

AN OUTLINE OF THE BARK ANATOMY OF SOME ARID ZONE *ACACIA* AND *PROSOPIS* WITH PARTICULAR ATTENTION ON SCLERENCHYMA DISTRIBUTION*

A. K. M. GHOUSE AND MUHAMMAD IQBAL

Department of Botany, Aligarh Muslim University, Aligarh 202001, India

ABSTRACT

Anatomical investigation of the bark of some arid zone trees of *Acacia* and *Prosopis*, carried out on a comparative basis, has brought out certain inter-specific variations in macro— as well as microscopic features of bark construction. Surface configuration of the bark, relative proportion of various bark zones, and distribution pattern of phloem sclerenchyma are among the features worthy of attention for exploiting in the differentiation and identification of seemingly alike isolated bark materials.

INTRODUCTION

According to ESAU (1964, 1965), information on the structure of bark is relatively deficient and rather incomplete. This becomes more obvious when one looks for knowledge about the bark of tropical trees in general and the Indian counterparts in particular. Consequently, the information usually imparted on plant anatomy to students in our class rooms is entirely based on foreign studies with exotic materials. In view of this, a project was initiated in this laboratory to work out the structural details of the cambium and bark of Indian tropical trees and recognise their mode of specialization, if any. One such study elucidating the anatomical framework of the bark of certain arid zone species of *Acacia* and *Prosopis*, is presented here.

MATERIAL AND METHODS

Bark samples (blocks of 2 cm² size) chiselled out from the main trunk of fully grown forest trees of *Acacia catechu* Willd., *A. farnesiana* Willd., *A. melanoxylon* R. Br., *A. nilotica* (L.) Willd. (vars. *cupressiformis*, *telia* and *vediana*), *Prosopis cineraria* Machb. and *P. spicigera* L., were fixed in FAA for 5 days and then kept in a mixture of 50% glycerol and 50% ethanol (1 : 1) for softening. After a couple of months, transverse sections of 10 µm thickness were cut on a sliding microtome, stained in hematoxylin and Bismark brown, and mounted in Canada balsam after passing through the ethanol series for dehydration (SASS, 1958).

In order to find out the relative proportion of sclerenchyma in the phloem, camera lucida drawings of different phloem components were made on tracing paper and exploited for calculating the percentage of transectional area occupied by sclerenchyma, following the method of GHOUSE AND YUNUS (1974).

OBSERVATIONS AND DISCUSSION

The term "bark" is applied in the present study to all the cell layers lying outer to vascular cambium. The dead rhytidome portion forming the outer hard crust of the

*Paper presented at the Second Indian Geophytological Conference, Lucknow, March 11-12, 1978.

stem axis has been referred to as non-functional bark while that with the living cells as functional one. The latter consists of conducting as well as non-conducting zones of secondary phloem. The non-conducting phloem in which the obliterated or crushed sieve elements are no longer active in translocation phenomenon, is also included in the functional bark because rest of the component elements of phloem such as axial and ray parenchyma do, however, perform activities like secretion, conduction and accumulation of ergastic substances.

The outer dead crust of barks experienced surface fissuring of varying degrees. Following WHITMORE (1962) the barks were categorized as (i) entire (*A. farnesiana*), (ii) shallow fissured (*A. melanoxyton*) and (iii) deep-fissured (rest of the species under study). The fissures, when present, were either V-shaped (*A. catechu* and *A. melanoxyton*), or compound i.e., sub-divided at their bottoms into smaller ones (*A. nilotica* var. *cupressiformis* and *P. cineraria*), or irregular in shape (*P. spicigera* and the remaining 2 varieties of *A. nilotica*) as seen in slash view. Ray expansion tissue near periderms was visible with unaided eye only in *A. farnesiana* and *A. melanoxyton*. Thick rhytidome was present in all the species except *A. farnesiana* which usually contained single, superficial periderm.

The functional bark zone was found to occupy from nearly one-tenth to three-fourths of the total bark thickness in the taxa under study (Table 1). The relative proportion

Table 1—Comparative data on the amount and magnitude of various bark zones and the phloem sclerenchyma in some *Acacia* and *Prosopis* spp.

Taxa	Bark thickness (mm)	Functional bark (Secondary phloem)		Amount of sclerenchyma in secondary phloem (%)
		Conducting phloem (mm)	Non-conducting phloem (mm)	
<i>Acacia catechu</i>	20	0.40	1.60	30
<i>A. farnesiana</i>	5	0.78	3.00	38
<i>A. melanoxyton</i>	8	1.22	2.00	31
<i>A. nilotica</i>				
var. <i>cupressiformis</i>	8	1.66	3.86	18
var. <i>telia</i>	22	2.42	6.78	28
var. <i>vediana</i>	15	1.83	3.30	16
<i>Prosopis cineraria</i>	20	2.17	7.20	15
<i>P. spicigera</i>	9	1.04	1.68	32

of this region, the secondary phloem, constituted about 10% (*A. catechu*) to 72% (*A. farnesiana*) of the bark in different species. The conducting phloem, i.e. the portion of phloem with active sieve tube members, however, comprised of only 2% (*A. catechu*) to 15% (*A. nilotica* var. *cupressiformis*) of the bark as a whole (Figs. 1 & 2).

Phloem sclerenchyma, mainly libriform fibres, formed the major component of the tissue, their distribution pattern in transections being diagnostic in the identification

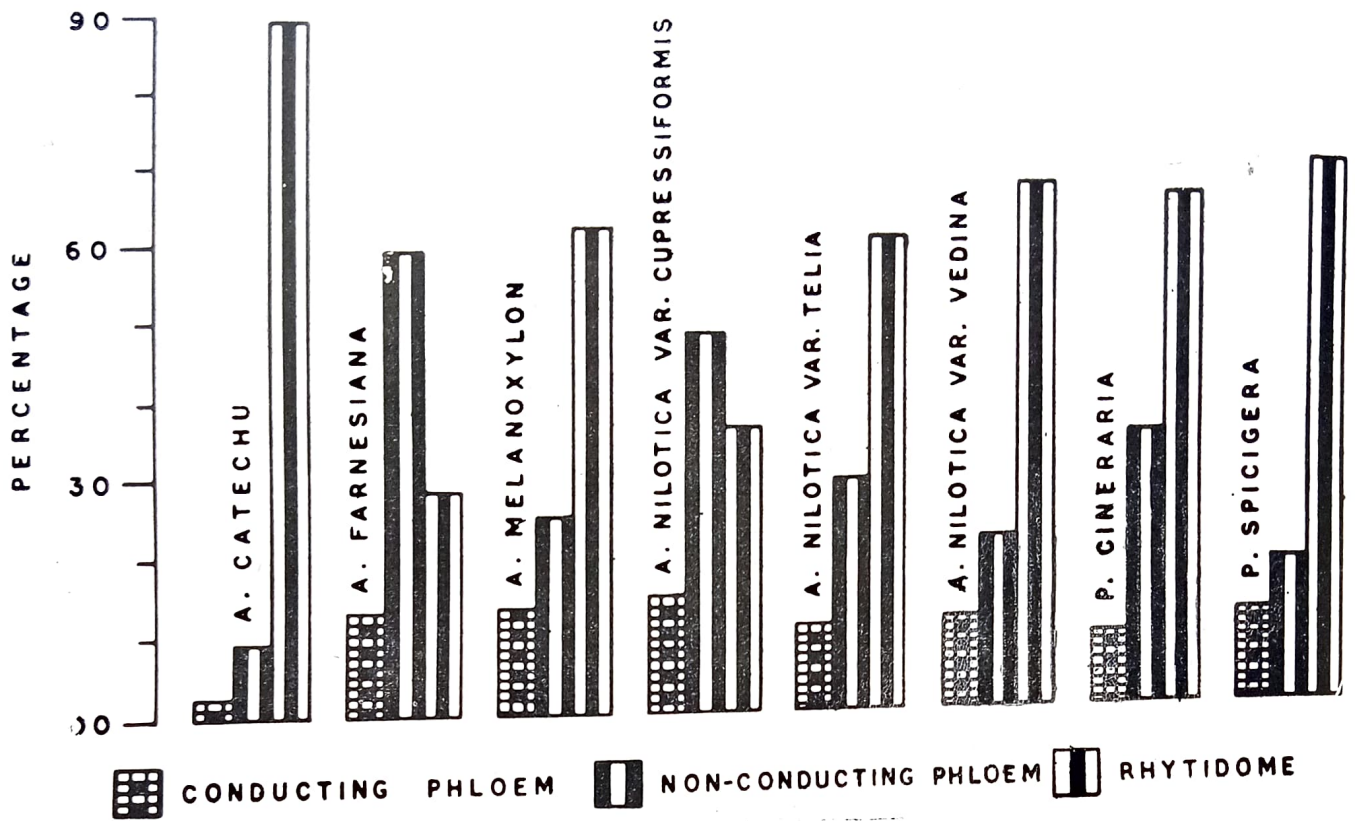


Fig. 1. Histogram showing the relative proportion of different bark zones in some *Acacia* and *Prosopis* species.

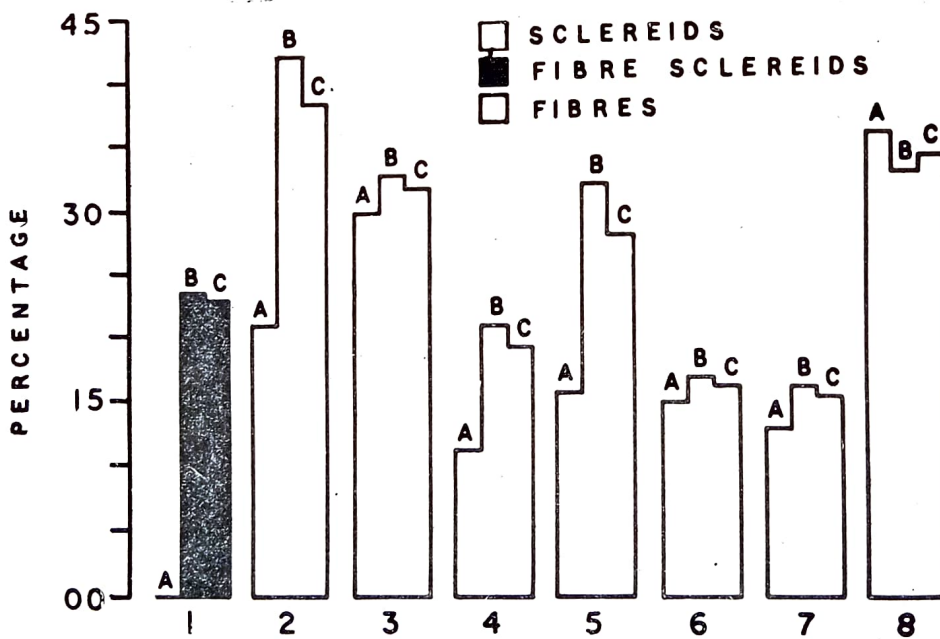


Fig. 2. Histogram showing the relative proportion of sclerenchyma in (A) conducting phloem, (B) non-conducting phloem and (C) secondary phloem as a whole in the bark of (1) *Acacia catechu*, (2) *A. farnesiana*, (3) *A. melanoxylon*, (4-6) *cupressiformis*, *telia* and *vediana* varieties of *A. nilotica*, (7) *Prosopis cineraria* and (8) *P. spicigera*.

of isolated bark materials. Sclerified elements were present throughout the secondary phloem in all the species except *A. catechu* which contained such elements only in the non-conducting zone. The fibres were grouped either in fascicles of irregular shapes (*A. farnesiana*, *A. nilotica*) or in tangentially extended elongate strips of diverse magnitude (*Prosopis* spp.) which were frequently traversed by the radially running phloem rays.

Relative proportion of the sclerenchyma calculated separately in the conducting, non-conducting and the entire secondary phloem is depicted in Fig. 2. It formed zero to 35% of the conducting zone, 17% to 42% of the non-conducting zone or, in other words, 15–38% of the secondary phloem as a whole in the various *Acacia* and *Prosopis* species (Table 1, Fig. 2).

As evident from the table, width of conducting phloem in the above species varies from 0.40 mm to 2.42 mm. It is at par with some earlier works (HOLDHEIDE, 1951; Zimmermann, 1961) describing a similar range of width of the conducting phloem in certain deciduous temperate trees. WHITMORE (1962), however, assumed the conducting phloem thickness in Dipterocarpaceae to be 5-6 mm. Distribution pattern as well as the relative proportion of sclerenchyma is subject to variation not only among different taxa but within the genus too and, hence, appears to be species-specific. This feature, when supplemented by others, may therefore, be of significant help in distinguishing and identifying barks of the related species.

ACKNOWLEDGEMENT

The second author owes to C.S.I.R., New Delhi, for the award of a Senior research fellowship.

REFERENCES

- ESAU, K. (1964). Structure and development of bark in dicotyledons. In M. H. Zimmermann (ed.) "*The formation of wood in forest trees*". Academic Press, New York.
- ESAU, K. (1965). *Plant Anatomy*, 2nd ed. John Wiley and Sons Inc., New York.
- GHOUSE, A. K. M. & YUNUS, M. (1974). Distribution pattern of phloem fibers in *Dalbergia*. *Bangladesh J. Bot.* **3** : 83-86.
- HOLDHEIDE, W. (1951). Anatomy Mitteleuropaischer Geholzirinden (mit mikrophotographischer Atlas). In H. Freund (ed.) "*Handbuch der Mikroskopie in der Technik*", **5** : 193-367, Frankfurt.
- SASS, J. E. (1958). *Botanical microtechnique*. Iowa State Univ. Press, Ames.
- WHITMORE, T. C. (1962). Studies in systematic bark morphology I. Bark morphology in Dipterocarpaceae. II. General features of bark construction in Dipterocarpaceae. *New Phytol.* **61** : 191-207, 208-220.
- ZIMMERMANN, M. H. (1961). Movement of organic substances in trees. *Science*, **133** : 73-79.