ANATOMICAL CHARACTERISTICS OF SOME CASUARINA SPECIES GROWN IN EGYPT

by

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Summary

Anatomical features of the wood of *Casuarina equisetifolia, C. glauca* and *C. cunninghamiana* as well as a putative natural hybrid between the last two species, are described. *C. equisetifolia* is easily distinguishable from the other two species as it has fewer vessels per mm^2 and the aggregate rays are absent. On the other hand, *C. cunninghamiana* and *C. glauca* share several features many of which are found in their hybrid. However, the hybrid has a higher number of vessels per mm^2 than its suggested parents and possesses intermediate fibre wall thickness between its parents.

Introduction

The genus *Casuarina* comprises nearly 50 species, which are found in the Southern Hemisphere from India and Malaya to the islands of the South Pacific Ocean, and find their greatest development in Australia where they occur both in the arid areas of the center and the higher rainfall coastal regions (Hall et al., 1972). The trees vary in size from small to large and their principal value is for shelter, soil conservation and rehabilitation, timber or fuel supply.

A few species were introduced into Egypt last century where they are planted essentially as windbreaks and to supply wood for local industries. The trees proved to be superior to several other exotic and native species as they are well adapted to local severe climatic and soil conditions. Plenty of them have been used as windbreaks in the northwestern regions of Egypt, where desert reclamation is underway.

A *Casuarina* breeding program for shelterbelt plantations was initiated at Alexandria University, the first step of which has been to identify the species. Badran et al. (1976) examined in detail the morphological and taxonomical characteristics of *Casuarina* species grown in Egypt and were able to identify three distinct species; namely *C. equisetifolia* Forst., *C. cunninghamiana* Miq. and *C. glauca* Sieber et Spreng. A natural hybrid between the last two species was also recognized and described morphologically by them for the first time. The identification of the above-noted species and the hybrid was confirmed after a serological study by El-Lakany et al. (1977) and a quantitative determination of flavonoids and phenolics by Saleh and El-Lakany (1979). Moseley (1948) described the wood anatomical features of many *Casuarina* species in detail.

The present investigation was carried out in order to provide anatomical descriptions for the three local *Casuarina* species and to further study the identity of the putative hybrid.

Materials and Methods

Six wood specimens were selected from mature healthy trees of *C. equisetifolia, C. cunninghamiana, C. glauca* and the hybrid (*C. cunninghamiana x C. glauca*). The trees were identified on the bases of morphological descriptions given by Badran et al. (1976). Cross, radial and tangential sections were then prepared for microscopic examinations according to the standard techniques.

The sections were examined for the main anatomical features (Moseley, 1948; Panshin & de Zeeuw, 1970). In addition, fifteen counts were made of the number of vessels/mm^2. The frequency classes used for this character are in accordance with Chattaway's proposed standards (Chattaway, 1932). The vessel diameters were measured for 50 vessels in both radial and tangential directions, the average of which was reported. The size classes used are those of Chalk (1938). The vessel wall thickness was also measured for the same number of vessels.

The fibre diameter was determined for 60 fibres in both radial and tangential directions whereas the wall thickness was measured on the same number of fibres in accordance with Chattaway's classification.

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Results and Discussion

Based on the data available for this study and the results presented in Tables 1 and 2, the following is a brief description of the anatomical characteristics of *Casuarina* species grown in Egypt.

Casuarina wood is diffuse porous (Figs. 2a & 3) but tends to be semi-diffuse or semi-ring-porous in *C. equisetifolia* (Fig. 1a). Vessels are solitary with moderately small to medium diameters ranging from 92 to 116 microns for the species studied (Table 1). *C. equisetifolia* has the smallest number of vessels per mm^2 (11 ± 3.6/mm^2), whereas the hybrid has the largest number (44 ± 12/mm^2). Corresponding mean values for *C. cunninghamiana* and *C. glauca* are 32 ± 7.3 and 27 ± 5.3/mm^2, respectively. Perforation plates are simple and occasionally scalariform. Sporadic spiral thickenings are occasionally present in the four *Casuarina* species. Vessel to vasicentric tracheid pits are alternate to opposite.

Vasicentric tracheids are present in all species studied and form a sheath around vessels. Fibre-tracheids with thick walls and conspicuously bordered pits, usually on both tangential and radial walls, constitute the ground tissue.

Longitudinal parenchyma is apotracheal, sporadic and in short tangential bands, mostly 1 or 2 cells wide in *C. equisetifolia* (Fig. 1a) and in short or long bands, 2 to 4 cells wide in the other species (Figs. 2a & 3). Some of these cells contain rhombic crystals.

Rays in *C. equisetifolia* are mostly uniseriate to three-seriate, rarely four-seriate (Fig. 1b). There is a tendency towards the grouping of rays together to form a structure similar to aggregate rays. In the other species, however, rays range from uniseriate to very wide and aggregate rays (Fig. 2b), that are mostly heterogeneous and occasionally contain rhombic crystals. The aggregate rays in the three species belong to the *cunninghamiana* type described by Moseley (1948).

It is obvious from the short anatomical description presented above that in Egypt *C. equisetifolia* can be easily distinguished from the other *Casuarina* species and the hybrid based upon its types of rays, and the longitudinal parenchyma. Both *C. cunninghamiana* and *C. glauca* have more or less similar anatomical characteristics many of which are found in their hybrid. Nevertheless, the hybrid could be distinguished from its suggested parents by the higher number of vessels per mm^2 (Table 1). However, it is evident from Table 2 that the hybrid possesses fibre wall thickness intermediate between its suggested parents. Comparable study on controlled crosses between *Pinus taeda* by Jackson and Green (1958) indicated that five of seven possible combinations produced tracheid length intermediate between the two parents. Similarly, pine hybrids in Australia exhibited physical properties that are intermediate between the parents (Dadswell & Nicholls, 1959).

This study revealed that the hybrid is characterized by the higher number of vessels per mm^2 as compared to its suggested parents. In addition, recent study by El-Lakany et al. (in preparation) showed that the growth of this hybrid is more vigorous than either of its parents. The interrelationship between these two characteristics merits further studies.

In conclusion it is obvious from the present study that, generally, woods from *C. glauca, C. cunninghamiana* and their putative hybrid are not anatomically distinct from each other, but quite different from *C. equisetifolia* wood.

Table 1. Some vessel characters of *Casuarina* species.

species	number of vessels per mm^2			vessel diameter (micron)			wall thickness (micron)		
	$\bar{X}$	S.D.	N^a	$\bar{X}$	S.D.	N^b	$\bar{X}$	S.D.	N^b
Casuarina									
equisetifolia	11	3.6	15	114	28.2	50	4.4	0.7	50
cunninghamiana	32	7.3	15	92	24.7	50	2.6	0.5	50
glauca	27	5.3	15	116	32.4	50	3.3	0.5	50
cunninghamiana x glauca	44	12.0	15	102	21.3	50	2.6	0.4	50

$\bar{X}$: average – S.D. : standard deviation – N^a : number of counts – N^b : number of measurements in the radial and tangential direction.

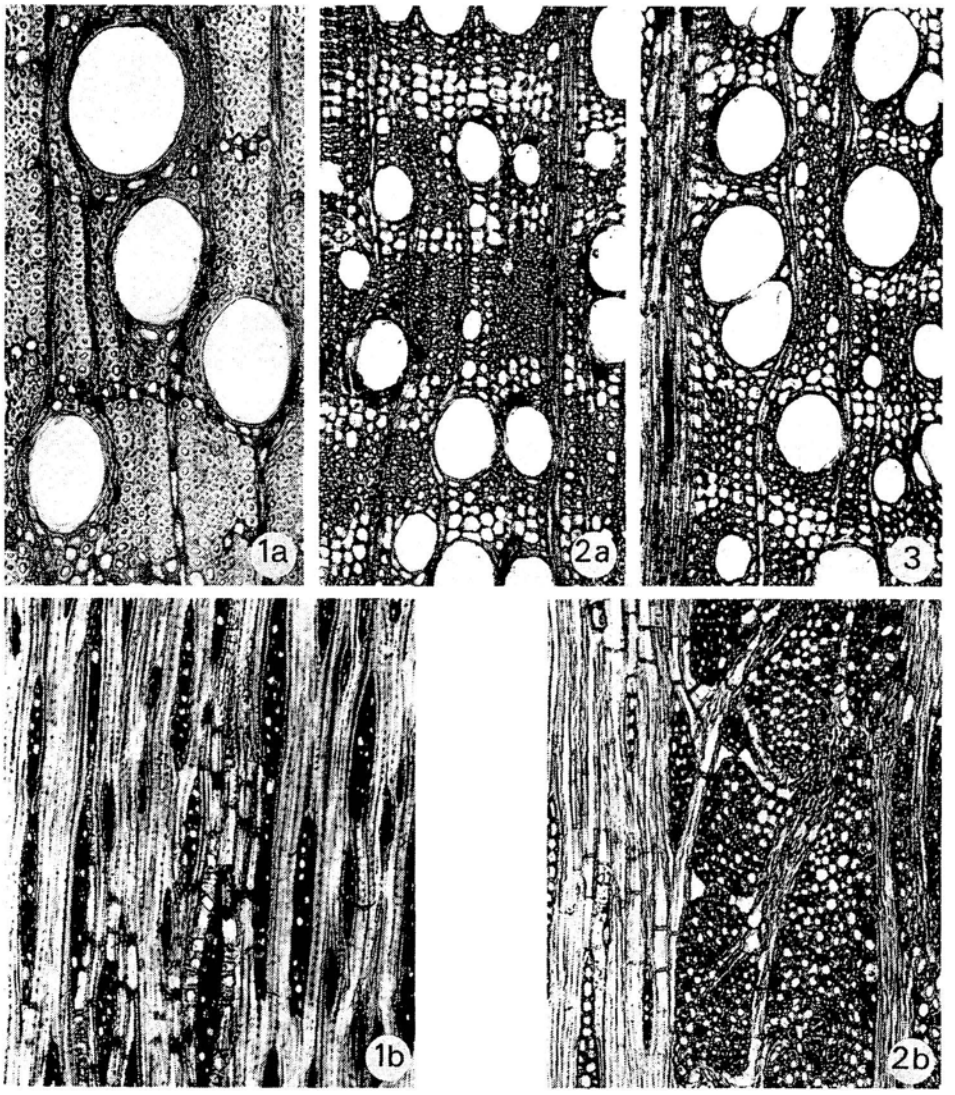

Fig. 1. (a) Transverse section (x 100) and (b) tangential section (x 100) of *Casuarina equisetifolia*.
Fig. 2. (a) Transverse section (x 100) and (b) tangential section (x 100) of *C. cunninghamiana*.
Fig. 3. Transverse section of the hybrid *C. cunninghamiana x C. glauca* (x 95).

Table 2. Fibre characteristics of *Casuarina* species.

species	diameter (micron)			wall thickness (micron)		
	$\bar{X}$	S.D.	N^a	$\bar{X}$	S.D.	N^b
Casuarina						
equisetifolia	13.8	3.1	60	5.0	0.78	60
cunninghamiana	12.7	2.2	60	4.0	0.77	60
glauca	12.4	2.4	60	3.2	0.62	60
cunninghamiana x glauca	13.3	2.4	60	3.3	0.69	60

$\bar{X}$: average – S.D. : standard deviation – N^a : number of measurements – N^b : number of measurements in the radial and tangential directions.

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