

Anatomical Investigations on Medicinally Important Plant *Trichosanthes Anguina* Linn

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Abstract: The family Cucurbitaceae is among the largest and the most diverse plant family is cultivated worldwide in a variety of environmental conditions. Plants from this family cultivated because of the fruits, seeds and vegetables are traditionally consumed in various Ayurvedic preparations and confectionaries. *Trichosanthes anguina* Linn.(snake gourd) is a cultivated species from the family Cucurbitaceae. The fruit is very long and usually consumed as a vegetable due to its good nutritional value. The fruit has good source of minerals, fibers and vitamins such as vitamin A, vitamin B, vitamin C. It increases appetite and acts as a tonic and stomachic, lessens thirst, cures biliousness and the seeds are considered cooling. Anatomical study of different parts of the *Trichosanthes anguina* Linn. like root, stem, leaf, petiole, tendril and epidermal study were carried out.

Keywords: Cucurbitaceae, *Trichosanthes anguina* Linn., Anatomy, Ayurvedic

1. Introduction

The Cucurbitaceae is commonly known as gourd family, and having high economic and medicinal value. The Cucurbitaceae is essentially a tropical family containing 110 genera and 640 species. In India the family is represented by 37 genera and about 97 species. Several of which are cultivated throughout India. *Trichosanthes anguina* Linn. is medicinally important climber, belonging to the family cucurbitaceae commonly known as Padaval. The fruits are generally long, narrow and cylindrical giving the shape of snake. The fruit appears green when unripe, turning orange-red on ripening and bitter in taste. The nutritional point of view the fruit of *Trichosanthes anguina* Linn. are important sources of nutrients necessary for human and animal health, the nutritional values make the plant pharmacologically and therapeutically active. This plant is largely used as a vegetable, either boiled or in curry. The fruits are used as a tonic, cure vata, thirst, biliousness. The roots and seeds are anthelmintic and anti-diarrhoeal, in syphilis. In Indo China, the plant is used as a purgative and vermifuge.

2. Material and Methods

The plants were collected from Amravati District. Detailed morphological characters regarding the vegetation and floral parts of the plants were studied. For identification standard floras were referred. For classification of plants Bentham and Hooker's system of classification were used. Only basic citation of valid names and synonyms were mentioned in the text. (Bentham and Hooker 1876; Cooke 1967; Naik 1998; Dhore 2002; Singh 2001). The epidermal study of stomata and trichomes were carried out by peeling method, the peeled part were stained in saffranine and mounted in a glycerin and observed the types of stomatas and trichomes under the compound microscope and identified. Anatomy of stem, root, leaves, petiole and tendril were studied. The collected plant materials of different plant parts were preserved in 4% formalin. The thin hand cut sections of the plant material were taken and selected for further permanent

slide preparation by using different stains. Slides were observed under microscope, anatomical characteristics and measurements were noted, also from the above slides photographs were shoot out by using Trinocular microscope of Carl Zeiss.

3. Morphological Observation

Plants Climber, annual herbs; stem herbaceous, furrowed or 5-angled, hairy; tendril 2-3 fid, slender; leaves large, broadly ovate or orbicular to reniform, 9-14.5x11-17.5cm, cordate at base, shallowly 5-7 lobed distantly, margin denticulate, pubescent, upper surface glabrous and scabrid beneath, alternate, reticulate venation; petiole 11.2-14cm, stout, striate, hairy or pubescent; plant monoecious; male flower in 9.5-24cm long, 8-15 flowered axillary racemes, slender, striate, pedicels 0.5-2cm long, puberulous, ebracteate; female flower solitary, axillary, short pedicellate 0.5-5cm long; calyx-tube, 2.2-3cm long, dilated at the apex, wide at the mouth, subcylindrical, teeth, 1.2-2mm long reflexed, acutely triangular; corolla, petals, 7-9 mm long, white, lanceolate to oblong, fimbriate at their margin or apex, epigynous; anther ovoid, filaments slender, 1-2mm long, anther ovoid, pistillode, 9.5-14 mm long, ovary oblong; fruits, 1-3 feet long, smooth or coiled, when young it is green and striped with white, changing to a bright yellow to orange red when ripe; seeds 11-14x5-10mm, semi ellipsoid, compressed, undulate, truncate at apex, narrow at base, rugulose, surrounded with pulp.

4. Anatomical Observations

4.1. T.S of Root

In transverse section observed circular outline. Epidermis single layered composed of some rectangular, barrel shaped, squarish cells, average 29.4 x 56.5 µm and range 26.5 - 42.4 x 53.6 - 75.8 µm. It is crushed at some places and observed initiation of differentiation of cork tissue or phellem 1-2 layered with some rectangular flattened or rounded cells,

average 34.2 x 65.5 μm and range 25.6 - 45.6 x 51.3 - 88.3 μm . Below it present single layered cork cambium or phellogen; composed of rectangular, cells present in 1-2 layered strips, average 17.1 x 30.4 μm and range 14.2 - 19.9 x 22.8 - 37 μm . Below it form phelloderm composed of 4-5 layered thin walled, rounded, squarish, oblong, average 19.9 x 36.1 μm and range 14.2 - 28.5 x 28.5 - 45.6 μm . Below the phelloderm parenchymatous cells present parenchyma loosely arranged with intercellular spaces, average 38.9 x 48.4 μm and range 31.3 - 48.4 x 39.9 - 62.7 μm . Below the cortex present 1-2 layered parenchymatous pericycle, average 19.9 x 37.5 μm and range 17.1 - 22.8 x 25.6 - 51.3 μm . In the pericycle region found sclerenchymatous patches above the phloem tissue, sclerenchyma thick walled hexagonal, polygonal, rounded, squarish, triangular in shape, average 15.2 x 19.9 μm and range 11.4 - 19.9 x 17.1 - 22.8 μm . Phloem tissue 10- 15 layered or more, cells triangular, oval, rectangular or irregular in shape and compactly arranged, average 19.9 x 18.5 μm and range 14.2 - 28.5 x 11.4 - 22.8 μm . Primary phloem present towards the periphery and secondary phloem present next to it. Below the phloem present cambium tissue cells rectangular, present in stacks 3-7 layered, average 8.55 x 15.2 μm and range 5.7 - 11.4 x 11.4 - 19.9 μm . Below it present secondary xylem exarch in condition. Protoxylem towards the periphery average 47.5 x 45.6 μm and range 34.2 - 62.7 x 28.5 - 68.4 μm and metaxylem towards the center Some metaxylem vessels enlarged, circular to oval in shape, thick walled vessels scattered, average 137.7 x 100.7 μm and range 102.6 - 173.8 x 71.2 - 125.4 μm . At the center present primary xylem exarch in nature present in four groups. Primary xylem tetrach in condition. From the primary xylem the four primary medullary rays present they composed of rounded, squarish, barrel shaped, rectangular, elongated parenchyma cells, average 42.7 x 13 μm and range 22.8 - 59.8 x 11.4 - 28.5 μm . Medullary rays runs from primary xylem through secondary xylem and phloem toward the periphery they becomes dilated. Pith absent.

4.2. T.S of Stem

In transverse section of stem observed, 5 ridges and 5 furrows with wavy outline. Epidermis single layered with thin cuticle. Cells rectangular or barrel shaped, average 17.9 x 32.2 μm and range 14.2 - 22.8 x 17.1 - 48.4 μm . On the epidermis externally present number of glandular trichomes, simple trichomes, average 107.4 x 23.6 μm and range 54.1 - 239.4 x 17.1 - 31.3 μm and stomata. Stomata raised. Below the epidermis present 7-8 layered collenchymatous hypodermis in the region of ridges and in the region of the furrow it may be 2-3 layered only composed of thick walled rounded, polygonal, squarish, oval, compactly arranged cells, average 19.9 x 25.6 μm and range 11.4 - 28.5 x 17.1 - 37 μm . Below it in cortex present chlorenchymatous tissue 1-2 layered in the ridge region and 3-5 layered in the furrow region. Cells polygonal, oval, rectangular and elongated; thin walled and with full of chloroplasts, average 17.9 x 41.6 μm and range 14.2 - 22.8 x 28.5 - 59.8 μm . Endodermis single layered composed of barrel shaped cells, average 17.9 x 34.2 μm and range 14.2 - 22.8 x 28.7 - 39.9 μm . Pericycle sclerenchymatous, in the region of ridges it may be 5-8 layered and 3-5 layered in the region of furrow. Pericycle formed a continuous ring of thick walled,

polygonal, hexagonal, rounded, squarish or triangular cells, average 23.6 x 35 μm and range 14.2 - 34.2 x 19.9 - 45.6 μm . Below it present ground tissue, composed of thin walled parenchymatous cells with intercellular spaces. Cells isodiametric, rounded, polygonal, oval in shape, large in size and loosely arranged, average 354.2 x 111.15 μm and range 62.7 - 190.9 x 51.3 - 179.5 μm . In the ground tissue 10 bicollateral vascular bundles present in a two rings. Outer ring composed of 5 cortical vascular bundles, smaller in size and oval in shape. Vascular bundles from the inner ring 5 in number, large in size, known as medullary vascular bundles, average 1073.3 x 873.8 μm and range 772.3 - 1276 x 592.8 - 1134 μm . In the vascular bundles xylem present at the center. Endarch protoxylem towards the center, average 54.1 x 41.6 μm and range 34.2 - 82.6 x 28.5 - 57 μm and metaxylem towards the periphery, average 256.5 x 235.4 μm and range 139.6 - 361.9 x 151 - 324.9 μm . Few vessels from each vascular bundle were prominent and enlarged, thick walled, rounded to oval in shape. On the upper side of the xylem present upper cambium it may be 7-8 layered, average 14.2 x 25.6 μm and range 8.55 - 19.9 x 17.1 - 34.2 μm and below the xylem present inner cambium it may be 8-9 layered, average 11.4 x 21.6 μm and range 8.55 - 14.2 x 14.2 - 28.5 μm . Cambium cells composed of rectangular, squarish flattened, arranged in rows, compactly arranged. Above the upper cambium present upper phloem it may be 10-13 layered, average 25.6 x 29.3 μm and range 17.1 - 31.3 x 19.9 - 42.7 μm . and below the inner cambium present inner phloem it may be 9-10 layered, average 35.1 x 33.3 μm and range 25.6 - 42.7 x 22.8 - 48.4 μm . Phloem composed of polygonal, rounded, squarish, compactly arranged cells. Sieve tubes with companion cells, sieve plates with perforations; fibers and parenchyma etc. At the central region hollow pith observed.

4.3. V.S of Leaf

In vertical section of leaf observed, typical dorsiventral structure. The epidermis from both the surfaces such as upper and lower epidermis single layered covered externally with thick cuticle. On both the epidermis present abundant trichomes variable in shape, size; multicellular, uniseriate, simple trichomes, multicellular uniseriate headed trichomes and some glandular trichomes, average 224 x 29.3 μm and range 105.4 - 316.3 x 22.8 - 34.2 μm . Raised Stomata's present on both the epidermal surfaces. More number of stomata's observed on lower epidermis than the upper one. The upper epidermal cells from lamina region, squarish, rectangular, barrel shaped, large in size and compactly arranged, average 27.3 x 35 μm and range 19.9 - 34.2 x 25.6 - 45.6 μm . In the midrib region it showed presence of circular, oval, barrel shaped, elongated, smaller cells, compactly arranged, average 30.2 x 50.1 μm and range 22.8 - 37 x 34.2 - 74.1 μm . The Lower epidermal cells in lamina region, composed of circular, rectangular, flattened, barrel shaped, compactly arranged and smaller than upper epidermal cells from lamina region, average 17.9 x 33 μm and range 14.2 - 22.8 x 22.6 - 48.4 μm . In the midrib region cells rounded, oval, barrel shaped, looks like small bids arranged in a string, smaller than epidermal cells of lamina and upper epidermal cells of lamina and midrib region, average 15.1 x 23.6 μm and range 11.4 - 19.9 x 17.1 - 31.3 μm . Mesophyll differentiated into palisade and spongy

tissue. Below the upper epidermis observed single layered palisade cells columnar, vertically much elongated, compactly arranged filled with numerous chloroplasts, average $74.1 \times 19.9 \mu\text{m}$ and range $62.7 - 85.5 \times 17.1 - 22.8 \mu\text{m}$. In between palisade and lower epidermis present spongy tissue. It composed of rounded to irregular cells filled with chloroplasts and starch grains, arranged very much loosely present large air spaces between them, average $21.6 \times 17.9 \mu\text{m}$ and range $14.2 - 28.5 \times 17.1 - 19.9 \mu\text{m}$. In the midrib region, towards the upper surface present dome shaped central elevation and lower portion of the midrib showed bigger U-shaped bulged portion. Beneath the upper epidermal layer in the elevation portion present 9-10 layered thick walled collenchymatous patch and beneath the lower epidermis present 2-3 layered collenchymatous tissue. Collenchyma composed of thick walled, circular, oval, triangular, polygonal, compactly arranged cells, average $33 \times 40.7 \mu\text{m}$ and range $26.9 - 45.6 \times 25.6 - 57 \mu\text{m}$. Inside the collenchymatous patch present parenchymatous ground tissue, it composed of circular, oval, polygonal, irregular cells with wavy boundaries, average $120.5 \times 118.5 \mu\text{m}$ and range $65.5 - 168 \times 76.9 - 165.3 \mu\text{m}$. At the center placed main vascular bundle and slightly above it 2-4 vascular bundles in number. Vascular bundles bi-collateral type average $503 \times 333.4 \mu\text{m}$ and range $416.1 - 589.9 \times 210.9 - 456 \mu\text{m}$. In the vascular bundle xylem present centrally, Xylem cells arranged in a rows one above the other. Metaxylem cells large in size and rounded to oval in shape, average $57.8 \times 53 \mu\text{m}$ and range $39.9 - 76.9 \times 45.6 - 62.7 \mu\text{m}$. Above the metaxylem present protoxylem smaller in size as compared to metaxylem and rounded to oval in shape, average $24.5 \times 25.6 \mu\text{m}$ and range $22.8 - 28.5 \times 19.9 - 34.2 \mu\text{m}$. Outside of the xylem towards the center present inner cambium it may be 3-4 layered, average $11.4 \times 15.9 \mu\text{m}$ and range $8.55 - 14.2 \times 14.2 - 19.9 \mu\text{m}$ and towards the periphery present 5-6 layered outer cambium average $11.4 \times 17.1 \mu\text{m}$ and range $8.58 - 14.2 \times 14.2 - 20.1 \mu\text{m}$. Cambial cells squarish, rectangular in shape. Outside the upper cambium present upper phloem 16-17 layered, average $14.2 \times 13.1 \mu\text{m}$ and range $11.4 - 19.9 \times 8.55 - 17.1 \mu\text{m}$ and below the inner cambium present inner phloem 8-9 layered, average $13.1 \times 12.2 \mu\text{m}$ and range $11.4 - 14.2 \times 8.55 - 17.1 \mu\text{m}$. Phloem cells well developed composed of rounded, oval, polygonal, rectangular some enlarged sieve elements along with companion cells parenchyma and fibers

4.4. T.S of Petiole

Transverse section of petiole observed, somewhat oval and at one end broad notch present. Epidermis single layered composed of oval, elongated, compactly arranged, cells externally covered with thick cuticle, average $22.8 \times 35 \mu\text{m}$ and range $17.1 - 31.3 \times 22.8 - 51.3 \mu\text{m}$. Also intermittently stomata's were present, stomatas raised. On the epidermis present multiple uniserate multicellular, some headed hairs, average $175.5 \times 35 \mu\text{m}$ and range $62.7 - 273.6 \times 17.1 - 54.1 \mu\text{m}$. Below the epidermis present 4-5 layered collenchymatous hypodermis composed of circular, polygonal, oval, compactly arranged thick walled collenchyma cells, smaller in size, average $23.2 \times 24.5 \mu\text{m}$ and range $14.2 - 42.7 \times 17.1 - 37 \mu\text{m}$. At the corner's of notch and at the center of the notch thick patches of angular collenchyma present. Below the collenchymatous layer

present chlorenchymatous tissue, these tissue present in the form of patches. It composed of thin walled circular, oval and polygonal, loosely arranged chlorenchymatous cells filled with chloroplasts, intercellular spaces in between the cells, average $20.8 \times 48.4 \mu\text{m}$ and range $17.1 - 25.6 \times 31.3 - 65.5 \mu\text{m}$. Below the chlorenchymatous tissue present parenchymatous ground tissue composed of circular, oval, polygonal, squarish, thin walled loosely arranged cells with intercellular spaces, average $186.9 \times 154.7 \mu\text{m}$ and range $128.2 - 256.5 \times 96.9 - 216.6 \mu\text{m}$. In the ground tissue in all 10 bicollateral and open vascular, bundles, average $572.8 \times 322.9 \mu\text{m}$ and range $250.8 - 977.5 \times 131.1 - 558.6 \mu\text{m}$. They arranged in U shaped manner, towards the apical notch present younger and smaller vascular bundles and remaining were bigger one and towards the opposite side of the notch at the center present most enlarged vascular bundle. Each vascular bundle shown 2-3 layer sclerenchymatous patch or looks like a crown, it composed of hexagonal to polygonal, thick walled, compactly arranged cells, average $24.5 \times 31.3 \mu\text{m}$ and range $8.55 - 39.9 \times 11.4 - 54.1 \mu\text{m}$. Xylem present centrally composed of enlarged vessels with thick walls and tracheids, oval, circular in shape, average $40.7 \times 29.3 \mu\text{m}$ and range $31.3 - 51.3 \times 25.6 - 34.2 \mu\text{m}$. Above the xylem present upper cambium it may be 2-3 layered composed of squarish, rectangular cells, compactly arranged, average $8.55 \times 13.1 \mu\text{m}$ and range $5.7 - 11.4 \times 8.55 - 17.1 \mu\text{m}$. Above the upper cambium present 15-16 layered upper phloem, it composed of circular, squarish and oval cells, average $10.7 \times 15.1 \mu\text{m}$ and range $8.55 - 17.1 \times 11.4 - 17.5 \mu\text{m}$. Below the xylem towards the center present 4-5 layered inner cambium composed of squarish, rounded to rectangular cells, compactly arranged smaller in size, average $9.40 \times 12.2 \mu\text{m}$ and range $8.55 - 11.4 \times 8.48 - 14.2 \mu\text{m}$ and below the inner cambium present 13-14 layered inner phloem composed of circular, oval, squarish, polygonal cells, average $10.2 \times 14.2 \mu\text{m}$ and range $8.55 - 11.4 \times 11.4 - 17.1 \mu\text{m}$. In the outer phloem and inner phloem, at the boundary present crystal containing cells; star shaped, prismatic and rhomboidal crystals observed. Central parenchymatous pith present.

4.5. T.S of Tendril

In transverse section of tendril observed, outline pentangular in shape with 5 distinct ridges and furrows. Epidermis single layered with rectangular, barrel shaped, elongated, compactly arranged, thin walled cells, average $18.8 \times 28.5 \mu\text{m}$ and range $12.5 - 22.8 \times 22.8 - 37 \mu\text{m}$. Cuticle thin. Abundant trichomes such as simple multicellular uniserate narrow pointed trichomes, simple multicellular headed trichomes and multicellular glandular trichomes, average $129.1 \times 23.6 \mu\text{m}$ and range $79.8 - 190.9 \times 17.1 - 31.3 \mu\text{m}$. On the epidermis few raised stomatas observed distributed on epidermal surface. Below the epidermis present collenchymatous hypodermis it composed of circular, oval, polygonal, thick walled cells, compactly arranged without any intercellular spaces, generally present in 3-4 layers but at the ridges region 7-12 layered or more variable, average $17.9 \times 24.5 \mu\text{m}$ and range $11.4 - 22.8 \times 14.2 - 34.2 \mu\text{m}$. Below the collenchymatous layers present chlorenchymatous tissue 2-3 layered cells bigger than the collenchyma oval to circular in shape filled with abundant chloroplasts, average $29.3 \times 49.3 \mu\text{m}$ and range $17.1 - 42.7 \times 25.6 - 76.9 \mu\text{m}$. Beneath the chlorenchyma found presence

of single layered prominent endodermis composed of oval to barrel shaped cells, compactly arranged, enlarged, average 23.7 x 38.9 µm and range 17.1 - 31.3 x 28.5 - 51.3 µm. Below the endodermis present sclerenchymatous pericycle with continuous ring, 3-4 layered, thick walled, circular, oval, polygonal, triangular, average 24.7 x 20.8 µm and range 14.2 - 37 x 14.2 - 31.3 µm. Beneath the pericycle present parenchymatous ground tissue it composed of enlarged, thin walled, circular, oval, isodiametric, loosely arranged, cells with intercellular spaces, Cells bigger towards the center and smaller towards the peripheral region, average 92.1 x 93.1 µm and range 39.9 - 162.4 x 45.6 - 173.8 µm . Initially observed 5 bicollateral vascular bundles present beneath the ridges. At maturity appeared some newly formed vascular bundles beneath the furrow region, average 319.2 x 174.8 µm and range 259.3- 393.3 x 136.8 - 159.6 µm. Centrally placed xylem vessels enlarged thick walled and scattered well developed circular to rounded in shape, average 32.3 x 38.9 µm and range 25.6 - 39.9 x 28.5 - 51.3 µm . Above the xylem present upper cambium it may be 2-3 layered, average 11.4 x 14.2 µm and range 8.55 - 14.2 x 11.4 - 17.1 µm and below the xylem present inner cambium it may be 4-5 layered, average 10.4 x 14.2 µm and range 8.55 - 11.4 x 11.4 - 17.1 µm . It is rectangular, squarish, compactly arranged, flattened, thin walled. Outside the outer cambium present outer phloem it may be 7-8 layered, average 13.3 x 15.2 µm and range 8.55 - 17.1 x 11.4 - 22.8 µm and inner side of the inner cambium present inner phloem it may be 9-10 layered, average 15.2 x 16.1 µm and range 11.4 - 19.9 x 11.4 - 22.8 µm. It compose of oval, rounded, squarish, polygonal cells, compactly arranged. At the central region, hollow part or lumen present, may be due to the disintegration of central parenchymatous ground tissue.

5. Epidermal Observations

5.1. Stomatal study

Leaf amphistomatic, Epidermal peels of both abaxial and adaxial surfaces, observed presence of anomocytic type of stomata. Guard cells surrounded by five unequal subsidiary cells sometimes it six in number. Subsidiary cells are rectangular to polygonal in shape, with straight wall.

5.2. Trichome study

Trichomes are known to be present on the surfaces of leaves, stem, tendrils, fruits as well as flowers. Abundant number of different types of trichomes were present on various parts of plant. Trichomes were such as simple, multicellular, uniseriate, glandular trichomes; multicellular globular headed trichomes. They were variable in size and shape.

6. Observations Table

Table I: Root Anatomy

Cell type	Dimensions in <i>Trichosanthes anguina</i> Linn.	
	Average (µm)	Range (µm)
Epidermis	17.9 x 32.2 µm	14.2-22.8x17.1-48.4 µm
Trichomes	107.4 x 23.6 µm	54.1-239.4 x 17.1-31.3 µm
Collenchyma	19.9 x 25.6 µm	11.4-28.5x17.1-37 µm

Chlorenchyma	17.9 x 41.6 µm	14.2-22.8x28.5-59.8µm
Endodermis	17.9 x 34.2 µm	14.2-22.8x28.7-39.9 µm
Sclerenchyma	23.6 x 35 µm	14.2 - 34.2x19.9-45.6µm
Parenchyma	354.2 x 111.15 µm	62.7-190.9x51.3-179.5 µm
Vascular bundle	1073.3 x 873.8 µm	772.3-1276x592.8-1134µm
Outer phloem	25.6 x 29.3 µm	17.1-31.3x19.9-42.7 µm
Outer cambium	14.2 x 25.6 µm	8.55-19.9x17.1-34.2µm
Metaxylem	256.5 x 235.4 µm	139.6-361.9x151-324.9µm
Protoxylem	54.1 x 41.6 µm	34.2-82.6x28.5-57µm
Inner phloem	35.1 x 33.3 µm	25.6-42.7 x 22.8-48.4µm
Inner Cambium	11.4 x 21.6 µm	8.55-14.2x14.2-28.5µm

Table II: Stem Anatomy

Cell type	Dimensions in <i>Trichosanthes anguina</i> Linn.	
	Average (µm)	Range (µm)
Epidermis	29.4 x 56.5 µm	26.5-42.4 x 53.6-75.8µm
Phellem or Cork	34.2 x 65.5 µm	25.6-45.6 x 51.3-88.3µm
Phellogen	17.1 x 30.4 µm	14.2-19.9 x 22.8-37µm
Phelloderm	19.9 x 36.1 µm	14.2-28.5 x 28.5-45.6µm
Parenchyma	38.9 x 48.4 µm	31.3-48.4 x 39.9-62.7µm
Pericycle	19.9 x 37.5 µm	17.1-22.8 x 25.6-51.3µm
Sclerenchyma patch	15.2 x 19.9 µm	11.4-19.9 x 17.1-22.8µm
Phloem	19.9 x 18.5 µm	14.2-28.5 x 11.4-22.8 µm
Cambium	8.55 x 15.2 µm	5.7- 11.4 x 11.4-19.9µm
Metaxylem	137.7x100.7µm	102.6-173.8x71.2-125.4µm
Protoxylem	47.5x45.6µm	34.2-62.7 x 28.5-68.4 µm
Medullary rays	42.7 x 13 µm	22.8-59.8 x 11.4-28.5 µm

Table III: Leaf Anatomy

Cell type	Dimensions in <i>Trichosanthes anguina</i> Linn.	
	Average (µm)	Range (µm)
Upper epidermis	30.2 x 50.1 µm	22.8 - 37 x 34.2 - 74.1 µm
Lower epidermis	15.1 x 23.6 µm	11.4 - 19.9 x 17.1 - 31.3 µm
Arm region upper epidermis	27.3 x 35 µm	19.9 - 34.2 x 25.6 - 45.6 µm
Arm region lower epidermis	17.9 x 33 µm	14.2 - 22.8 x 22.6 - 48.4 µm
Trichomes	224 x 29.3 µm	105.4 - 316.3 x 22.8 - 34.2 µm
Pallisade cells	74.1 x 19.9 µm	62.7 - 85.5 x 17.1 - 22.8 µm
Mesophyll cells	21.6 x 17.9 µm	14.2 - 28.5 x 17.1 - 19.9 µm
Collenchyma	33 x 40.7 µm	26.9 - 45.6 x 25.6 - 57 µm
Parenchyma	120.5x118.5 µm	65.5 - 168 x 76.9 - 165.3 µm
Vascular bundle	503 x 333.4 µm	416.1 - 589.9 x 210.9 - 456µm
Outer phloem	14.2 x 13.1 µm	11.4 - 19.9 x 8.55 - 17.1 µm
Outer cambium	11.4 x 17.1 µm	8.58 - 14.2 x 14.2 - 20.1 µm
Metaxylem	57.8 x 53 µm	39.9 - 76.9 x 45.6 - 62.7 µm
Protoxylem	24.5 x 25.6 µm	22.8 - 28.5 x 19.9 - 34.2 µm
Inner phloem	13.1 x 12.2 µm	11.4 - 14.2 x 8.55 - 17.1 µm
Inner cambium	11.4 x 15.9 µm	8.55 - 14.2 x 14.2 - 19.9µm

Table IV: Petiole Anatomy

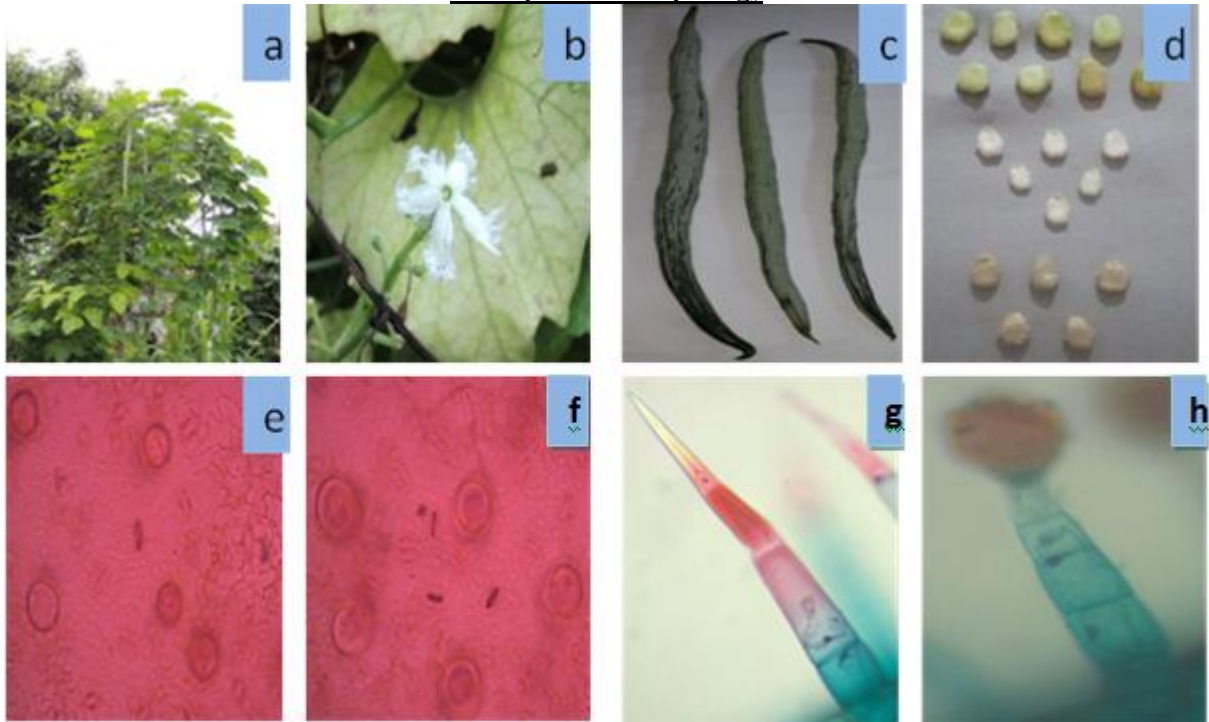
Cell type	Dimensions in <i>Trichosanthes anguina</i> Linn.	
	Average (µm)	Range (µm)
Epidermis	22.8 x 35 µm	17.1 - 31.3 x 22.8 - 51.3 µm
Trichomes	175.5 x 35 µm	62.7-273.6x17.1 -54.1 µm
Collenchyma	23.2 x 24.5 µm	14.2 - 42.7 x 17.1 - 37 µm
Chlorenchyma	20.8 x 48.4 µm	17.1 - 25.6 x 31.3 - 65.5 µm
Parenchyma	186.9x154.7µm	128.2-256.5x96.9-216.6 µm
Vascular bundle	572.8x322.9µm	250.8-977.5x131.1-558.6µm
Sclerenchymacap	24.5 x 31.3 µm	8.55 - 39.9 x 11.4 - 54.1 µm
Outer phloem	10.7 x 15.1 µm	8.55 - 17.1 x 11.4 - 17.5 µm
Outer cambium	8.55 x 13.1 µm	5.7 -11.4 x 8.55 - 17.1 µm
Xylem	40.7 x 29.3 µm	31.3 - 51.3 x 25.6 - 34.2 µm
Inner phloem	10.2 x 14.2 µm	8.55 - 11.4 x 11.4 - 17.1 µm
Inner cambium	9.40 x 12.2 µm	8.55 - 11.4 x 8.48 - 14.2 µm

Table V: Tendril Anatomy

Cell type	Dimensions in <i>Trichosanthes anguina</i> Linn.	
	Average (µm)	Range (µm)
Epidermis	18.8 x 28.5 µm	12.5 - 22.8 x 22.8 - 37 µm
Trichomes	129.1 x 23.6 µm	79.8 - 190.9 x 17.1 - 31.3 µm
Collenchyma	17.9 x 24.5 µm	11.4 - 22.8 x 14.2 - 34.2 µm
Chlorenchyma	29.3 x 49.3 µm	17.1 - 42.7 x 25.6 - 76.9 µm
Endodermis	23.7 x 38.9 µm	17.1 - 31.3 x 28.5 - 51.3 µm
Sclerenchyma	24.7 x 20.8 µm	14.2 - 37 x 14.2 - 31.3 µm

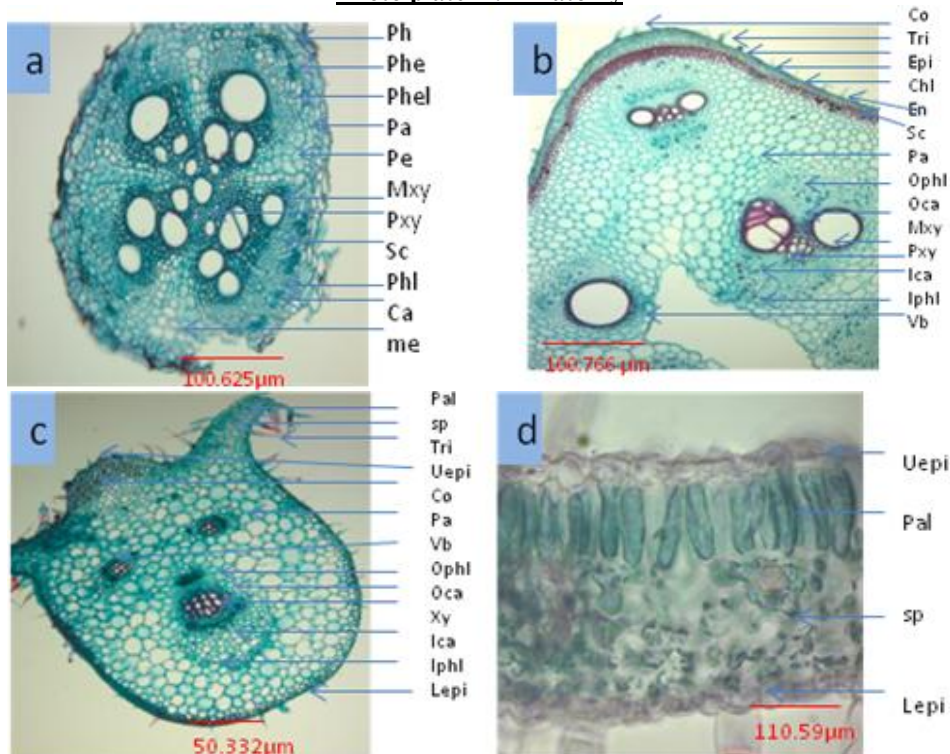
Parenchyma	92.1 x 93.1 µm	39.9-162.4x45.6-173.8 µm
Vascular bundle	319.2x174.8 µm	259.3-393.3x136.8-159.6µm
Outer phloem	13.3 x 15.2 µm	8.55 - 17.1 x 11.4 - 22.8 µm
Outer cambium	11.4 x 14.2 µm	8.55 - 14.2 x 11.4 - 17.1 µm
Xylem	32.3 x 38.9 µm	25.6 - 39.9 x 28.5 - 51.3 µm
Inner phloem	15.2 x 16.1 µm	11.4 - 19.9 x 11.4 - 22.8 µm
Inner cambium	10.4 x 14.2 µm	8.55 - 11.4 x 11.4 - 17.1 µm

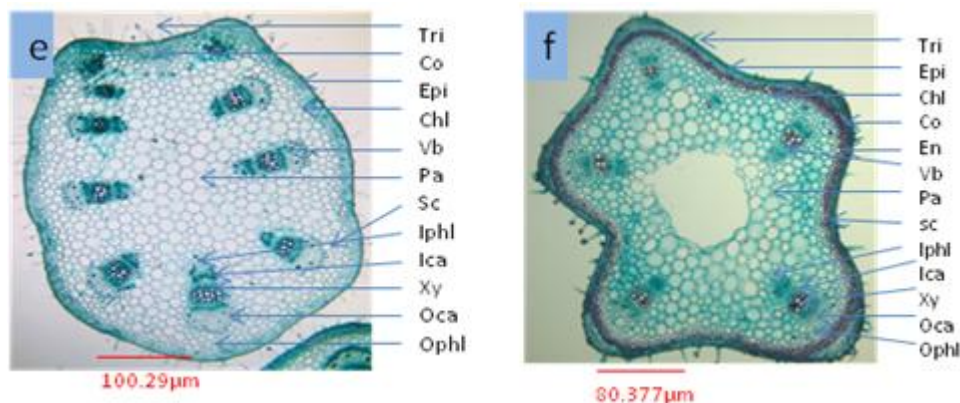
Photo plate I:- Morphology



a) Habit, b) Flower, c) Fruits, d) Seeds, e) Upper leaf surface stomata. f) Lower leaf surface stomata, g) Multicellular simple trichome, h) Multicellular headed trichome.

Photo plate II:- Anatomy





a-T.S of root, b-T.S of Stem, c-V.S of Leaf, d-Leaf lamina, e-T.S of petiole, f-T.S of tendril, Uepi-upper epidermis, Lepi-lower epidermis, Pal-pallisade, Sp-spongy parenchyma, Epi-epidermis, Tri-trichome, Co- collenchyma, Chl- chlorenchyma, En- endoremis, Sc sclerenchyma, Pa- parenchyma, Vb-vascular bundle, Ophl-outer phloem, Iphl-inner phloem, Oca-outer cambium, Ica-inner cambium, Xy-xylem, Mxy-metaxylem, Pxy-protoxylem, Phl-phloem, Ph-phellem, Phe-phellogen, Phel-phelloderm, Pe-pericycle, Ca- cambium, Me- medullary rays.

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