Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences 10 (2): 158-161, 2011
ISSN 1682-3974 / DOI: 10.3923/ajps.2011.158.161

Anatomical Studies of *Lagenaria siceraria* (Mol.) Standl and *Cucumis sativa* L. (Cucurbits.)

[1]N.K. Sharma, [2]Y.J. Thanki and [1]Shaily Bhardwaj
[1]N.V. Patel College of Pure and Applied Sciences, Vvnagar, India
[2]Department of Bioscience, V.N. South Gujarat University, Surat-388120, Gujarat, India

Abstract: The study was carried out on the histology of two cucurbits *Lagenaria scieraria* (Mol.) Standl. and *Cucumis sativa* L. The transverse hypocotyl and epicotyl section shows ridges alternately with furrows and root is circular. The complete cylinder of extra xylary fibres in cortex is typical of the cucumber family. Nine bicollateral vascular bundles each are situated in an inner and an outer circle. Articulated ramified sap filled idioblasts are a special feature not described until now in Cucurbits.

Key words: Histology, cortex, stem, secondary growth

INTRODUCTION

Lagenaria scieraria (Mol.) Standl. (Bottle gourd) is native of Africa, it is named because of bottle like shaped of its fruit (Singh *et al*., 1999). It is a tendril climber with hollow angular stem and large, long petiolated and palmetely lobed leaves. The flowers are yellow unisexual and produced in the leaf axiles. The fruit is a pepo which develops from the receptacular tissue and epicarp. *Cucumis sativa* L. has been cultivated for at least 3000 years in western Asia. The cucumber is a creeping vine that roots in the ground and grows up or other supporting frames, wrapping around ribbing with thin spiraling tendrils. The plant has large leaves that form a canopy over the fruit. The melon-like fruits of the Nara plants are the main staple of the local people (Henschel *et al*., 2004) and the roots are of importance for the pharmaceutical industry. In diagnostic key to taxa, anatomical characters are frequently useful at all levels. Some anatomical works on the histology of different families was done by Myrtaceae (Tantawy, 2004) Leguminoceae (Begum *et al*., 2007; Islam *et al*., 2005, 2007; Edeoga *et al*., 2007).

MATERIALS AND METHODS

Two 15 cm long twigs from aboveground and one 5 cm long piece of a stem from under soil were collected, dissected in approximately 3 cm long pieces and then fixed immediately in an ethanol and water mixture (1:1). A sledge microtome (Reichert, Vienna) was used to prepare transverse and longitudinal sections approximately 35-45 μm thick. The sections were stained in picric acid (saturated solution) and acid fuchsin (1%), both dissolved in distilled water or in safranin (1 g/100 mL a.d.) and astra blue (0.5 g astra blue and 2 g tartaric acid 100 mL^{-1} a.d.). Specimens were viewed using a CH3-microscope (Olympus) and images captured using camera (Nikon).

RESULTS AND DISCUSSION

Root: The primary root was tetrarch in these plants, in which the pith was absent and central region was made up of few metaxylem cells. The development of vascular cambium was normal and almost similar to that described earlier. It was initiated by the divisions in parenchymatous cells present below the phloem strands to form the cambium stripes which united with the cambium stripes developed by the divisions of pericyclic cells. The cambium originated from two different types of cells had different activity. The vascular cambium originated in the pericycle produced only ray parenchyma cells. The cambium formed on the inner region of the primary phloem produced secondary conducting elements and associated cells of xylem and phloem (Fig. 1a, b). This was resulted into formation of four wedge shaped sectors of secondary conducting tissues separated by wider ray parenchyma (Fig. 1c, d, Fig. 2b). The ray cells were not observed in the region of secondary conducting elements (Fig. 1c, d, Fig. 2b).

Hypocotyl: Since leaves are absent, the photosynthetically active tissue is located in the stems. The epidermis in investigated plant species was one layered. Epidermal cells were of different size, thin walled, tubular, squarish or rectangular. The epidermal cells were moderately cuticularised. Many eglandular, uniseriate,

Corresponding Author: Dr. Nitin Kumar Sharma, N.V. Patel College of Pure and Applied Sciences, Vvnagar, India
Tel: +911344-253247, 09723309219

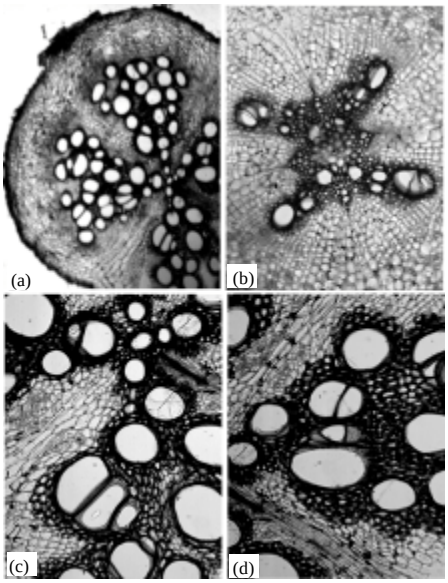

Fig. 1: (a) transverse section of a root of *C. sativa* (c, d) *C. sativa* (b) *L. siceraria*

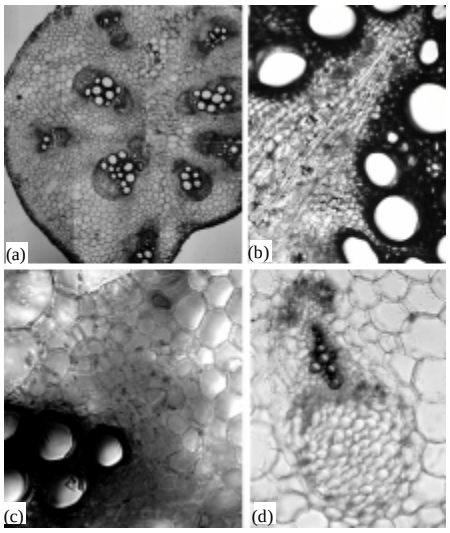

Fig. 2: (a) transverse section of a hypocotyl of *L. siceraria* (c, d) *C. sativa* (b, d) Vascular bundle of *C. sativa* B. *L. siceraria*

trichomes of various shapes were observed. Hypodermis was present situated immediately below the epidermis. It was composed of 2-5 or more layers of spherical or rounded collenchyma cells having thickenings at corners. Cortex was consisted of several layers of parenchyma

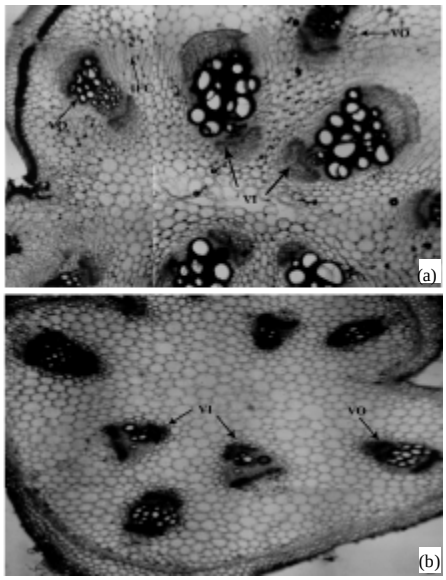

Fig. 3: Transverse section of epicotyl (a) *C. siceraria* and (b) *C. sativa* IFC: Inter fascicular cambium, VI: Vascular bundle of inner ring, VO: Vascular bundle of outer ring

cells. The starch grains were observed in the cortical cells of bottle gourd. The vascular bundles were bicollateral and arranged in two circles. The outer circle was made up of five larger bundles and the inner was of four vascular bundles in bottle gourd (Fig. 2a). There were four vascular bundles in each circle in cucumber. In each bundle the xylem was flanked by outer and inner phloem (Fig. 2c, d). These bundles were characterized by the presence of outer and inner intrafasicular cambia. The outer cambium was present between xylem and outer phloem whereas inner cambium was between xylem and inner phloem (Fig. 2c). The vascular bundles were separated by small, compact, oval or spherical interfasicular parenchyma cells (Fig. 2a).

Epicotyl: Epicotyls of both selected plants were angular with ridges and shallow furrows. Epidermis was single layered with rectangular, tubular or squarish cells which were compactly arranged, thin walled. Hypodermis was made up of 2 to 6 layers of collenchyma cells. Cortex was parenchymatous. The cortical cells were oval or roundish, thin walled and had minute intercellular spaces. Endodermis was consisted of cells similar to the cortex but the cells of this layer were comparatively smaller in the size. The vascular system was made up of discrete bundles arranged in two circles or rings around the central pith (Fig. 3a, b). In bottle gourd and cucumber, the

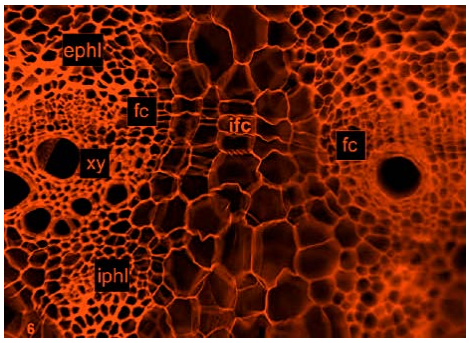

Fig. 4: Transverse section of Lagenaria stem showing secondary growth. ifc: Interfascicular cambium, FC: Fascicular, iphl: internal phloem, ephl: external phloem, xy: xyle

vascular bundles were large and bicollateral where the xylem was flanked by outer and inner phloem (Fig. 3a, b). In these bundles outer and inner cambia were present as in hypocotyl of these two plants. The secondary growth was similar to that observed in the hypocotyl (Fig. 4). The bicollateral strands were in two rings. Interfasicular cambium was produced by the divisions in parenchyma cells which were united with intrafasicular cambium. The formation of secondary vascular tissues was restricted by interfasicular cambium. Therefore, the vascular tissues were present in the form of strands (Fig. 3a, b).

DISCUSSION

The roots of investigated plants were devoid of hypodermis. In most of the dicotyledones cortex of root consists of parenchyma cells (Fahn, 1982; Patel, 1999; Shah, 2001; Garasia, 2002). The cortex was parenchymatous in the investigated plants. Many intercellular spaces were observed in the cortical cells similar results was obtained by Prodhan *et al.* (2001). This is the characteristic of the root cortex (Fahn, 1982).

In these hypocotyls, the origin of cambium zone was normal by the union of interfasicular and intrafasicular cambia. The secondary vascular tissues were produced by intrafasicular cambium while the interfasicular cambia formed only ray parenchyma. Therefore, the secondary vascular tissues appeared as larger strands. Similar cambial activity was observed by Kartusch and Kartusch (2008) in the *Acantosicyos horridus* of Cucurbitaceae. Such cambial activity is common in vines (Esau, 1965, 1977).

Palisade like cells are situated on both borders of the furrows. The gas exchange is therefore reduced (Hebeler *et al.*, 2004) and a supplementary protection against high irradiation must be present. For a stem in an upright position the amount of the absorbed light will be minimal during the hours with the strongest irradiance (Von Willert *et al.*, 1992). A certain part of the incoming light is to be reflected, as indicated by the silvery pale-green appearance of the plant.

Another mechanism of adaptation to the harsh environmental conditions is the formation of hummocks. The greater part of the plant is buried in the moist sand of the hummocks, where no assimilation occurs. The chloroplasts of the palisade-like cells retrogress into leucoplasts. Thus only a small part of the plant is able to assimilate and transpiration is presumably absent from the buried parts (Kutschera *et al.*, 1997).

The presence of a ramified system of idioblasts might be of importance. The idioblasts of A. horridus are a series of fused cells filled with an aqueous solution containing among others a high concentration of cucurbitacines typical for Cucurbitaceae (Braemer, 1893; Kartusch and Kartusch, 2008). Solereder (1899) as well as Metcalfe and Chalk (1950) have pointed to the lack of internal secretory structures in the cucumber family but Cortesi, 1960 cited in Kartusch and Kartusch (2008) observed simply or compound idioblasts in Bryonia, Citrullus and Ecballium. In *L. siceraria*, the idioblasts are stained selectively and intensively with acid fuchsin-picric acid, thereby showing a primary nature of their cell walls (Bruni and Tosi, 1980). These solution-filled idioblasts may act as a water-storage compartment, thus balancing the water management. Therefore we conclude that the main stress factor in the case of *A. horridus* is high irradiation and that its anatomical and physiological adaptations have developed in relation to this stress.

ACKNOWLEDGMENT

The authors are thankful to the Head, Dept. of Bioscience, V N South Gujarat University, Surat, Gujarat for providing laboratory facilities.

REFERENCES

Begum, S., M.A. Islam and A.K.M.A.U.D. Prodhan, 2007. Anatomy of the stem of pigeonpea (*Cajanus cajan*). Asian J. Plant Sci., 6: 276-281.

Braemer, L., 1893. De la localisation des principes actifs des cucurbitacees. Ph.D. Thesis, University of Toulouse, France.

Bruni, A. and B. Tosi, 1980. A method for localizing embryonal laticifers by combined conventional and fluorescence microscopy. Protoplasma, 102: 343-347.

Cortesi, R., 1960. Inventaire anatomique des vegetaux superieurs: (spermatophytes et quelques pteridophytes). Institute de Botanique Generale, Universite de Geneve.

Edeoga, H.O., G. Omosun, G.G.E. Osuagwu and O.O. Emezue, 2007. Microscopic anatomy and histochemistry of the stem and root of some mimosa species (Leguminosae-Mimosoideae). Asian J. Plant Sci., 6: 688-691.

Esau, K., 1965. Plant Anatomy. 2nd Edn., John Wiley and Sons, New York, USA.

Esau, K., 1977. Anatomy of Seed Plants. 2nd Edn., John Wiley and Sons Inc., New York, USA., pp: 550.

Fahn, A., 1982. Plant Anatomy. 3rd Edn., Pergamon Press, Oxford, New York, USA.

Garasia, K.K., 2002. Morpho-histological studies in the seedlings of some Apocynaceae. Ph.D. Thesis, SG. University, Surat, India

Hebeler, F., C.E.J. Botha and A.J.E. Van Bel, 2004. Water, Photosynthesis and Transpiration of Nara /Acanthosicyos Horridus. In: Nara: Fruit for the Development of the Kuiseb Topnaar, Henschel, J., R. Dausab, P. Moser and J. Pullett (Eds.). Namibian Scientific Society, Windhoek, Namibia.

Henschel, J., R. Dausab, P. Moser and J. Pullett, 2004. Nara: Fruit for Development of the Kuiseb Topnaar. Namibia Scientific Society, Windhoek, Namibia.

Islam, M.T., A.K.M.A.U.D. Prodhan and A.K.M.G. Sarwar, 2007. Root anatomy of country bean. Int. J. Agric. Res., 2: 508-517.

Islam, M.T., A.K.M.A.U.D. Prodhan, S.M.A. Bari and A.K.M.G. Sarwar, 2005. Anatomy of the hypocotyl of country bean. Asian J. Plant Sci., 4: 223-233.

Kartusch, B. and R. Kartusch, 2008. Stem anatomy of *Acanthosicyos horridus* (Cucurbitaceae). S. Afr. J. Bot., 74: 647-650.

Kutschera, L., E. Lichtenegger, M. Sobotik and D. Haas, 1997. Die Wurzel, das neue Organ. Eigenverlag. Pflanzensoziologisches Institut, Klagenfurt.

Metcalfe, C.R. and L. Chalk, 1950. Anatomy of the Dicotyledons. Vol. 2, Clarendon Press, USA.

Patel, B.R., 1999. Anatomical studies on the seedlings of some taxa of Papilionaceae. Ph.D. Thesis, S.G. University, Surat, India

Prodhan, A.K.M.A.U.D. and S.M.A. Bari, 2001. Anatomy of lignosus bean (*Dipogon lignosus*) I: Root. Pak. J. Biol. Sci., 4: 1052-1056.

Shah, K., 2001. Anatomical studies on the seedlings of some taxa of Caesalpinae. Ph.D. Thesis, S.G. University, Surat, India

Singh, V., P.C. Pande and D.K. Jain, 1999. A Textbook of Botany: Angiosperms. Rastogi Publications, Meerut, India.

Solereder, H., 1899. Systematische Anatomie der Dicotyledonen. 1st Edn., Ferdinand Enke, Stuttgart, pp: 439-448.

Tantawy, E.M., 2004. Morpho-anatomical study on certail taxa of Myrtaceae. Asian J. Plant Sci., 3: 274-285.

Von Willert, D.J., B.M. Eller, M.J.A. Werger, E. Brinkmann and H.D. Ihlenfeldt, 1992. Life Strategies of Succulents in Deserts: With Special Reference to the Namib Desert. Cambridge University Press, Cambridge.