965. Plant Anatomy, 2nd ed. John Wiley and Sons, Inc. New York, London.
- Grierson, A.J.C, In Dassanayake, M. D. 1980. A Revised Handbook to the Flora of Ceylon. Vol. I. Amerind Publishing Co. Pvt. Ltd., New Delhi.
- Hundley, H.G. and Chit Ko Ko. 1987. List of Trees, Shrubs, Herbs and Principal Climbers, etc. Fourth the Revised Edition, Shwe Daw Oo press, Mayargon, Rangoon, Burma.
- Heywood, V.H. Brummitt, R.K., Culham, A., and O. Seberg. 1978. Flowering Plant Families of the World. Oxford University Press, London.

- Hooker, J. D. 1881. The Flora of British India, Vol. III, L. Reeve and Co, 5 Henrietta Street, Convent Garden, London.
- Johansen, D. A. 1940. Plant Microtechnique. Mc Graw-Hill Book Company, Inc. New York and London. 1940.
- Kress, J., R. A. Defilippis Ellen Farr and Daw Yin Yin Kyi, 2003. A Checklist of the Trees, Shrubs, Herbs and Climbers of Myanmar. Department of Systematic Biology-Botany. National Museum of Natural History, Washington DC. USA.
- Metcalfe, C. R and L. Chalk. 1950. Anatomy of Dicotyledons. Vol. II. Oxford University Press, London.
- Naw Wah Wah Paw. 1972. A Taxonomic Revision of the Tribe Heliantheae (Compositae) In Burma Genera of Family Compositae (in Part) in Upper Myanmar. M.Sc Thesis, Department of Botany, Mandalay University.
- Pandey, S. N and A. Chadh. 1993. Plant Anatomy and Economic Botany. Vol III. Vikas Publishing House PVT. Ltd., New Delhi.
- Stern, K. R. 2006. Plant Biology. Mc Graw-Hill Publishing Co. Inc. New York.
- Sharma, O.P. 1993. Plant Taxonomy. Tata Mc Graw – Hill Publishing Company Limited, New Delhi.
- Singh, Jagjit. 1957. Systematic Botany. Published by G. S. Sharma for S. Chand & Co., Fountain, Delhi and Printed at Rakesh Press, Delhi.
- Small, J. K. 1933. Manual of the Southeastern Flora, Chapel Hill. University North Carolina Press.
- Trease, G. E and W.C. Evan. 1978. Pharmacognosy. Macmillan Publishing Co. Inc. New York.
- Wiat, C. 2000. Medicinal Plants of Southeast Asia. Pelanduk Publication (M) Sdn Bhd, Malaysia.