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RESEARCH ARTICLE

Pharmacognostic Studies leaves and wood of *Tamarindus indica* Linn. Subjected to Cement Dust Pollution.**A. Maajitha Begam and M. H. Muhammad Ilyas*.**

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Abstract

Tamarindus indica is a branched tree which belongs to the family Caesalpiniaceae and is distributed throughout in India. *Tamarindus indica* has been of keen interest is due to its excellent medicinal values. This investigation has been done on above plant grown in two different locations one served as control and the other in the cement dust polluted site. Therefore in this context the detailed pharmacognostic study of leaf and wood has been carried out with the aim to establish its Pharmacognostical standards. The parameters selected were microscopical anatomical studies and proximate analysis.

Introduction:-

Air pollution has become a major threat to the survival of plants in the industrial areas and is responsible for vegetation injury and crop yield losses are causing increased concern (Gupta, 1994). Increased concentrations of the air pollutants cause progressive reduction in the photosynthetic ability of leaves, closure of stomata and, mainly, a reduction in growth and productivity of plants (Larcher, 1995). Air pollution directly affects the net carbon dioxide exchange rate and dry matter accumulation of many plants and is increased the photosynthetic carbon uptake (Olszyk, 2001). Previous reports have shown that all plants (including trees) can act as biological filters in removing large quantities of polluted particles from the urban atmosphere. As air diffuses through the stomata, most of the airborne particles will not pass through the stomata but will rather land on the leaf's outer surface. The concentration of particles on abaxial surface of the leaf normally do not observed higher than that of the top surface of the leaf (adaxial surface) and according to Central pollution control board, it considered that the Thermal Power Stations, Stone Crushers, Coal Mines and Cement Plants are high dust producing industries (CPCB,2007).

Plant injury also occurs near industries which produce bricks, pottery, cement, aluminum, copper, nickel, iron or steel, zinc, acids, ceramics, glass, phosphate fertilizers, paints, stains, rubbers, soaps and detergents, and other chemicals (Edward Sikora, 2004). Cement dust can cause illness by skin or eye contact as well as inhalation. Risk of injury depends on duration and level of exposure and individual sensitivity. Pollution stress can alter structure of plant leaves exposed to air pollution, but nevertheless, some are quite resistant to air pollutants and grow to maturity with several modifications (Gostin, 2009).

There is paucity of information on the anatomical modifications of leaves of plants exposed to cement dust pollution. Deposition of cement dust causes many several biochemical and physiological effects (Lepedus et al., 2003) in plants; and anatomical structure of plants are also distorted when pollutants in cement dusts are taken in by plants (Gostin, 2009). Different types of leaves tend to have differences in several aspects of their surfaces. Some types of leaves have greater surface rigidity or roughness than other leaves, which affect their stickiness or particle solubility. Stickier leaves would be better for collecting particles because more particles would stick to their surface and once the deposited particles are washed away, the leaves will be ready for dust capture again. Therefore, certain

morphological features of leaves are more favorable for particulate capture from the surrounding environment (CPCB, 2007).

Tamarindus indica tree produces edible, pod-like fruit which is used extensively in cuisines around the world. Other uses include traditional medicine and metal polish. The wood can be used in carpentry. Because of the tamarind's many uses, cultivation has spread around the world in tropical and subtropical zones (Maajitha, 2015)

Tamarindus indica is a large evergreen tree up to 30 m tall, bole usually 1- 2 m, up to 2 m diameter; crown dense, widely spreading, rounded; bark rough, fissured, greyish-brown. Leaves alternate, compound, with 10-18 pairs of opposite leaflets; leaflets narrowly oblong, 12-32 x 3-11 mm, petiole and rachis finely haired, midrib and net veining more or less conspicuous on both surfaces; apex rounded to almost square, slightly notched; base rounded, asymmetric, with a tuft of yellow hairs; margin entire, fringed with fine hairs. Stipules present, falling very early. Flowers attractive pale yellow or pinkish, in small, lax spikes about 2.5 cm in width. Flower buds completely enclosed by 2 bracteoles, which fall very early; sepals 4, petals 5, the upper 3 well developed, the lower 2 minute. Fruit is a indehiscent pod, sub cylindrical, 10-18 x 4 cm, straight or curved, velvety, rusty-brown; the shell of the pod is brittle and the seeds are embedded in a sticky edible pulp. The number of seeds per pod is approximately 3-10, The average seed length is 1.6 cm , irregularly shaped, testa hard, shiny and smooth.(Agroforestry database, 2009).

The aim of the study was to make a comparative evaluation on the effect of the cement dust pollution on the anatomy of leaves and wood of *Tamarindus indica*.

Materials and methods:-

Collection of Plant Materials:-

Plant materials like leaves and wood of both non polluted and polluted were collected from the wild surrounding of India cement Limited, Sankari, Salem district. The plants was identified and authenticated at the PG and Research Department of Botany, Jamal Mohamed College, Trichirappalli, Tamilnadu, India. Plant material which was collected near the cement industry is considered as polluted and it is located around 1 KM radius and the plant material which was collected 10 KM away from the cement industry is considered as control non polluted.

Microscopy:-

To study the leaf and wood anatomical structure of both non polluted and polluted, leaf and wood samples were used from freshly collected samples. The collected materials were fixed in FAA and preserved in 70% ethyl alcohol for 72 hours (Bilal Ahmad Wani, 2010). Transversal sections (7 µm) were obtained by using razor. The sections were stained with safranin and toluene blue and the leaves were examined under light microscope Olympus-BX51. The Sections were photographed by digital camera inbuilt in Olympus –DP12 and measured by Image- Pro Plus 6.1.

Quantitative microscopy:-

For studying individual components of the wood, the specimens were macerated employing Jeffrey's maceration fluid. Length of tracheids, length of vessels, length of fibres and length of parenchyma were measured in control and polluted wood of *Tamarindus indica*. The histomorphological measurements were taken with the help of linear micrometer in a weswox calibrated binocular microscope. For calibration of microscope the eye piece was removed from the microscope, the lens was unscrewed and in the ridge the eyepiece micrometer was placed. The lens was then replaced. The stage micrometer was then placed on the stage of the microscope and focused with the eyepiece scale superimposed. The division of eyepiece, which coincides with the division of stage micrometer, was noted. The calibration factor was calculated using the formula.

$$\text{Each division of eye piece micrometer} = \frac{\text{No. of divisions of eyepiece micrometer}}{\text{No. of divisions of stage micrometer}} \times 10$$

The readings for quantitative values such as size (length and breadth) were taken of polluted and control leaves, stem and readings were taken. The length and width of fibres, width of xylem vessels, tracheids and parenchyma were measured using stage micrometer and the eyepiece micrometer by standard methods.

Results and discussion:-

Morphologically leaves of polluted samples showed pale in color and texture while compared with normal plant leaf.

Anatomy of the leaf:-

The leaf has dorsi-ventral orientation.

- **Upper epidermis:-**

In both non polluted and polluted leaves upper epidermis was single layer of thin walled closely arranged cells and covered externally by a layer of cuticle. The upper epidermis was a continuous layer but slight projection is seen in the centre and interruption present by minimal number stomata.

- **Lower epidermis:-**

Lower epidermis was single layer of parenchyma cells which is interrupted by the stomata. The type of stomata is Anisocytic and Paracytic. In polluted *Tamarindus indica* opening of stomata are being wider than normal that due to overcome the stress through effective water loss. This is in accordance with the findings of Anil Raina (2004).

- **Mesophyll:-**

The region between the upper and lower epidermis is constituted by mesophyll. The mesophyll was formed of chlorenchyma cells and is the seat of photosynthesis. Mesophyll was differentiated in to upper palisade parenchyma and lower spongy parenchyma. Palisade parenchyma consists of two or three layers of compactly arranged cells in perpendicular to the surface. Spongy parenchyma consists of loosely arranged cells having air filled spaces in between. The chloroplasts are most abundant in palisade cells than spongy parenchyma.

- **Vascular bundles:-**

Vascular bundles range from 7 to 9 in number. The phloem lies towards the lower epidermis and the xylem lies towards the upper epidermis.

Anatomy of the wood:-

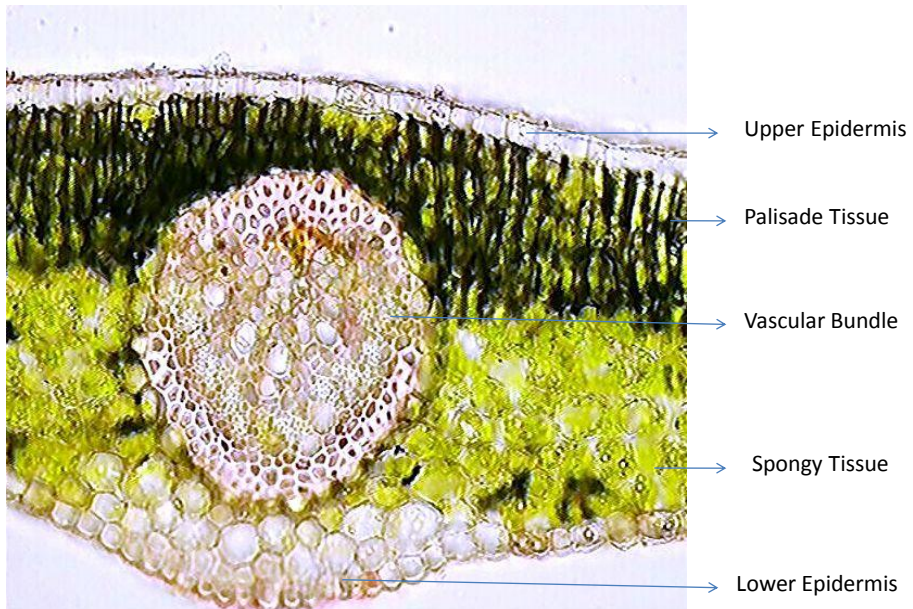
Solitary, bi and group vessels were identified in transverse section of stem. Solitary vessels are dominant in control stem and group vessels are dominant in polluted stem. TLS shows uniseriate cambium initials and rarely biseriate cambium initials.

Measurements:-

TABLE 1:-QUANTITATIVE MICROSCOPY OF WOOD PARAMETERS LENGTH μm WIDTH μm

Wood Parameters	Control Plant		Polluted Plant	
	Length μm	Width μm	Length μm	Width μm
Xylem vessel	295-365	98-107.5	122-280	70-110
Tracheids	762.5-795	15-17.5	545-675	10-12
Fibre	830.5-947	12.5-15	812.5-942.5	12-15
Parenchyma	132.5-170	22.5-32.5	82.5-160	17.5-21

Plate I (Normal leaf T.S)



T.S of Normal Wood shows Solitary Vessels

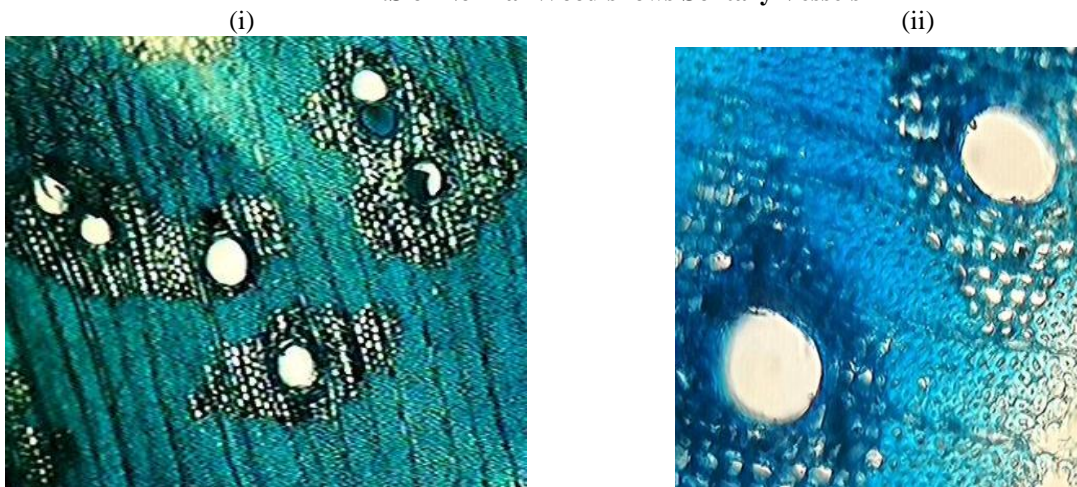
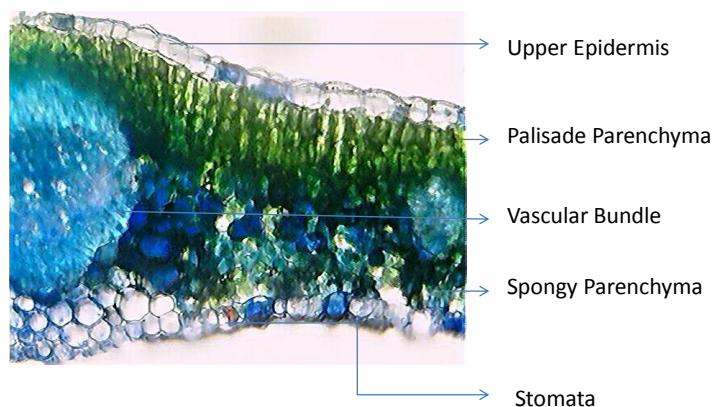
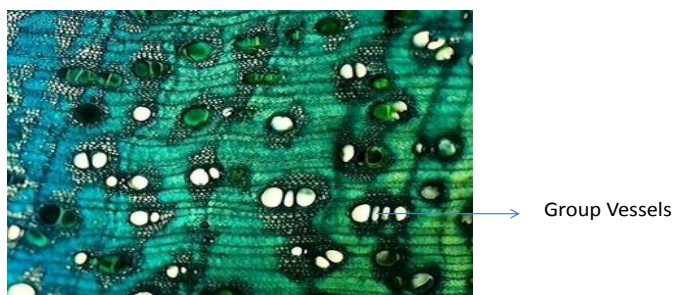


Plate II (Polluted leaf T.S)

7

T.S of Polluted Wood shows Solitary and Group Vessels

Vessel length was found to vary from 295 μm to 365 μm in the control and from 122 μm to 280 μm in the polluted samples. The results obtained are tabulated in Table-1. The vessel width ranges from 98 μm to 107.5 μm with an average value of 44 μm in the control and from 70 μm to 105 μm . The tracheid length varied from 762.5 μm to 795 μm and from 545 μm to 675 μm . The tracheid width varied from 15 μm to 17.5 μm . The fiber length was found to vary from 830.5 μm to 947 μm and from 812.5 μm to 942.8 μm . The fiber width was found to vary from 12.5 μm to 15 μm and from 12 μm to 14.5 μm . The parenchyma length varied from 132.5 μm to 170 μm and from 82.5 μm to 160 μm . The parenchyma width varied from 22.5 μm to 32.5 μm and from 17.5 μm to 21 μm .

Conversely, the vessel length and vessel width underwent a decrease to a highly significant level in the polluted samples. The variations in the vessel area and fiber length between the control and the polluted samples remained

statistically insignificant. Besides, a reduction in the tracheid cell was also found in the polluted sample. The variation in the vessel length was not significant.

Trees act as a sink for air pollutants and thus reduce their concentration in the air, especially in urban environments (Woo and Je 2006). The cement production process is accompanied with the emissions of considerable amounts of dust which causes changes in the growth conditions of forest trees. Dust falling from the atmosphere to the forest ecosystem is deposited mostly stomatal functioning and productivity (Nanos and Ilias, 2007). The reduced photosynthetic activity retards cambial activity and consequently xylem and phloem production (Wahlmann et al., 1986). Transpiration rate decreases and assimilation processes are starved of minerals (Halbwachs, 1970). The activity of cambium depends on the availability of water, starch, soluble sugars, minerals and growth hormones etc. (Iqbal, 1995).

Leaf Structure:-

Pollutants such as ground-level ozone physically damage leaves by causing chlorosis, or an abnormal yellowing of the leaves, resulting from a deficiency of chlorophyll. Chlorophyll is vital for photosynthesis. This molecule fuels the food-making process by capturing energy from the sun. Without chlorophyll, a plant cannot manufacture food or energy. In areas with high concentrations of ozone, parts of the leaf will die as a result of exposure.

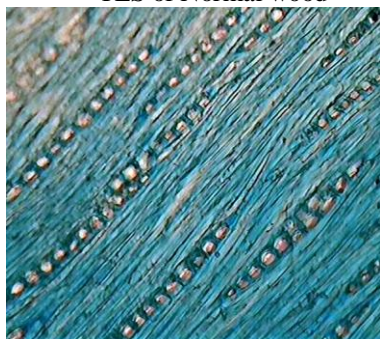
Stomata Damage:-

Stomata are the tiny pores found on leaves. Their function is to act as sites of gas exchange between the plant and the atmosphere. Carbon dioxide is taken up through the stomata and oxygen released during photosynthesis.

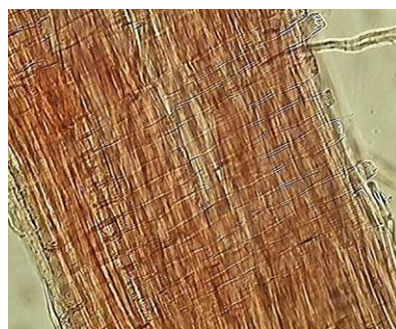
Researchers have shown that plants (including trees) can act as biological filters, removing large quantities of particles from the urban atmosphere (CPCB, 2007).

Plate III- Macerated Elements

TLS of Normal wood



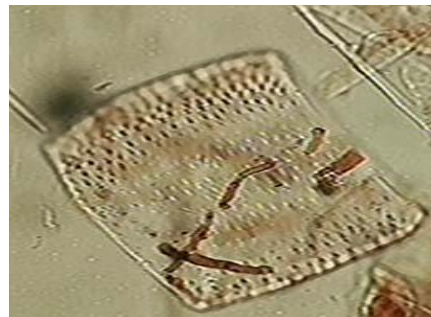
RLS of Normal wood



Tracheids



Vessels



Fibres



Parenchyma



Plate IV- Macerated Elements

TLS of Polluted wood



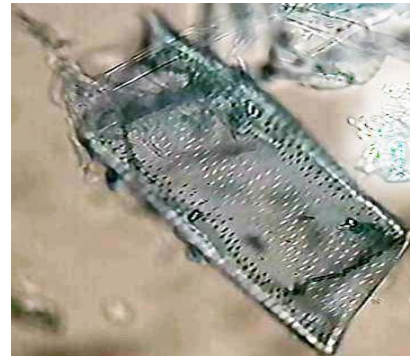
RLS of polluted wood



Tracheids



Vessels



Fibres



Parenchyma



Conclusion:-

The shortening of cell components is due to decreased transpiration, because water content is reduced in the stem and cell components readjust their dimensions to decrease in size. The short size of fusiform initials is coupled with structural shortening of other features of the bark and wood namely, the size and structure of sieve tube members, vessel elements, xylem and phloem rays and the amount and distribution of parenchyma so as to support the capillary action in the lumen (Esau, 2002). The analysis of dimensions of cell components in the present study indicates that they undergo a decrease in the polluted environmental conditions as compared to healthy trees (Gostin 2009).

The vessel length decreased significantly as reported earlier in case of some weeds subjected to pollution (Ghouse and Khan, 1983) and in *Polygonum glabrum* (Khan *et al.*, 1984). The present data revealed that the fiber length remained unaffected by the dust pollutants. The vessel elements of *Tamarindus indica* are more prone to the cement dust pollution. The effects of air pollutants on various anatomical traits have been studied by various workers in India and abroad. Dipu Sukumaran (2014) recorded that a highly significant increase in the fiber length and vessel width occurred in the polluted atmosphere than the normal atmosphere on *Abutilon indicum* G. Don, *Croton sparsiflorus* Morong and *Cassia occidentalis* Linn. This may be some adaptations of plants to survive the pollution and stress.

On the basis of the present study, it may be concluded that, the cement pollution can be considerably reduces the biological activity of plants. Among the both samples of *Tamarindus indica* investigated in the present study, that growing under the influence of cement dust pollution has been found to possess comparatively short cell components than those growing normal conditions. Possibly this may be one of the adaptive features to reduce the damage caused by dusting.

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