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MORPHO-ANATOMICAL ASPECTS OF *PROBOSCIDEA LOUISIANICA* (MILL.) THELL.

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Abstract. *Proboscidea louisianica* (Mill.) Thell. is a member of *Martyniaceae* family, known as *devil's claw* or *unicorn plant*. Is an annual plant of almost 80 cm high with thick stem where the medullary parenchyma disorganizes and forms a wide aeriferous canal. Leaves are amphistomatic, with bifacial-heterofacial structure and normal dorsiventrality. Whole body of the plant is covered by secretory hairs. The flowers are trompet-shaped. The fruit is a dehiscent capsule of almost 10 cm length ended in a beak. When the fruit reaches maturity, the sclerenchyma fibers strongly lignify and determine its breakage in two symmetric parts (as claws, where the common name of the plant comes from) liberating the seeds. Ornamental plant, alimentary, too, because the pots can be eaten as pickles.
Key words: *Proboscidea louisianica*, morpho-anatomy

Introduction

Proboscidea louisianica (Mill.) Thell. (Figs. 1-4) belongs to *Martyniaceae* family [2, 5-7, 9] and lives in the southern part of USA. A few times ago, taking into account that the entire body of the species belonging to *Martyniaceae* family was covered by numerous secretory hairs, the family was considered to be of carnivorous plants [4-5]; that is why Rice B. [5] initiated some tests in otder to identify some enzyme activities in the species of *Martyniaceae* family together with some veritable carnivorous plant species. At the end of the experiment (after 24 hours) the author explaied that no enzyme activities could be evidenced and decided not to consider this family a carnivorous one. *Proboscidea louisianica* (Mill.) Thell. (Figs. 1-4) is a hairy annual plant of 80 cm high, known for a long time as *Martynia proboscidea* or *M. louisianica* from *Pedaliaceae* family [3]. Leaves are velvety, cordiform and wavy-edged. The flowers are pink, trompet-shaped, 5-lobed, fragrant, clustered in axillar racemes. Fruits appear later in summer. The common names of this plant (*devil's claw* and *unicorn plant*) refer to the shape of the seed pods. The entire aspect of the plant, the coloured and fragrant flowers, the peculiar form of the fruits make it an important ornamental plant; also, the pots can be eaten as pickles.

Material and methods

The analyzed material is represented by exemplars of *Proboscidea louisianica* (Mill.) Thell. obtained from seeds acquired by free international exchange in "Anastasie Fătu" Botanic Garden of Iaşi. The sections were cut manually, using microtome and elder pith as support. The histological sections were washed in sodium hypochlorite, then in acetic acid and distillate water [1, 8]. The sections were coloured with iodine green (1 minute), washed in 90% ethylic alcohol and distilled water then coloured with ruthenium red (1 minute) and again washed in distilled water. In order to obtain the permanent slides,

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the histological sections were mounted in gel; then they were analyzed in Optika light microscope. The light micrographs were performed using a Canon A540 camera.

Results and discussions

The cross section of a **young root** (Figs. 5-7) reveals a primary structure, with the known anatomic regions: rhizodermis, cortex and central cylinder. Rhizodermis bears small cells, almost isodiametric, most of them being transformed in short root hairs. The cortex consists of 7-8 layers of big cells; the external layer is not an exodermis, but the cells are bigger than the others belonging to the next layers. The endodermis is well developped, with Caspary thickenings in the lateral walls of the component cells. The central cylinder consists of 4 xylem bundles with vessels having thickened and lignified walls and 4 phloemic bundles, formed by sieved tubes and guard cells. As the histologic sections show, the vascular bundles are almost overlapped and not alterne, as in a normal root structure.

The cross section of a thicker root (Figs. 8-10) presents a secondary structure. The outer part of the root is protected by a quite thick peridermis, made by suber, phellogen and phelloderm. The cortex is thin, consisting of 7-8 layers of small cells; no typical endodermis is present. In the central cylinder, cambium forms a thin phloem ring and a central thick xylem massive, represented by large or narrow vessels with thickened and lignified walls. The central cylinder is rifted by medullar parenchymatic rays which bear cells with thickened walls (in the xylem massive). In a very thick root (Figs. 11-13) the structure is similar to the anterior one, but: the suber is thicker, the phloemic ring is thicker as well as the xylem massive, penetrated by more medullar rays.

A very **thin stem** (Figs. 14-19) has a circular profile in cross section. The epidermis bears small izodiametric cells; some of them are tranformed in long secretory hairs. A secretory hair is formed by multicellular unilayered stalk; the cells are big, with cellulosed walls; in the apex of this stalk, there is a socket cell which bear 16 cells of similar dimensions, disposed around 3-4 central cells. The cortex is thin, differentiated in a collenchymatic region towards the external part and a parenchymatic one towards the central cylinder. The collenchymatic region consists of 9-10 layers of cells of various dimensions; the walls of the cells present thick angular collenchyma. The parenchymatic region consists of 4-5 layers of cells with thin cellulosed walls; most of the cells present division walls. The central cylinder is thick, represented by a continuous phloem ring which consists of sieved tubes and guard cells. At the external part of the phloem there are isles of sclerenchymatic fibers with thickened and lignified walls. The xylem forms a ring, too, represented by wide xylem vessels with thickened and lignified walls, nearby xylem fibers and cells of xylem parenchyma are olso present, all of them bearing thickened and lignified walls. Pith consists of big isodiametric cells with thin and cellulosed walls. Cuttings at other levels of the stem (middle- Figs. 20-23 and inferior levels- Figs. 24-27) reveal similar structures as the one of the superior level, but the diameter is bigger and the medullar parenchyma disorganizes, resulting a wide aeriferous canal.

Leaves are opposite, long petiolated, cordiform with waved edge. The cross section through the **petiole** (Fig. 28-30) from the leaves belonging to the superior part of the stem shows a circular profile, bearing a similar structure to that of the stem from the same level. The medullar tissue from the center of the petiole is partially dezorganized that is why a narrow aeriferous canal appears.

In all analized levels, both upper and lower epidermis (Figs. 31, 32, 42, 43, 46) of the **foliar limb**, in **front side view,** display cells with curved lateral walls, secretory trichomes and big anomocytic stomata, so the foliar limb is amphistomatic. The walls are more curved in the lower epidermis.

The cross section through the foliar limb (Figs. 32-37) shows that the middle vein is strongly prominent at the abaxial face. Both epidermis bear large cells, the external wall is stucked out and covered by a thin cuticle. A few stomata and long secretory hairs can be seen. The abaxial face of the middle vein presents short secretory hairs, formed by a short stalk-cell and a multicellular gland, consisting of elongated cells. The mesophyll is differenciated in assimilatory pallisade tissue formed by high cells and lacunary tissue with big cells which form big meatus and lacunas. The conductive tissue of the middle vein is sorrounded by parenchymatic tissue consisting of big cells of cellulosed walls. Just beneath both epidermis of the middle vein there are a few layers of collenchymatic tissue. The conductive tissue is represented by a very big vascular bundle U-shaped. The xylem consists of numerous vessels with thickened and lignified walls and cells of cellulosed xylem parenchyma; the phloem consists of sieved tubes and guard cells. At the external part of the phloem there are few sclerenchymatic elements represented by cells with thin and lignified walls. The cross sections through the **petiole** belonging to the leaves of the median (Figs. 38-41) and lower (Fig. 46) regions of the stem show circular wider profile, similar as structure with those of the stem from the same level. The medullary canal is wider. The foliar limb (Figs. 44-45, 48-49) has a similar structure with that of the one analyzed in the anterior level, but the middle vein is more prominent.

The **flowers** (Fig. 50-51) are pink and form lax axillary racems. They are trumpet-shaped, 5-lobed. Both upper an lower epidermis of the sepals (Figs. 52-53) show waved-wall cells. Stomata are present in the lower epidermis. Both epidermis of the petals (Figs. 54-55) display cells with straight walls. All the cells belonging to the upper epidermis are transformed in papillae, giving a velvety aspect of the petal. Most of the cells contain antocians in their vacuoles; only the lower epidermis bears stomata.

The **androecium** consists of two stamens coupled by their anthers; the filaments are geniculated. Each anther bears two chambers.

The **gynoecium** has a bifid foliaceus stigma; numerous elongated papillae can be distinguished on it. The style is long, bearing a small ovary, with orthotrop ovules. The fruit is an elongated capsule (Figs. 56-57), wider at the basis and narrowed at the top. The petals are deciduous, but the sepals remain on the fruit. A cross section through a young pot (Figs. 58-61), in the wide portion, shows a single-layered epicarp formed by small cells, a multi-layered mezocarp, formed by cells of various dimentions and numerous small vascular bundles disposed on numerous rows. At the outer part of the endocarp, the vascular bundles are very well ordered, resulting a cordon. The endocarp bears sclerenchyma fibers with thin cellulosed walls, grouped as fascicles, separated by elongated cells; these fascicles are disposed as two rings, delimitting an internal region, with big cells, of thin, cellulosed walls. The two rings formed by sclerenchyma fascicles define two closed cavities between them with two septums, where the seeds develop. As the pot maturates, the sclerenchyma fibers get thicker and strongly lignify their walls, delimitting the cavity of the pot. A cross section through the distal part of the pot (where there is no cavity- Figs. 62-63), shows an unilayered epicarp, multilayered mezocarp with numerous vascular bundles and a fibrous endocarp; the cavities are substituted by a region of parenchymatic tissue, formed by cells

with cellulosed walls. When the pot reaches maturity, the epicarp and mezocarp exfoliate (Fig. 67), while the endocarp strongly lingifies (Figs. 64-66) and determines the breakage of the parenchymatic tissue, induceing the opening of the fruit (Fig. 68). Seeds are numerous, black, with rought superficies (Fig. 69).

Conclusions

The entire body of the plant is covered by secretory multicellular hairs.

The roots are strongly developed, especially the thicker ones; the young roots present short root hairs.

The stem is thin; the medullary parenchyma disorganizes and forms a wide aeriferous canal.

The structure of the petiole is quite similar to that of the corresponding level of the stem.

The leaves are hypostomatic (anomocytic stomata), with bifacial-heterofacial structure and normal dorsiventrality.

The fruit is a dehiscent capsule of almost 10 cm length ended in a beak. When the fruit reaches maturity, the sclerenchyma fibers of the endocarp strongly lignify and determine the breakage of the fruit in two symmetric parts (as claws, where the common name of the plant comes from), liberating the seeds.

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Explanation of plates

PLATE I *Proboscidea louisianica* (Mill.) Thell. (Figs. 1-4)
Cross section throuth the inferior level of the root (Figs. 5-7)
Cross section throuth the middle level of the root (Figs. 8-10)
Cross section throuth the superior level of the root (Figs. 11-13)
Cross section throuth the superior level of the stem (Figs. 14-19)

PLATE II

Cross section throuth the middle level of the stem (Figs. 20-23)
Cross section throuth the inferior level of the stem (Figs. 24-27)
Cross section throuth the petiole of the superior leaves (Figs. 28-30)
Front side epidermis: upper epidermis (Fig. 31) and lower epidermis (32)
Cross section throuth the foliar limb of the superior leaves (Figs. 33-37)

PLATE III

Cross section throuth the petiole of the middle leaves (Figs. 38-41)
Front side epidermis: upper epidermis (Fig. 42) and lower epidermis (43)
Cross section throuth the foliar limb of the middle leaves (Figs. 44-45)
Cross section throuth the inferior leaves: petiole (Fig. 46), lower epidermis (Fig. 47), foliar limb (Fig. 48, 49),
Flower (Fig. 50); cluster of flowers (Fig. 51); sepals: upper epidermis (Fig. 52) and lower epidermis (Fig. 53)
Petals: upper epidermis (Fig. 54) and lower epidermis (Fig. 55)
Fruit: young fruit (Fig. 56), fruit full of imatured seeds (Fig. 57)

PLATE IV

Cross section through the wide part of a young fruit (Figs. 58-61)
Cross section through the narrow part of a young fruit (Figs. 62-63)
Cross section through the narrow part of a mature fruit (Figs. 64-66)
Mature fruit (Fig. 67), without epicarp and mezocarp (Fig. 68), mature fruit with mature seeds (Fig. 69).Bar = 100 μm


Fig. 1


Fig. 2


Fig. 3


Fig. 4

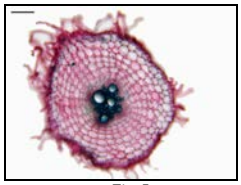
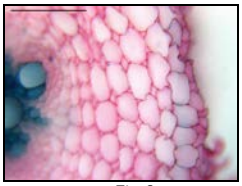


Fig. 5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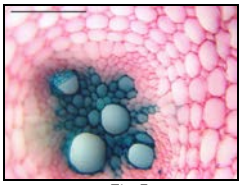
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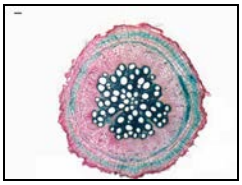
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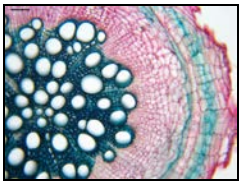
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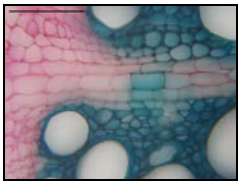
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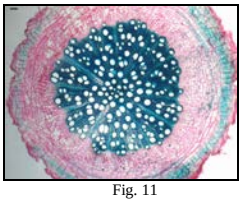
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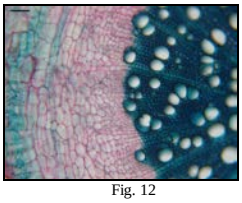
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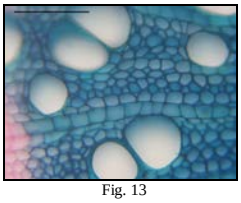
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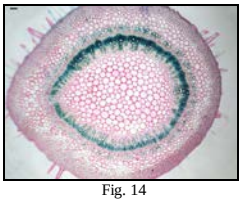
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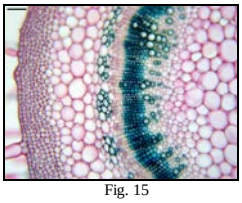
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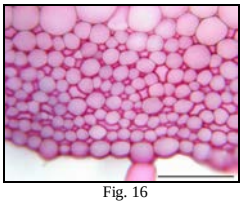
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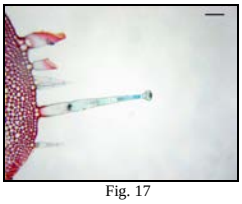
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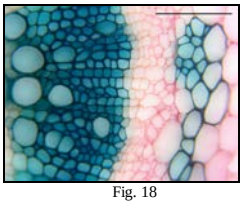
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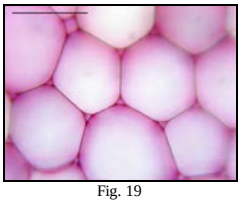
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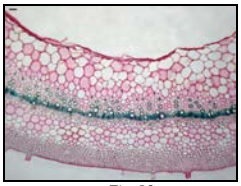
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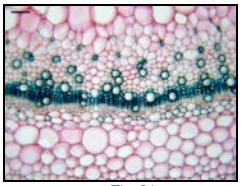
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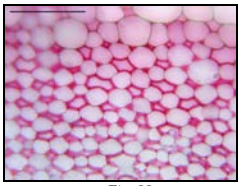
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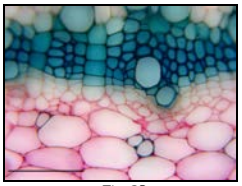
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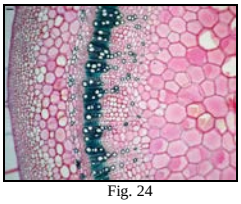
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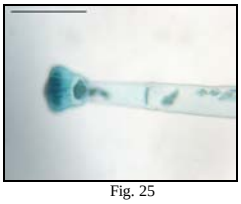
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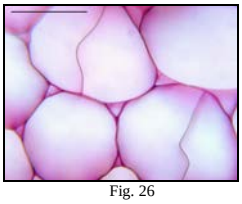
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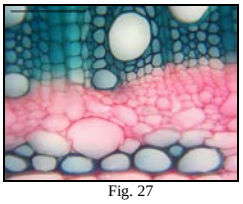
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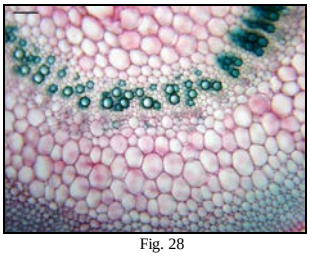
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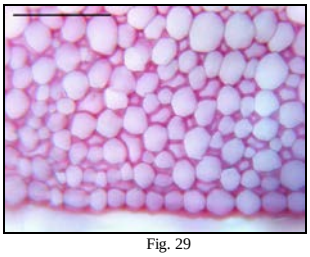
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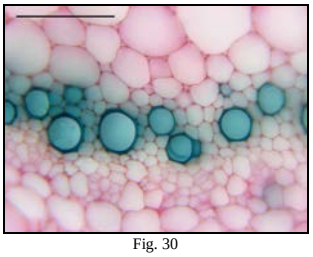
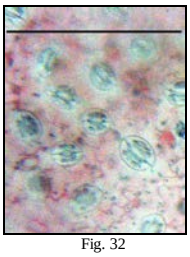


Fig. 30


Fig. 31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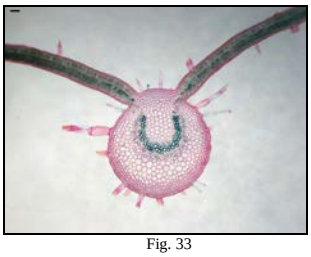
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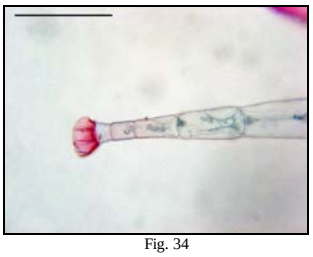
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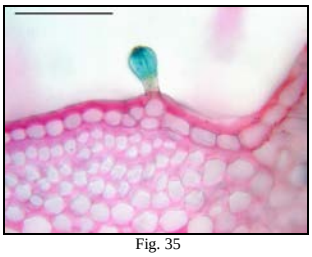
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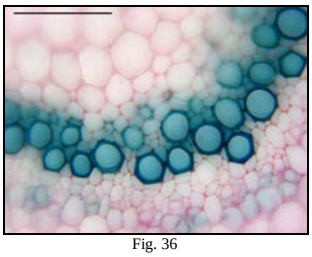


Fig. 36

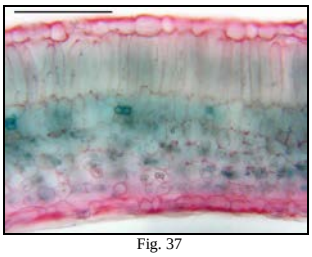
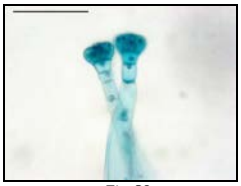


Fig. 37


Fig. 38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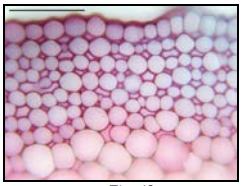
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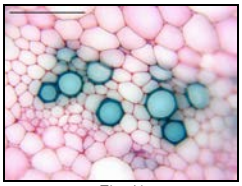
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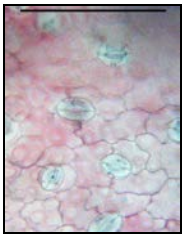
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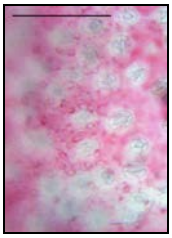
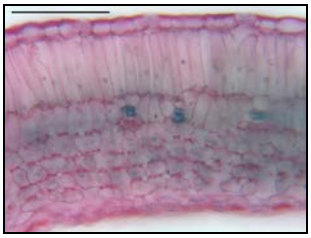


Fig. 43


Fig. 44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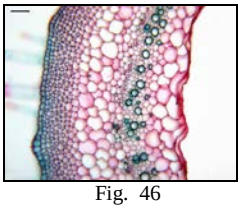
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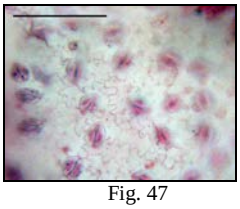


Fig. 47


Fig. 48

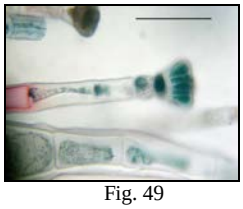
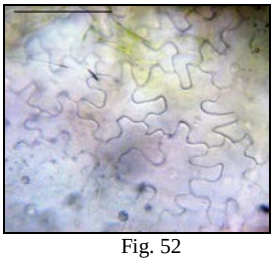


Fig. 49


Fig. 50


Fig. 51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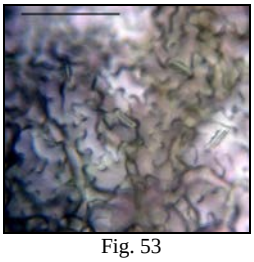
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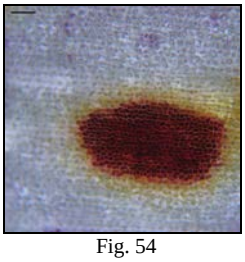
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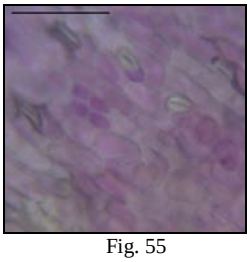
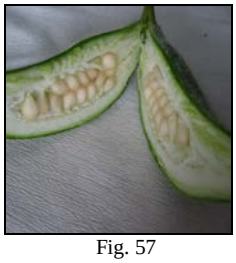


Fig. 55


Fig. 56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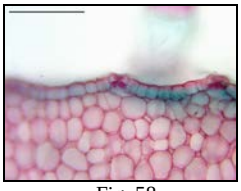
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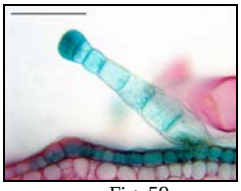
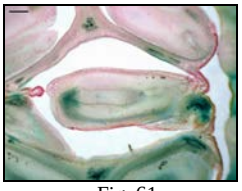


Fig. 59


Fig. 60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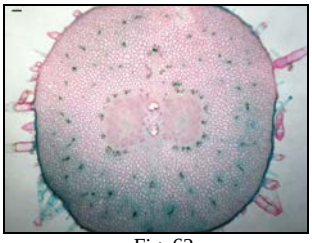
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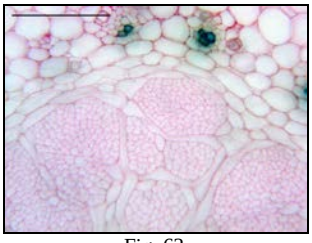
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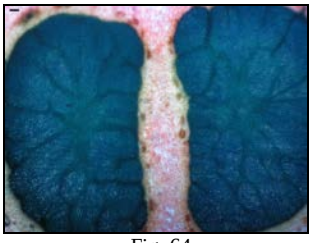
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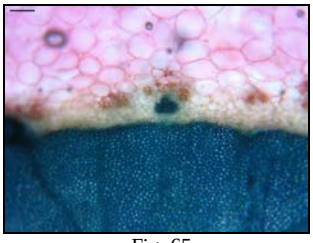
Fig. 65

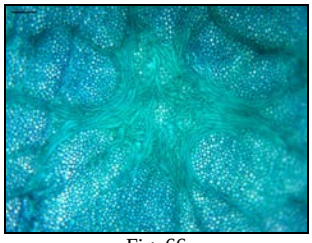
Fig. 66


Fig. 67


Fig. 68


Fig. 69