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MORPHOLOGICAL CHARACTERISTICS AND INFLUENCE OF ENVIRONMENT ON PHYTOLITH OF SOME MEMBERS OF WOODY DICOTYLEDONS

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Abstract: Within the ûeld of biodiversity–ecosystem functioning research, the majority of attention has been given to how aboveground plant diversity impacts biomass production and nutrient stocks. Phytoliths are siliceous microscopic particles found within and among the cellular tissue of many plants. Every species was found to produce a diverse array of phytoliths. Phytoliths form in most plants and are produced in a multitude of shapes and sizes. Phytolith shapes are found to be consistent within a species and hence they can provide significant taxonomic information. Both related and unrelated species may produce some of the same distinct types. A phytolith type may be considered characteristic if it is common in one specific taxon but also produced in very limited amounts in one or more other taxa. A phytolith type is diagnostic if its shape or size are specific to a particular taxon. Phytolith analysis of dicotyledons, particularly woody dicotyledons, has largely been ignored by many phytolith researchers in favour of grass phytoliths, thereby creating avoid in phytolith classification. The taxonomic significance of phytolith types produced by trees and shrubs from this part of the study area is largely poor. We contribute to filling the current information gap in woody phytoliths and explore their taxonomic value through phytolith analysis. The present phytolith study shows the diagnostic phytoliths from some woody plants (*Cassia fistula ,Tectona grandis, Terminalia arjuna, Rhizophora mucronata and Ceriops decandra*.). The study is based on the analysis of about five dicots from various families. (Wet-digestion method). The wood and bark of dicotyledons and gymnosperms contain a large proportion of phytoliths with variable, irregular morphologies compared to phytoliths with consistent or characteristic morphologies. Among the phytoliths with consistent morphology, there is a low variation of forms among the different species. These forms tend to repeat themselves in most of the plants analyzed. The most common forms encountered are the spheroids and ellipsoids with surfaces that have psilate or scabrate textures. The redundancy of phytoliths with similar morphology in all the species analyzed, together with the fact that the amount of phytoliths varies considerably depending on each species, indicates that different plants will contribute differentially in the amounts of phytoliths. This in turn implies that taxonomical identification of phytoliths derived from wood and bark is difficult.

Key words: Phytoliths, Morphotypes, Woody dicots

INTRODUCTION

Phytoliths are microscopic, amorphous, silicon-di-oxide particles (SiO_2. H_2O) occurring in plants. During absorption of water through their roots , it is absorbed in the form of monosilicic acid and gets deposited in various plant cells. It takes on the shape of the cells (Chauhan *et al* ., 2011). Phytolith shapes are found to be consistent within a species and hence they can provide significant taxonomic information. Phytoliths are released from the plant tissues when they get decayed , burned or is digested (Portillo, 2006). Released phytoliths are used as a tool in the reconstruction of past vegetation. Silicon protects the plants from various bacterial and fungal diseases and enhances capacity to tolerate the attack of insects and pests (Lanning, 1966; Fauteux *et al*., 2005,2006; Savant *et al.,* 1997; Ma *et al.,* 2008; Chauhan *et al.,* 2011). Phytoliths are seen to be abundant in monocotyledons when compared to dicotyledones and not much work in this regard have been reported in dicotyledones. The present work is about the phytolith morphology of some taxa available in Annamalai nagar.

MATERIALS AND METHODS

The various taxa selected for the phytolith analysis were *Cassia fistula, Tectona grandis, Terminalia arjuna, Rhizophora mucronata* and *Ceriops decandra.*

Phytoliths were extracted from the leaf samples by wet-digestion method (Carter 1997). The leaf samples were thoroughly washed in distilled water and dried in hot air oven at 52°C. The dried sample was taken and digested with concentrated sulphuric acid. After complete digestion the sample was treated with 30% hydrogen per oxide and heated till the solution becomes clear. Then it was washed repeatedly with distilled water till the acid contents were exhausted. Then the residues were collected, dried, weighed and mounted in Canada balsam. Slides were observed under light microscope and photographs were taken using Olympus digital camera attached with Olympus trinacular microscope. Phytolith morphotypes were classified and described using the international code of phytolith nomenclature (Madella *et al.,* 2005). Measurements were made along the longest axis of the phytoliths.

RESULTS

1. *Cassia fistula* L.

Rod shaped phytoliths are frequently noticed in this species and they are 23-38 µm long. Rectangular Forms having a size of 12-15 µm were also observed (Fig. 1a, 1b).

2. *Tectona grandis* L.

Epidermal cell type are the only forms observed here and they are seen in groups (conjoined phytoliths). The diameter of each phytolith is about 35-44µm (Fig.2).

3. *Terminalia arjuna* (Roxb. ex DC.) Wt. & Arn.

Cubical forms are predominantly observed in this species. Their size varies from 14-22µm. It accounts about 70% of the total phytoliths observed. Rod shaped forms were also seen with a length of 20-55µm. Apart from these some epidermal cells are also noticed (Fig.3).

4. *Rhizophora mucronata* Poiret

Irregular spherical bodies were abundantly seen in the species. Their diameter range from 26-41µm. This is found to be distinct to the species (Fig.4).

5. *Ceriops decandra* (Griffth) Ding Hou

The only morphotypes observed here are the short cylindrical forms and they have a length varying from 20-29µm (Fig.5).

Fig. 1a. Cassis

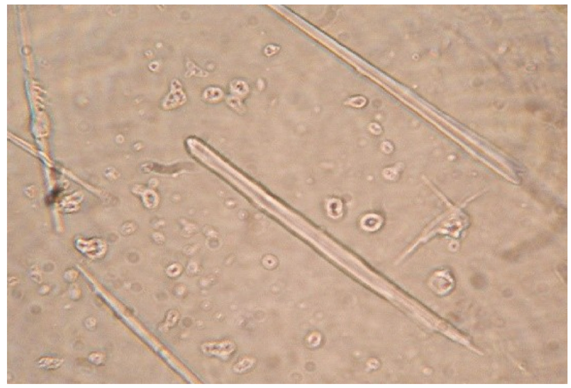

Fig. 1b. *Cassis fistula*

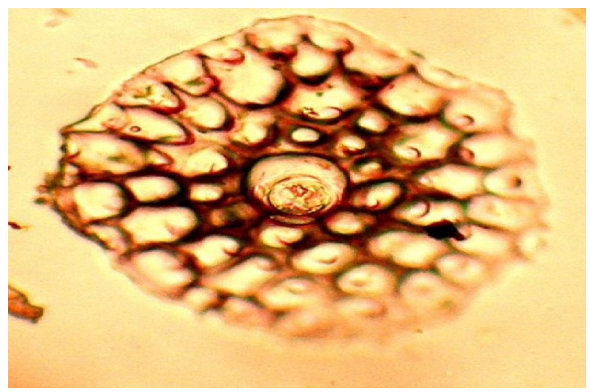

Fig. 2. *Tectona grandis*

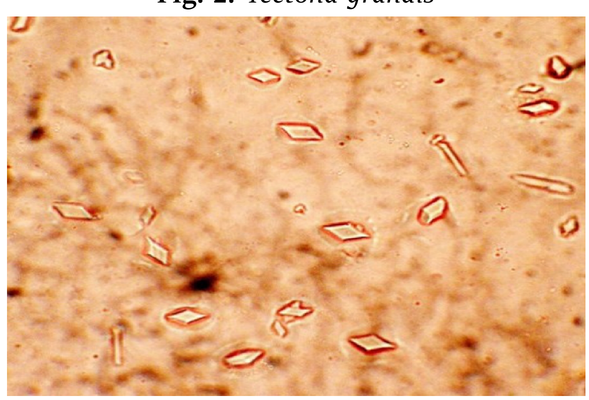

Fig. 3. *Terminalia arjuna*

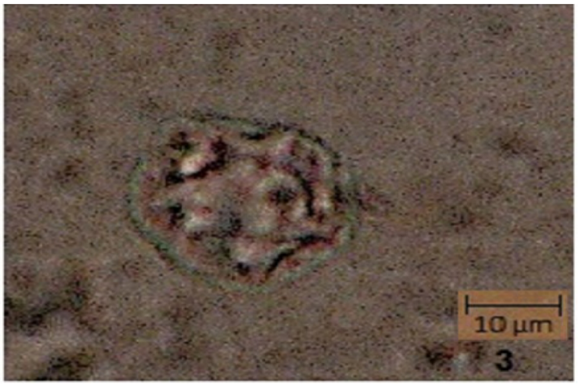

Fig. 4. Rhozophora mucronata

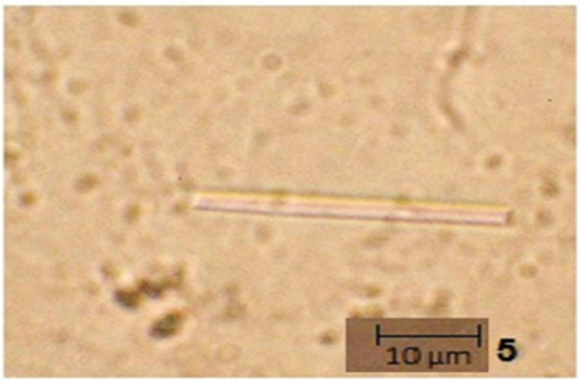

Fig. 4. Ceriops decandra

DISCUSSION

The present study is about phytolith analysis of five species of dicotyledonous plants. In this observations, *Cassia fistula* shows two different kinds of phytolith morphotypes, rectangular forms and rod forms, but in other species of *Cassia,* phytoliths are not yet reported. (Kealhofer and Piperno, 1998).

In *Tectona grandis,* epidermal cell types were observed but the earlier report of Kealhofer and Piperno showed short cones and plate like structures in the species (Wallis, 2003).

In *Rhizhophora mucronata* phytoliths are of irregular spherical shaped bodies whereas *Ceriops decandra* which also comes under Rhizophoraceae only rod shaped phytoliths were observed. This showed that a strong variation of phytolith morphotypes occurs within the family itself. In the report of non-grass phytoliths in Sunderbans by Das *et al.,* (2013) it was documented that *Ceriops decandra* produced globular lacunose type phytoliths but in this study only rod shaped phytoliths are observed. This may be due to the environmental influence.

According to Piperno , Combretacean members are usually rare or non-producers of phytoliths. In *Terminalia arjuna*, cubical forms, rod forms and epidermal types were observed wheras *Terminalia hadleyana* produced psilate elongated cones and one unidentified species of *Terminalia* produced large amount of anticlinal plate (Wallis, 2003).

Although the taxa showed some species distinct phytoliths, the earlier reports (Das *et al.,*2013; Kealhofer and Piperno, 1998) proved that in different areas, the same species showed variations in phytolith morphotypes. This may be due to the influence of environment on the taxa. Hence more studies are required in this part for providing relevant information to support systematics. But still then phytolith studies play a significant role in systematics.

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