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COMPARATIVE MORPHOLOGICAL, ANATOMICAL AND PALYNOLOGICAL
OBSERVATION IN *AGERATUM CONYZOIDES* AND *AGERATUM*

HOUSTONIANUM OF THE FAMILY COMPOSITAE

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Abstract: This paper deals with the comparative morphological, anatomical and palynological observation between *Ageratum conyzoides* and *Ageratum houstonianum* of the family Compositae.

Keywords: *Ageratum conyzoides*; *Ageratum houstonianum*; morphology; anatomy; palynology



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INTRODUCTION

The genus *Ageratum* L. is included under the family Asteraceae under order Asterales of the subclass Asteridae belonging to class Magnoliopsida (Mabberley, 1997)

The genus *Ageratum* L. has about 40 species distributed in old world and in new world countries. According to Hooker (1897), the genus has one species *Ageratum conyzoides*. In addition to that in India has another species of *Ageratum* i.e. *A. houstonianum* is also found as exotic weed. So, at present 2 species of *Ageratum* are found in India. The species of *Ageratum* L. is distributed chiefly in Tropical America having about 16 spp.

In India, the genus is distributed in West Bengal, Bihar, Odisha, some parts of Assam, Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu, i.e. throughout in India ascending up to the Himalayas about 5000 feet.

The *Ageratum houstonianum* Mill. is distributed throughout India as well as Himalayan region. The widely cultivated species are with blue (CVS white or pink) flowers.

The *Ageratum conyzoides* L. is widely distributed in many tropical and sub-tropical countries mainly in tropical America. In India, it is found all over the country as well as in Himalayan region. The common name of *Ageratum conyzoides* is quite different in different regions, Billy-

goat-weed (Australia), Camara Jape (Portuguese-Brazile), Neel phulnu (India), Oochunt (Bangladesh) and Va-sap-raeng (Thailand).

Most of the floras deal with only short description of the plants, diagnostic characters with some times key to the species along with vegetative, reproductive parts of the plants and some medicinal important features of the plant.

In this project special attention is given on the various anatomical characters stem, petiole, node, cypselar and pollen characters in details and the comparison of these characters are presented for the proper identity of two species of the genus *Ageratum* in India.

MATERIALS AND METHODS

Fresh plant materials of *Ageratum houstonianum* were collected from the garden of Bidhan Chandra Krishi Viswavidyalaya Campus near the Department of Botany, University of Kalyani. Another species *Ageratum conyzoides* is collected from Udaypur near Payradanga Railway Station area of Nadia district.

All specimens were collected and studied from November 2012 to May, 2013 for duration of 7 months only. Description of each species has been given in brief. For anatomical studies, fresh materials are used.

PREPARATION FOR STEM, NODE, PETIOLE AND ROOT:

Stem, node, petiole and roots were taken from mature plant and transverse sections were prepared by hand sections. The sections were passed through a simple staining process (stained in aqueous safranin solution) and were mounted in Phenol Glycerin solution. Camera Lucida drawings were made from these semi-permanent preparations.

PALYNOLOGICAL PREPARATION:

Pollen grains are acetolysed by following Nair's modified acetolysis method (1960). Pollen grains collected in 70% alcohol were centrifuged. Glacial acetic acid was added in the tube and centrifuged again for 5 min. and alcohol was decanted. Glacial acetic acid was removed and acetolysis mixture (9 Acetic acid: 1 H₂SO₄) was added over the pollen grains. The tube was heated in water bath from 70°C to boiling point. The dispersion was stirred with a glass rod, centrifuged and waste acetolysis mixture was decant. Pollen grains were again centrifuged in Glacial Acetic Acid. Acid was decanted and pollen grains were mounted in glycerin and observed under microscope.

RESULT AND DISCUSSION

ANATOMICAL STUDY

Stem anatomy

Ageratum houstonianum :(Fig. 1, 2)

Transverse section of *Ageratum houstonianum* through the internode of the stem shows following arrangement of the tissue from periphery to centre-

Epidermis: Outer most layer, single cell layered thick, compactly arranged, without any intercellular spaces, rectangular in outline, thick walled; outer surface cuticularized; hypodermis present below epidermis.

Hypodermis: 2-3 cell layered thick, hexagonal to spheroid in outline, compactly arranged, without any intercellular spaces, thick walled, consisting of collenchymatous tissue; below this cell layer cortex present.

Cortex: 5-6 cell layered thick, cells rounded to ovoid, or variously shaped, loosely arranged, with intercellular spaces, thin walled, consisting of parenchymatous cells; endodermis present below cortex.

Endodermis: 1 cell layered thick, compactly arranged, without any intercellular spaces, rectangular in outline and thick walled.

Stele: Consisting of 10-12 vascular bundles arranged in the form of ring; vascular bundles collateral, conjoint and open, xylem end arch; amount of xylem more than the phloem; the major part of xylem is contributed by xylem parenchyma, which are radially elongated.

Ground tissue: Very distinct, cells parenchymatous, thin walled, oval to polygonal in outline, with more intercellular

spaces, the pith cells below the xylem smaller than the central cells.

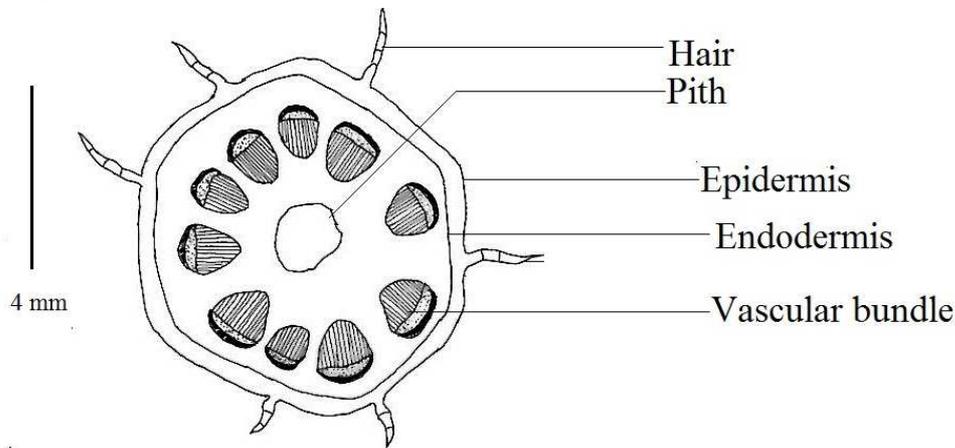


Fig. 1

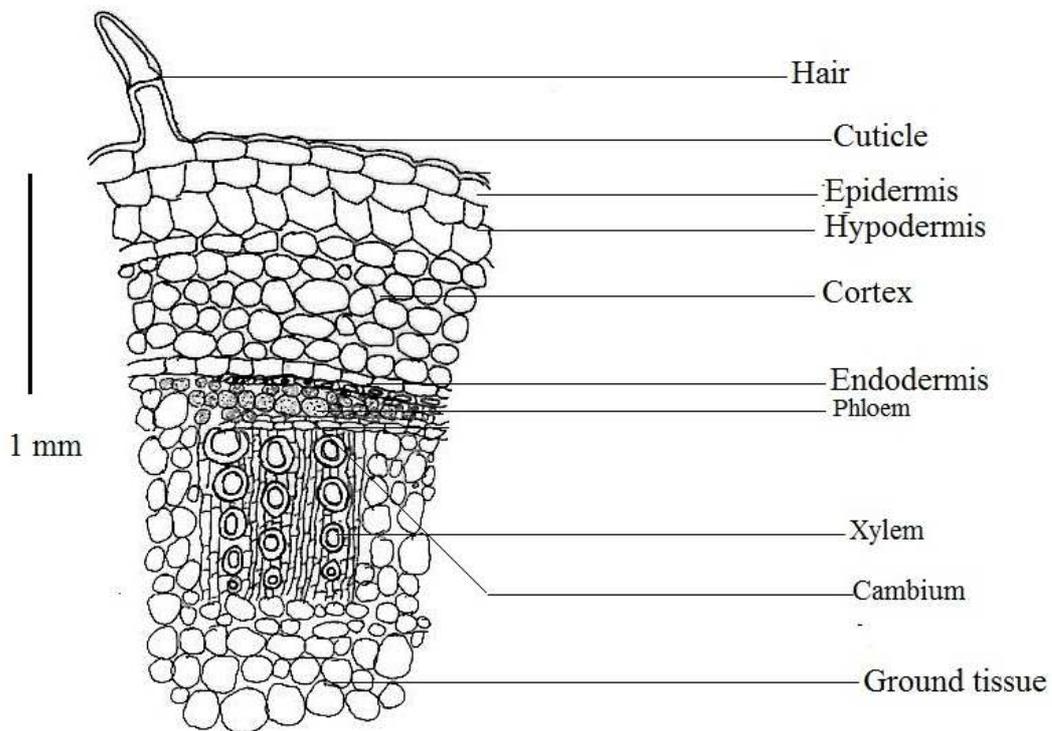


Fig. 2

Fig. 1. T.S of internode of *Ageratum houstonianum* stem (Diagrammatic)

Fig. 2.T.S part of internode of *Ageratum houstonianum* stem (Cellular)

Ageratum conyzoides: (Fig. 3, 4)

Transverse section of *Ageratum conyzoides* through the internode of the stem shows following arrangement of the tissue from periphery towards center.

Epidermis:Outer most layer, single cell layered thick, compactly arranged, without any intercellular spaces , rectangular outline , thick walled ; outer surface cuticularized ; hypodermis present below epidermis.

Hypodermis:2 cell layered thick, hexagonal to spheroid in outline, compactly arranged, without any intercllulal spaces, thick walled, consisting of collenchymatous tissue; below this cortex exist.

Cortex 5-6 cell layered thick ; cells rounded to ovoid , or variously shaped ,loosely arranged , with intercllulal spaces , thin

walled , consisting of parenchymatous cells ; endodermis present below cortex.

Endodermis:1 cell layered thick, compactly arranged, without any intercellular spaces, rectangular in outline, thick walled.

Stele:

Consisting of 9-10 vascular bundles arranged in the form of ring, vascular bundles collateral, conjoint and open, xylem end arch, amount of xylem more than the phloem; the major part of xylem is contributed by xylem parenchyma, which is radially elongated.

Ground tissue: Very distinct, cells parenchymatous, thin-walled, oval to polygonal in outline, with more intercellular spaces.

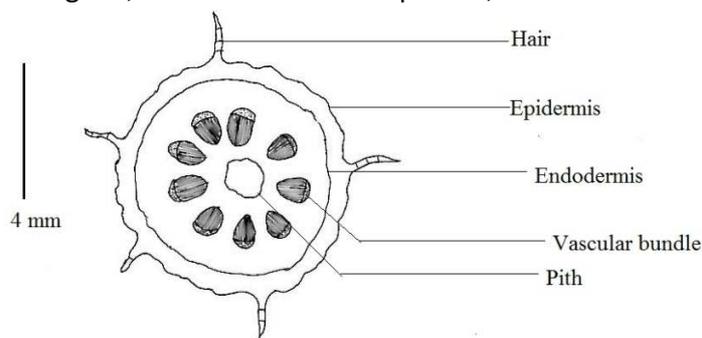


Fig. 3

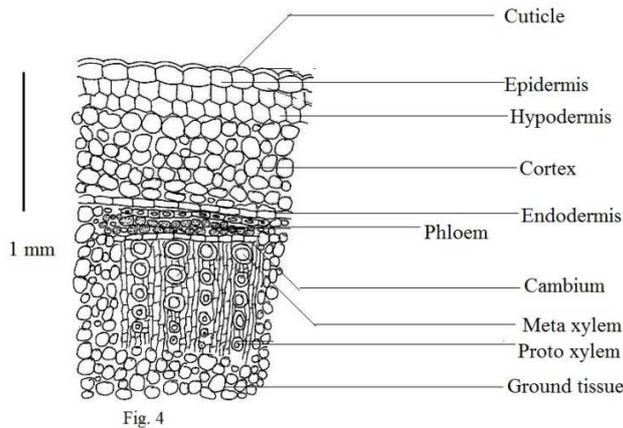


Fig.3 T.S of Internode of *Ageratum conyzoides* stem (Diagrammatic)

Fig. 4T.S of Internode of *Ageratum conyzoides* stem (Cellular)

Node anatomy

In *Ageratum houstonianum*, it is triangular, tritraced condition, 4 – trace cut out from the lateral side of the stem.(Fig. 5)

In *Ageratum conyzoides* it is trilacunar, 8 traced condition. 8 traces are developed from the stem vascular trace at the lateral side. (Fig. 6)

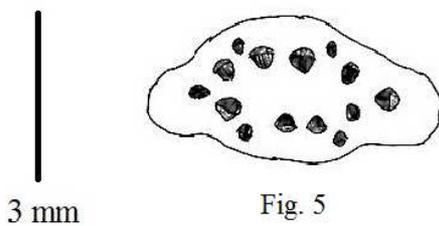


Fig. 5

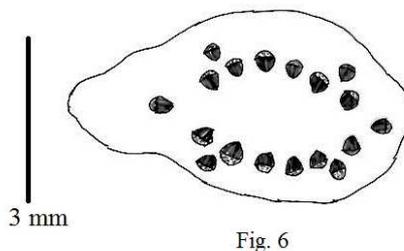


Fig. 6

Fig. 5.Node of *Ageratum houstonianum* Fig. 6.Node of *Ageratum conyzoides*

Petiolar anatomy

Ageratum houstonianum:(Fig. 7, ABC)

In *Ageratum houstonianum*, the proximal end of the petiole is tritraced. In the middle portion of the petiole one small trace is cut out from the middle trace and as a result 4-traced condition (Fig. 7B) present in the

middle portion of the petiole. At distal end there is no extra trace so at the distal end of the petiole is again 3 traced condition. Length of the petiole is gradually elongated towards the distal end inversely diameter of the petiole is slightly decreased towards the distal end of the petiole than the proximal end.

Ageratum conyzoides:(Fig. 8, ABC)

In *Ageratum conyzoides*, the proximal end of petiole is 5- traced condition. Petiole is structurally identical in medial region i.e. 5-traced condition. At the distal end two

small traces are developed from the middle trace. As a result the distal end of it becomes 7- traced condition (Fig. 8C) with alternate small and large traces. Length and diameter of the petiole is more or less identical with the *Ageratum houstonianum*.

Fig. 7

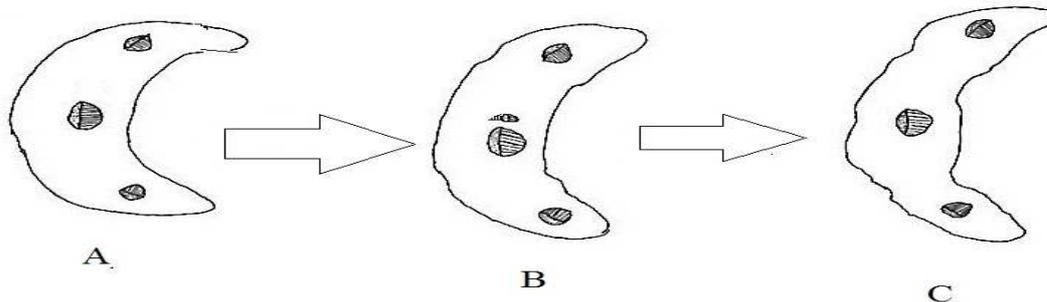


Fig. 8

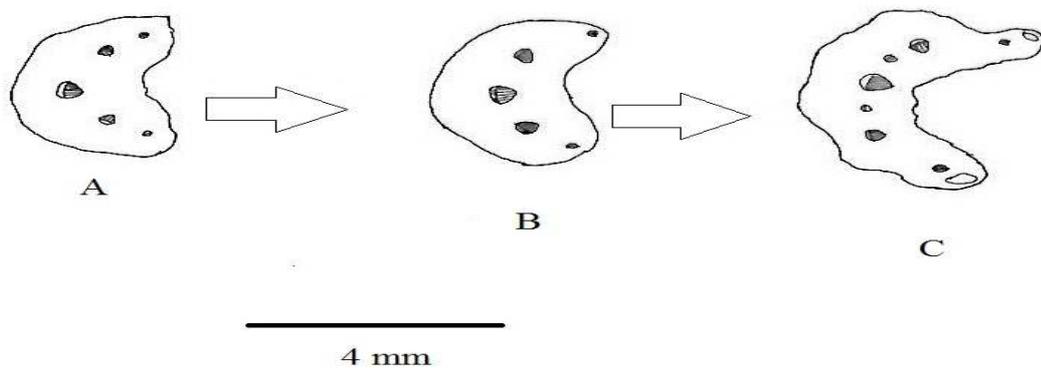


Fig.7. Petiole of *Ageratum houstonianum*

- A) Proximal end
- B) Median region
- C) Distal end

Fig.8.Petiole of *Ageratum conyzoides*

- A) Proximal end
- B) Median region
- C) Distal end

Root anatomy

Ageratum houstonianum:(Fig. 9, 10)

Transverse section of *Ageratum houstonianum* through the root shows following arrangement of the tissue from periphery to Centre

Epiblema: Outer most layer, single cell layered thick, compactly arranged, without any intercellular spaces, rectangular outline;cortex present below epiblema.

Cortex :6 cell layered thick ,loosely arranged , with intercellular spaces , thin walled ,

consisting of parenchymatous cells ; in the outer part of the cortex single row of ducts exist ; endodermis present below cortex , oval to rounded shaped , yellowish in colour.

Stele: The primary xylem is polyarch, secondary phloem exist in few layers surrounding the secondary xylem of widezone. Amount of xylem more than the phloem.

Pith: Pith is very small, consisting of loosely arranged, oval shaped, parenchyma cells with profuse intercellular spaces.

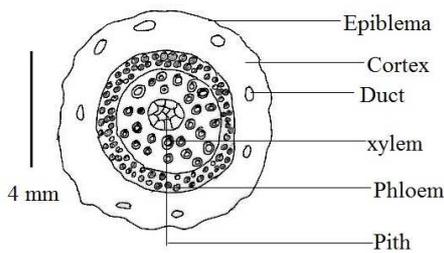


Fig. 9

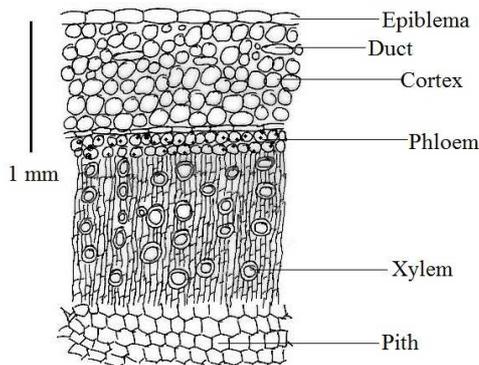


Fig. 10

Fig.9.T.S. of root of *Ageratum houstonianum* (Diagrammatic)

Fig.10. T.S. of root of *Ageratum houstonianum* (Cellular)

Ageratum conyzoides: (Fig. 11, 12)

Transverse section of *Ageratum conyzoides* through the root shows following arrangement of the tissue from periphery to centre-

Epiblema: Outer most layer, single cell layered thick, compactly arranged, without any intercellular spaces, rectangular outline; cortex present below epiblema.

Cortex : 6 cell layered thick ,loosely arranged , with intercellular spaces , thin walled , consisting of parenchymatous cells ; in the

outer part of the cortex single row of ducts exist ; endodermis present below cortex , oval to rounded shaped , yellowish in colour.

Stele: The primary xylem is polyarch, secondary phloem exist in few layers surrounding the secondary xylem of wide zone. Amount of xylem more than the phloem.

Pith: Pith is very small, consisting of loosely arranged, oval shaped, parenchyma cells with profuse intercellular spaces.

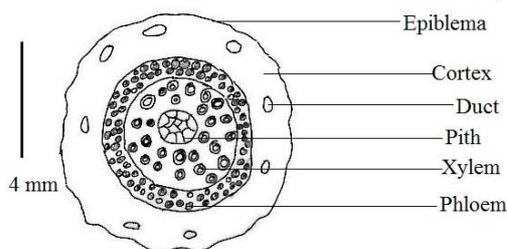


Fig. 11

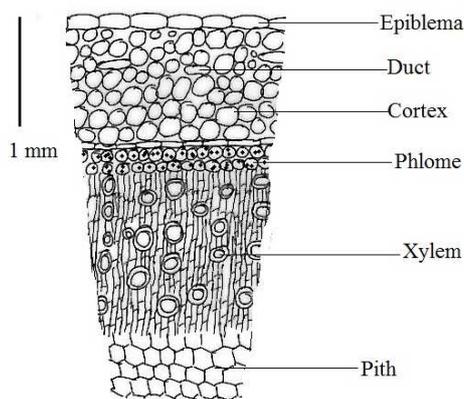


Fig. 12

Fig. 11.T.S. of root of *Ageratum conyzoides* (Diagrammatic)

Fig.12. T.S. of root of *Ageratum conyzoides* (Cellular)

Cypselar morphology

Ageratum houstonianum: (Figs. 13, 14)

Cypselas homomorphic, 3 mm X 1 mm including pappus, slightly curved, blackish brown, linear, upper part truncated, basal part slightly tapered, round to ellipsoidal in cross sectional configuration. Surface slightly pubescent, containing twine hairs, ascending in orientation with the surface made up of body cell and basal cell. The tip portion of the body cells with unequal arrangement. At the upper portion of the cypselas stylopodium present, inconspicuous fully emerged in the nectary. Pappus represented by 5 strongly unequal scaly pappus bristles, yellowish in colour, at the basal region of cypselas carpodium present, narrower than the base, symmetric. Carpodium cells with thick walled, medium not pitted, arranged in single row.

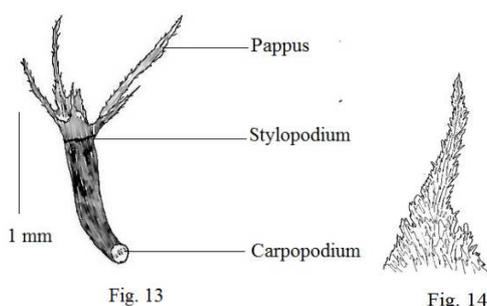


Fig.13.Cypselas of *Ageratum houstonianum*

Fig.14. Single pappus of *Ageratum houstonianum*

Ageratum conyzoides : (Figs. 15, 16)

Cypselas homomorphic, 3 mm X 1 mm including pappus, black brown, linear, upper part truncated, basal part slightly tapered, round to ellipsoidal in cross sectional configuration. Surface slightly pubescent, containing twine hairs, ascending in orientation with the surface made up of body cell and basal cell. The tip portion of the body cell with bifurcation. At the upper portion of the cypselas stylopodium present, inconspicuous fully emerged in the nectary. Pappus homomorphic represented by 5 slightly unequal, scaly pappus bristles, yellowish in colour, at the basal region of cypselas carpodium present, narrower than the base, symmetric. Carpodium cells with thick walled, elongated, not pitted, arranged in single row.

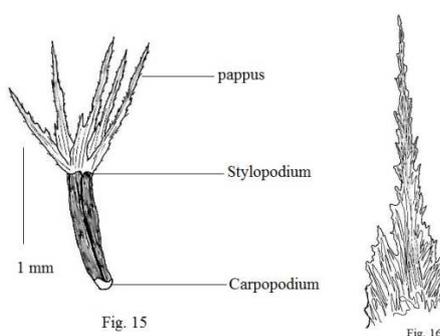


Fig.15. Cypselas of *Ageratum conyzoides*

Fig.16. Single Pappus of *Ageratum conyzoides*

PALYNOLOGICAL OBSERVATION:

Ageratum houstonianum: (Fig. 17)

Pollenspheroidal, 30 μm ; tricolpate, colpus short, end acute, pore operculate. Spine thick 4 μm thick, echinate, spine 25 μm high, base bulbous as a cushion. Sexine thicker than nexine.

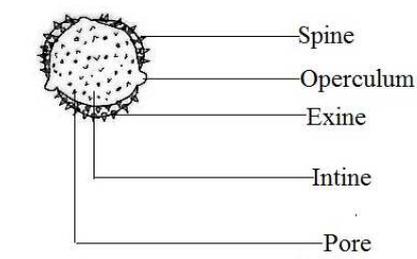


Fig. 17

Ageratum conyzoides:(Fig. 18)

Pollen spheroidal, 30 μm ; tricolpate, colpus short, end acute, pore operculate. Spine thick 4 μm thick, echinate, spine 15 μm high, base bulbous as a cushion. Sexine thicker than nexine.

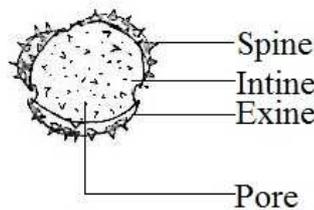


Fig. 18

Fig. 17. Pollen of *Ageratum houstonianum*

Fig. 18. Pollen of *Ageratum conyzoides*

Two species of *Ageratum* (*A. conyzoides* and *A. houstonianum*) are commonly found as an exotic obnoxious weed of Nadia district. In Bengal plants (Prain, 1963) only one species (*A. conyzoides*) had been included. There is no report regarding the presence of *Ageratum houstonianum* in Nadia district (Das, 1969). Although this species is widely growing in different parts of Nadia district specially in Kalyani area. Apparently two species of *Ageratum* is somehow identical but there are some morphological distinguishing characters which are as follows:

Ageratum conyzoides

Ageratum houstonianum

-
- | | |
|--|---|
| 1. Plants are less vigorous usually not above the length of 40 cm. | 1. Plants are more vigorous usually reaching up to 70 cm. high. |
| 2. Leaf base usually cuneate. | 2. Leaf base usually hastate to rounded rarely cuneate. |
| 3. Diameter of capitulum is less, up to 4mm. wide. | 3. Diameter of capitulum is more usually up to 6mm. wide. |
| 4. Involucral bracts glabrous. | 4. Involucral bracts pubescent. |
| 5. Corolla shorter than pappus scales white or blue in colour. | 5. Corolla longer than pappus scales maroon or blue in colour. |
| 6. Length of style is usually 3-4 mm. long. | 6. Length of style 4-7mm long. |
| 7. Cypselas comparatively shorter (1mm) than <i>A. houstonianum</i> | 7. Cypselas larger than previous species (1.3 mm) |
| 8. Cypselas densely hairy on the ribs region. | 8. Cypselas sparsely hairy on the ribs region. |
| 9. Mature pappus scales slightly narrower and more elongated than <i>A. houstonianum</i> . | 9. Mature pappus scales wider and slightly shorter than the previous species. |
-

In addition to the above morphological variation plants also possess some distinguishing anatomical and palynological characters –

Ageratum conyzoides

Ageratum houstonianum

1. Hypodermal region of the stem is always constituted by 2 layers of collenchymatous cells.

1. Hypodermal region of the stem is usually composed of 2 – 3 layers of collenchymatous cells.

2. Number of vascular bundles in stem is usually variable from 9 – 10 .

2. Number of vascular bundles in stem is usually variable from 10 – 12.

3. Node is trilacunar and tritraced condition in both the species, but the number of dorso-ventral trace is 6 in each side.

3. Node is trilacunar and tritraced condition in both the species, but the number of dorso-ventral trace is 4 in each side.

4. Petiolar construction :

4. Petiolar construction :

2L + 3M + 2L(Distal end)

1L + 1M + 1L(Distal end)

2L + 1M + 2L(Mid region)

1L + 2M + 1L(Mid region)

2L + 1M + 2L(Proximal end).

1L + 1M + 1L(Proximal end).

5. Petiole is more thicker and shorter in length than *Ageratum houstonianum*.

5. Petiole is comparatively thinner and longer in length than previous one.

6. At the distal part in two petiolar ends possess 2 secretory ducts.

6. There is no secretory ducts in distal part of petiole.

7. Pollen grains are more or less identical, but the length of spine is quite different.

7. Spine is 25 µm high.

Spine is 15 µm high.

Therefore from the present investigation it is seen that some morphological characters are important for characterization of each taxon. Similarly some anatomical features like stem anatomy, petiolar, and nodal anatomy are important; but the root anatomy has no role for isolation of taxon. Other than the length of spine, pollen grains are more or less identical in nature.

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