

CONTRIBUTION TO THE WOOD ANATOMY OF TINOSPORA SINENSIS (LOUR) MERRILL IN RELATION WITH T.CORDIFOLIA MIERS

S.D. BONDE and A.S.UPAEHYE

Department of Botany, M.A.C.S. Research Institute, Pune – 411 004, India

Received: 19 October 1987

Accepted: 4 March 1989

ABSTRACT: *Morphologically Tinospora sinensis (Lour.) Merrill is differentiated from T. cordifolia Miers. Only by the tomentose leaves. The present anatomical study aids in differentiating pieces of woods of T. sinensis from those of T. cordifolia which is often mixed as adulterant or substitute for T. cordifolia in several Ayurvedic compound preparations.*

Introduction

Tinospora is an Old World climber with about sixty species distributed in tropical and subtropical regions. Of these, five species are indigeneous to India. *T. crispa* (L) Miers. And *T. mastersii* Diels. Occur in Assam, *T. andamanica* Diels. In Andaman Islands, whereas *T. cordifolia* Miers. And *T. sinensis* (Lour.)Merrill occur throughout the country. *T. sinensis* is known to be a climber with 1-2 cm thick stem. However, recently we have noted a gigantic liana of 8-9 cm thickness and 20 meter height covering entirely a *Mangifera Indica* L. tree is a sacred grove at Dakhne (Lat. 18°31'; Long 73°31'E) in pune district, Maharashtra (Upadhye et al., 1987)¹

The anatomy of Tinospora is very meagerly known although considerable work has been done on its pharmacognosy (see Mitra, 1985)². Solereder (1908)³ *T. cordifolia*, Beauquesne (1937)⁵ *T. tuberculata*, Metcalfe and Chalk (1950)⁶ gave general

features of tinospora whereas Raghunathan and Mitra (1982)⁷ studied *T.cordifolia* and *T. sinensis* in relation to their pharmacognosy.

Morphologically *T. sinensis* is differentiated from *T. cordifolia* by the tomentose leaves only. The detailed anatomy of this exceptionally giant tinospora species was undertaken to differentiate its wood pieces from that of *T. cordifolia* as they are often mixed as an adulterant or substitute to *T. cordifolia* in several Ayurvedic compound preparations used against debility, dyspepsia, fever and urinary disorders.

Material and Methods

Fresh material of young and mature roots and stems was collected from plants growing in the sacred grove at young, mature roots and young stems were taken. Whereas sections of 2.5-9.0 cms thick old stems were taken with the help of a wood microtome. Sections of *T. cordifolia* were also taken for comparison. They were

double stained with safranin and fast green and made permanent using standard methods (Johnsen, 1940). Photographs were taken on Carl-Zeiss Lobovolt-2 and Citovolt binocular microscopes.

Observations and discussion

Young aerial root:

The young aerial roots are threadlike, squarish, 1600-2200 x 1300-1400 μm in size and show pentarch to hexarch primary structure. Epiblema is single layered with thick-walled polygonal cells. Cortex is composed of two distinct zones, outer 5-7 layered, sclerenchymatous and inner one 10-15 layered made up of thin-walled, compactly arranged parenchymatous cells containing starch grains. The primary xylem bundles have long tapering arms of protoxylem and a group of metaxylem vessels at the base of the strand. Phloem bundles lie in between the two xylem groups and are composed of sieve tubes, companion cells and phloem parenchyma. A large schizogenously formed cavity lies below each phloem bundle. A large parenchymatous pith with compact cells containing starch grains is present in the centre (Pl. I, Fig. 1)

The mature aerial root is very similar in structure with young aerial stem except for the presence of nodal swellings.

Young stem:

Periderm formation is observed at a very early stage. Lenticels protrude out breaking the periderm at a number of places. Cortex is composed of two distinct zones, outer 1-2 layered sclerenchymatous and inner one 15-

22 layered. Parenchymatous full of starch grains. Pericycle is composed of thick-walled tangentially elongated cells and present as a cap-like structure on the vascular bundles. These fibrous caps and the intervening parenchymatous cells between in bundles adjoining to them join together to form a continuous pericyclic ring. The stele consist of 5-7 collateral vascular bundles separated by parenchyma and medullary rays. A thin band of cambium exists between phloem and xylem. A parenchymatous pith with compact cells containing starch grains is present in the centre. 5-6 primary xylem groups are present at the peripheral region of pith. Few groups of thick-walled sclerenchymatous cells are also present in the pith (Pl. I, Fig. 3).

Mature stem:

In a 9.0 cm thick stem 90 vascular bundles are noted. Periderm and cortex are 1.5-1.8 cm wide and pith 1.8-2.2 cm in diameter. The fascicular cambium and interfascicular cambium formed by the parenchymatous cells present in between the two vascular bundles cut off phloem and xylem elements continuously to the outer and inner sides respectively and thus number of vascular bundles increases in size and number as the stem grows older. The periderm gets peeled off periodically. The pericyclic sclerenchyma and phloem capping the vascular bundles gets disintegrated forming a banded structure.

A number of groups of stone cells are present in the cortical region. The thin-walled parenchymatous cells are full of starch grains. No calcium oxalate crystals are noted in the cortex (Pl. II, Fig. 5)

Wood:

Wood is diffuse porous. Growth rings present, delimited by large vessels. Vessels small to medium sized, round to oval, mostly solitary, sometimes in pairs and rarely in groups of 3-4, evenly distributed, 9-12 per mm² tyloses abundant. Gummy content present in some of the large vessels near the centre. Small vessels have 75-135 µm tangential diameter (t.d.) and 110-170 µm radial diameter (r.d) and large vessels with 228-354 µm t.d and large vessels with 288-354 µm t.d and 270-485 µm r.d The vessel elements are 200-270 µm long with simple perforations. Intervessel pits alternate, hexagonal, 10.9 x 24.1 µm bordered with horizontal pore. Parenchyma apotracheal, diffuse or in short bands. Cells are round, oval or elliptical in cross section, thin walled, t.d. 25-40 µm and r.d 17-38 µm.

Xylem rays are scanty and interfascicular only, exclusively uniseriate, mostly 1-2 celled, very rarely 3-4 celled; homogeneous rarely heterogeneous. Procumbent cells 29x29 µm and upright cells 125x50 µm long and 17-35 µm wide. Fibres 45-105 µm long, thickwalled, septate with distinct bordered pits on both radial and tangential walls. Vessel fibre pits large, round to oval, bordered, 17x24 µm in size (Pl. II, Figs. 5-9). Pith is 1.8 – 2.2 cm wide made pericyclic sclerenchyma and phloem, their persistence as a cap like structure on the xylem groups in the stem, (iv) persistent primary xylem in the pith, (v) continuous addition of new collateral vascular bundles due to the activity of inter fascicular cambium, (vi) exclusively uniseriate, 1-2 celled xylem rays and (vii) absence of secretary sacs and calcium oxalate crystals.

Table –I gives its differentiating character of *T. sinensis* from those of *T. cordifolia*.

Pharmacognostically *T. sinensis* possesses less quantity of carbohydrates, sterols, alkaloids and tannins making the

Characters	<i>T. Sinensis</i>	<i>T. Cordifolia</i>
I. Root	Pith conspicuous, unobliterated, schizogeneus cavities equal to the number of xylem or phloem groups	Pith obliterated, schizogeneus cavities absent
II. Young Stem	Outer cortex sclerenchymatous, Pericyclic sclerenchyma narrow	Outer cortex collenchymatous, pericyclic sclerenchyma broad
III. Mature stem	Pericyclic sclerenchyma disintegrated forming persistent bands along with phloem	Pericyclic sclerenchyma and phloem persistent in original

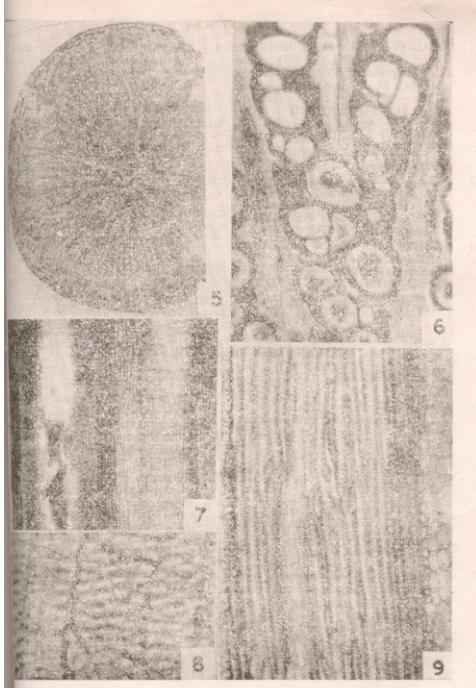
	Primary xylem persistent in the pith Wood with continuous addition of vascular bundles Secretory sacs and calcium oxalate crystals absent	Primary xylem not observed Wood with limited addition of vascular bundles Secretory sacs and calcium oxalate crystals present.
--	---	--

up of thin-walled, compactly arranged parenchymatous cells containing starch grains. A number of primary xylem groups are present in disorderly manner at the peripheral region (Pl. I, Fig.3; Pl. II, Fig 5).

Tinospora sinensis shows a number of diagnostic characters such as (i) distinct unobliterated pith with schizogeous cavities equal to the number of xylem or

phloem groups in young root, (ii) 1-2 layered sclerenchymatous cortex in young stem, (iii) presence of disintegrated bands of therapeutical compounds of inferior quality than those prepared from genuine material of *T. cordifolia* (Raghunathan and Mitra, 1982)⁷. The present study helps in differentiating the wood pieces of these two species used in these preparations.





ACKNOWLEDGEMENTS

We are thankful to Dr. S.H. Godbole and Dr. V.D. Vartak for the facilities and encouragements and to shri D.N. Nagpure for his help in photography.

1. UPADHYE, A.S.; KUMBHOJKAR, M.S. AND VARTAK, V.D. Note on magnificent *Tinospora sinensis* (Lour.) Merrill in sacred groves of Pune district. *Indian Forester*, vol. 113, 154-157 (1987).
2. MITRA, R. Bibliography on pharmacognosy of medicinal plants. EBIS, National Botanical Research Institute, Lucknow, 525-526 (1985).
3. SOLEREDER, H. Systematic anatomy of the dicotyledons. Vols I & II. English edition, translated by L.A Boodle and F.E Fritsch. Oxford, 1183 (1908)
4. DESHMUKH, v.k.;; GODBOLE, S.R. AND MAHABALE, T.S. Studies on pharmacognosy of some Indian medicinal plants. I.D.R.A. Poona, Publication no 1: 9-10 (1957).
5. BEAUQUESNE, L. Recherches surquelques Menispermacees medicinal des genres *tinospora* et *cocculus*. *Trav. Lab Mat med Paris*, vol. 28, 181 (1937).
6. METCALFE, C.R. AND CHALK, L. Anatomy of the Dicotyledons. I&II. Clarendon Press, Oxford, 52-58 (1950)
7. RAGHUNATHAN, K. AND MITRA, R. (Eds) Pharmacognosy of indigenous drugs. Vol.I. Central council for research In Ayurveda and siddha, New Delhi, 594 (1982).

8. JOHNSEN, D.A. 1940. Plant Microtechnique. McGraw-Hill Book Company, INC, New York and London, 2nd ed. 523 (1940)

8. T.L.S Showing polygonal bordered intervessel pits with horizontal pore x 500 .

9. T.L.S Showing uniseriate, 1-2 celled xylem rays x 30.

Explanation of plate figures

Plate-I. Figs 1-4.

1. Cross section of young aerial root of *T. sinensis* showing six schizogeneus cavities at the periphery of unobliterated pith x70.
2. T.S of *T. cordifolia* root devoid of schizogeneus cavities x70
3. T.S. of *T. sinensis* stem showing collateral bundles with thin pricyclic sclerenchma and persistant primary xylem in the pith x35.
4. T.S of *T. cordifolia* stem capped with conspicuous pericyclic sclerenchyma. Note the absence of primary xylm n the pith x 35.

PLATE – II Figs. 5-9.

5. T.S of *T. sinensis* mature stem showing large number of collateral bundles capped with bands of disintegrated sclerenchyma and phloem. Note the presence of primary xylem in the pith x 2.5.
6. The same, enlarged showing secondary wood with large radial bands of intervascular parenchyma. Note the presence of tyloses in the vessels x 30.
7. R.L.S showing septate fibres with pits x 30 .