BULLETIN OF THE IRAQ NATURAL HISTORY MUSEUM
Iraq Natural History Research Center & Museum, University of Baghdad
https://jnhm.uobaghdad.edu.iq/index.php/BINHM/Home
 Online ISSN: 2311-9799, Print ISSN: 1017-8678

Bull. Iraq nat. Hist. Mus.
(2025) 18 (3): 577-610. https://doi.org/10.26842/binhm.7.2025.18.3.0577

ORIGINAL ARTICLE

TAXONOMIC REVISION OF THE FAMILY CASUARINACEAE R. BR., 1814 (ORDER, FAGALES) IN EGYPT

Fatema S. Mohamed*♦, Rim Hamdy** and Essam M. Abd-Elkhader***
*Flora and Phyto-taxonomy Research Department, Horticultural Research Institute, Agricultural Research Center, Giza, Egypt.
**Department of Botany and Microbiology, Faculty of Science, Cairo University, Giza, Egypt.
***Timber Trees Department, Horticultural Research Institute, Agricultural Research Center, Giza, Egypt.
♦Corresponding author: rhamdy@sci.cu.edu.eg

Recived: 20 Jan. 2025, Revised: 11 April 2025., Accepted: 13 April 2025, Published:20 June 2025

ABSTRACT

The taxonomic features of the Casuarinaceae family were carefully examined to determine which characters were most trustworthy for taxonomic delimitation. Morphological characteristics that represented habit, leaf teeth, article, phyllichnia, male spike, female cone, samara, and seed were used in our evaluation. Fieldwork revealed that seven taxa were present, among which four species belonged to the genus *Casuarina* L., 1759. On the other hand, herbarium studies identified the previous record of three species belonging to the genus *Allocasuarina* L.A.S. Johnson, 1982, nevertheless could not be found in the field. *Casuarina cunninghamiana* Miq., 1848 and *Casuarina equisetifolia* L., 1759 were represented in Egypt by the subspecies *cunninghamiana* and the subspecies *incana* (Benth.) L.A.S. Johnson, 1982 respectively. For each taxon, a thorough description of the family, genus, and species was given, along with images and synonyms. Moreover, a constructed identification key to the taxa of Casuarinaceae is included. This investigation demonstrated the significance of morphological characteristics for taxonomic assessment among the Casuarinaceae taxa surveyed in Egypt. The numerical analysis supported the separation of the two genera, *Allocasuarina* and *Casuarina*.

Keywords**:** *Allocasuarina*, *Casuarina*, Casuarinaceae, Numerical analysis, Taxonomy.

INTRODUCTION

The Casuarinaceae family comprises four genera and ninety-one species of shrubs and trees, and native to Australia, Southeast Asia, Malesia, Papuasia, and the Pacific Islands. Johnson (1980, 1982) separated many of the species that were previously included in the genus *Casuarina* L., 1759 and reclassified them into the new genera *Gymnostoma* (1980 and 1982), *Allocasuarina* (Johnson, 1982), and *Ceuthostoma* (Johnson, 1988). Among the angiosperms,

this family is distinct and lacks close relatives. A phylogenetic study of the family later supported the monophyly of these genera (Sogo *et al*., 2001; Dorothy *et al*., 2003). This family was the only one placed in the order Verticillatae in the Wettstein system. Similarly, Casuarinaceae was the only family assigned to the order Casuarinales in the Engler, Cronquist, and Kubitzki systems (Beadle, 1981; Turnbull,1990 ; Bousquet, 1994).

Numerous criticisms have been raised regarding the classification of many new *Allocasuarina* species and the division of *Casuarina* into four genera (Hwang, 1990, 1991a, b, 1992; Crisp, 1991; Johnson, 1991). According to Johnson and Wilson (1989), *Allocasuarina* was the most derived genus, whereas *Gymnostoma* and *Ceuthostoma* were the more primitive genera of the family. Four genera have been recognized based on the findings of a study conducted by Sogo *et al.* (2001) on the family's matK and rbcL sequences.

Extreme morphological reduction and a distinctive combination of morphological characteristics defined the family (e.g., drooping equisetoid twigs, reduced scale-like leaves in whorls forming toothed sheaths at each node, inflorescence with alternating whorls of tooth-like bracts and reduced flowers, wind-pollination, woody cone-like inflorescence, winged samaras as fruits (Dorothy *et al.*, 2003). The whorls of leaves at the nodes are fused to the stem throughout the length of the internode above, forming the ridges, according to Metcalfe and Chalk (1979). Their lateral margins joined the distal part of the leaves at the next higher node to form the sheath that envelops the next internode's base. The tips of the leaves formed the teeth.

Actinorhizal woody plants in the Casuarinaceae family can fix nitrogen from the atmosphere when associated with the Actinomycete *Frainkia*. Important tree species in the family have a great chance of being used for afforestation in tropical and subtropical climates, including arid and semiarid regions (El-Lakany, 1983 a, b; Turnbull, 1990).

The scarcity of data on *Casuarina* in Egypt may indicate the need for a taxonomic revision. In many regions, including Egypt, ecological and botanical surveys may have been insufficient or outdated, leading to gaps in knowledge regarding species distribution, population status, and potential threats. The current study aims to provide a more accurate diagnostic key for the species of *Casuarina* cultivated in Egypt.

MATERIALS AND METHODS

Plant materials: This work investigated seven species belonging to two genera of Casuarinaceae in Egypt. The morphological information used in this study was derived from analyses of more than 150 herbarium specimens deposited at the Agricultural Research Centre, Flora and Phytotaxonomy Herbarium, CAIM, and Cairo University Herbarium, CAI. The acronyms for herbaria follow Thiers (2020). Additionally, digital photographs of authentic specimens from several online herbaria were examined. In addition, the authors collected fresh specimens of the studied taxa from public or private gardens and avenues in Egypt between January 2023 and December 2024.

Voucher specimens of the taxa under study are kept at Cairo University Herbarium (CAI). Identification and updated nomenclature were revised and confirmed using the available literature, including: Brenan (1949), Dale and Greenway (1961), Täckholm and Drar (1969), White (1962), Sykes (1970), Badran *et al.* (1976) Woodroffe (1985), Wilmot-Dear (1985, 1991), Wilson and Johnson (1989), Jones (1991), George *et al.* (1993), Govaerts (1999), Fairhurst (2004), Iwatsuki *et al.* (2006), Hokche *et al.* (2008), Oppenheimer (2011), Girmansyah (2013) Muer *et al*. (2020) and Pusalkar *et al.* (2022).

Morphological characters: A total of 43 characters- 16 quantitative and 27 qualitative- were observed. The terms for the traits were taken from the Kew Plant Glossary (Beentje, 2016). The remaining characters were scored as multistate, such as leaf arrangement (opposite, spiral, or alternate), while thirty were rated bistate. A stereomicroscope was used to examine and measure the collected specimens: Wild Heerbrugg, M1B at CAI and a stereomicroscope (P 202X 35783) at CAIM.

Statistical analysis: Statistical analysis of the different morphological features was based on hierarchical cluster analysis. The resulting data revealed certain morphological correlations among the species under study. Characters and character states were coded as multistate characters. The interval numbers of morphological characters were used for the studied species (Tab. 1). The data were treated using Pearson correlation in a data matrix to measure the degree of similarity, using SPSS version 22 (SPSS, 2013). The output was plotted as a UPGMA (Unweighted pair group method with arithmetic mean) dendrogram (Diag.1). Average linkage cluster analysis between taxa and the rescaled distance cluster combination served as the foundation for the dendrogram (Sneath and Sokal, 1973).

RESULTS AND DISCUSSION

Brief descriptions of *Casuarina* L., 1759 have been published for Egypt very infrequently (e.g., Bircher, 1960; Täckholm and Drar, 1969; Youssef and Hamdy, 2013). All available data about the genus in Egypt are compiled in Table (1).

Casuarina was introduced to Egypt in the 19th century; the oldest documented record is of *C. stricta* growing in Ibrahim Pacha's garden on Roda Island, where it flourished from 1830 to 1850. This species' wood was exported from Egypt to exhibits in Cologne in 1875 and Paris in 1878. The tree was also documented in Cairo's Ezbekiya garden (Delchevalerie, 1875; Sickenberger, 1901).

Concurrently, *C. equisetifolia* was cultivated in Cairo, Alexandria (Figari, 1865), the khedivial garden in Shubra (Delchevalerie, 1871), along the canals of Ismailia (Barbey-Boissier and Barbey, 1882) and Suez (Bonaparte, 1904), documented in the works of Draper (1898), Ascherson and Schweinfurth (1887), Muschler (1912) and Brown (1917). In her gardens of Hesperides, Bircher (1960) mentioned seven species of *Casuarina* in El Saff Garden. In 1969, Täckholm and Drar added eight more species.

Casuarinaceae R. Br., Voy. Terra Austral. 2: 571(1814), nom. cons.

Dioecious or monoecious trees or shrubs. Branchlets wiry, slender, and articulate, with several basal articles and one to many- elongated articles. Articles have many ridges (phyllichnia) and teeth (reduced leaves), phyllichnia being divided by deep, closed furrows that contain the stomates. There are 4-20 whorls of leaves reduced to teeth at the tip of each article of the assimilatory branchlets. Inflorescences consist of alternating whorls of tooth-like bracts; within each bract are two lateral scale-like bracteoles, persistent, occasionally deciduous in male *Allocasuarina*, and a single flower. Male inflorescence with a short to long spike. Male flowers have one or two tepals, hooded, scale-like, and deciduous at anthesis; one stamen; a two-locular, basifixed anther. Female inflorescence forms a globular or ovoid head. Female flowers: perianth absent; two-united carpels; two ovules, rarely four; style with two branched, reddish in colour. Infructescence with woody cone, the two floral bracteoles enlarged as valves. Fruit with a winged nut (samara). Seed solitary in each samara; cotyledons large; endosperm absent; often contains more than one embryo.

Table (1): Historical data of the *Casuarina* species recorded in Egypt with their currently accepted names.

Old name cited in literature	Currently accepted name	Figari (1864-5)	Delchevalerie (1871)	Barbey and Barbey (1882)	Delchevalerie (1875)	Ascherson and Schweinfurth (1887)	Delchevalerie (1897)	Draper (1898)	Delchevalerie (1899)	Sickenberger (1901)	Blomfield (1901)	Bonaparte (1904)	Muschler (1912)	Brown (1917)	Bircher (1960)	Täckholm and Drar (1969)	Hamdy et al. (2007)	Hamdy (2010)	Youssef and Hamdy (2013)
Casua-rina distyla- Vent.	1. *Allocasu-arina distyla* (Vent.) L.A.S.Johnson															1			
Casua-rina fraseri-ana Miq.	2. *Allocasu-arina fraseriana* (Miq.) L.A.S.Johnson														1	1			
Casua-rina huege-liana Miq.	3. *Allocasu-arina huegeliana* (Miq.) L.A.S.Johnson															1			

***Casua-rina quadrivalvis* Labill.**	***Casua-rina bicuspidata* Benth.**	***Casua-rina torulosa* Aiton**	***Casua-rina nana* Sieber ex Spreng.**	***Casua-rina littoralis* Salisb.**	***Casua-rina suberosa* Ott o & A.Dietr.**	***Casua-rina leptocla-da* Miq.**
8. *Allocasu-arina verticillata* (Lam.) L.A.S.Johnson	**7. *Allocasu-arina trichodon* (Miq.) L.A.S.Johnson**	**6. *Allocasuarina torulosa* (Aiton) L.A.S.Johnson**	**5. *Allocasu-arina nana* (Sieber ex Spreng.) L.A.S.Johnson**	**4. *Allocasu-arina littoralis* (Salisb.) L.A.S.Johnson**		
1						
1		1				1
		1			1	
	1	1	1		1	
				1		

Casua-rina glauca Sieber ex Spreng.	*Casua-rina equiseti-folia* L.	*Casua-rina cunninghamiana* Miq.	*Casua-rina lepidophloia* F.Muell.	*Casua-rina stricta* Aiton	*Casua-rina verticill-ata* Lam.
12. *Casuarina glauca* Sieber ex Spreng.	**11. *Casuarina equiseti-folia* L.**	**10. *Casuarina cunninghamiana* Miq.**	**9. *Casuarin-a cristata* Miq.**		
	1				
	1				
	1				
	1			1	
	1				
				1	
	1				
	1			1	
				1	
	1			1	
	1				
	1				
	1				
1	1	1		1	
1	1	1	1	1	
		1			1
1	1				
	1	1			

		1	1	1	3	1	1	1	5	1	2	1	1	1	7	15	3	2	2
***Casua-rina sumatrana* Jungh. ex de Vriese**	**15. *Gymn-ostoma sumatranum* (Jungh. ex de Vriese) L.A.S.Johnson**															1			
***Casua-rina rumphiana* Miq.**	**14. *Gymnostoma rumphianum* (Miq.) L.A.S.Johnson**															1			
***Casua-rina montana* Lesch. ex Miq.**	**13. *Casuarina junghuhniana* Miq.**															1			

Key to species of *Allocasuarina* and *Casuarina* cultivated in Egypt:

- Mature samaras red-brown to black in colour, shining; cone bracteoles thick; teeth 4-14 per whorl……..…….....…..…. **I. *Allocasuarina***
- Mature samaras grey or yellow-brown in colour, dull; cone bracteoles thin; teeth 5-20 per whorl ……..……..……...…… **II. *Casuarina***

I a. Teeth 4-5 ……...……..…...….... ***A. torulosa***

I b. Teeth 7-9

Cone sessile or subsessile, 20-40 x 15-20 mm, warty…….…. . ***A. fraseriana***

Cone pedunculate, 10-30 x 12-20 mm, pubescent ……..…….... ***A. littoralis***

II a. Phyllichnia narrow and angular, teeth 6-9

Branchlets and cones densely pubescent, cone 10-24 x 9-13 mm, samara 6-8 mm long……..... ***C. equisetifolia***

Branchlets and cones minutely pubescent, cone 7-14 x 4-6 mm, samara 3-4 mm long……..... ***C. cunninghamiana***

II b. Phyllichnia broad and rounded, teeth 8-20.

Teeth 12-20, phyllichnia smooth, samara 3.5-5 mm long, cone bracteole 2- 2.5 mm wide peduncle 3-12 mm long ……..…….…...….. ***C. glauca***

Teeth 8-13, phyllichnia wrinkled, samara 6-10 mm long……...……..…….…...….. ***C. cristata***

I. ***Allocasuarina*** L.A.S. Johnson, J. Adelaide Bot. Gard. 6: 73 (1982).

Description: Trees or shrubs, dioecious or monoecious. Young, persistent branchlets usually distinguishable from the deciduous branchlets. Branchlet articles have deep furrows, concealing the stomates. Leaves reduced to teeth in whorls of 4–20. Male inflorescence with a simple, short to elongated spike; bracteoles thickly woody, and convex. Female inflorescence with a small globose or ovoid head on short lateral branchlets ('peduncles'). Cones borne among or below assimilatory branchlets, either pedunculate or sessile; bracts are thin in exposed portion; bracteoles considerably thickened and often divided, so that the dorsal portion forms one or more distinct protuberances. Samara body glabrous, red-brown to black, and shining.

Type species: *A. torulosa* (Aiton) L.A.S. Johnson

The native range of this genus is Australia (POWO, 2025).

Key to the sections of *Allocasuarina*:

A. Trees, bark fissured and reddish, male spike bracteoles persistent

B. Teeth 4-5, Cone sessile or subsessile, 2-4 x 1.5-2 cm, warty …….. Sect.1. *Allocasuarina*

BB. Teeth 6-8, Cone pedunculate, 15-23 mm long, 1-3 x 1.2-2 cm, pubescent……..…..... Sect. 2. *Amorphopitys*

AA. Shrubs, bark fissured and greyish, male spike bracteoles deciduous ……....…… Sect. 3. *Cylindropitys*

Section 1. ***Allocasuarina***

Trees dioecious or monoecious; penultimate branchlets woody. Branchlets not waxy; elongated articles numerous, terete or quadrangular, smooth; teeth not overlapping. Male spikes elongate; bracteoles persistent. Cone bracts inconspicuous; bracteoles with protuberance 8–20-parted. Samaras glabrous, mid-brown to black.

Type: *A. torulosa* (Aiton) L.A.S.Johnson

Allocasuarina torulosa (Salisb.) L.A.S. Johnson, J. Adelaide Bot. Gard. 6: 76 (1982). 'Forest oak, Rose she-oak'

Synonyms: = *Casuarina torulosa* Aiton in Hort. Kew. 3: 320 (1789)

= *Casuarina lugubris* Salisb., Prodr. Stirp. Chap. Allerton: 2 (1796)

= *Casuarina tenuissima* Sieber ex Spreng., Syst. Veg., ed. 16. 3: 804 (1826)

= *Casuarina torulosa* f. *gracilior* Miq., J.G.C. Lehmann, Pl. Preiss. 1: 640 (1845)

= *Casuarina ericoides* Gentil, Pl. Cult. Serres Jard. Bot. Brux.: 48 (1907)

Description: Usually dioecious, a tree growing to 12–16 m in high. Bark fissured, reddish, and thin. Branchlets thin, filiform, drooping, up to 14 cm long; articles terete, quadrangular on young growth, 5–6 x 0.4–0.5 mm, minutely pubescent in furrows; phyllichnia slightly rounded; teeth number 4 or 5, erect, and short with 0.3–0.5 mm in length. Male spikes slender and filiform, 10– 25 mm long, compact, with 7–12 whorls per cm; anther spikes measure 0.5–0.6 mm long. Cones shortly cylindrical or barrel-shaped, warty, occasionally densely pubescent, and pendent or spreading; peduncle with 11–20 mm in length; cone body measures 15–27 x 12–23 mm; bracts inconspicuous; bracteoles acute, with protuberance divided into 8–12 small tubercles that slightly shorter than or as long as bracteole body. Length of samara 7–10 mm long, mid to dark brown. Seed is 1.5-2 mm long, brown, glabrous; wing with 3.5-5 mm in length, pale brown, glabrous, entire, and obtuse. Timber reddish, strong, and close-grained (Pl. 1).

Global distribution: Indigenous to E. Australia (POWO, 2025).

Herbarium specimens examined: El Saff, Alfred Bircher North eastern garden, 15.v.1961, V. Täckholm and Ibrahim El Sayed s. n. (CAI); El Saff, Alfred Bircher Eastern Garden, 1.vi.1961, V. Täckholm and Ibrahim El Sayed s. n. (CAI); El Saff, Alfred Bircher North eastern garden, 23.vi.1961, V. Täckholm and Ibrahim El Sayed s.n. (CAI); Giza, Basatin (Tree 2 from south at entrance), 25.ix.1961, V. Täckholm and M. Drar s. n. (CAI); Giza, Basatin (Tree 3 from south at entrance), 25.ix.1961, V. Täckholm and M. Drar s. n. (CAI); Giza, Basatin, 19.xii.1961, V. Täckholm s. n. (CAI).

Notes: It was first introduced in 1929 by the Ministry of Agriculture's Horticultural Department from the Botanic Gardens in Rome. In 1961, a few magnificent trees were observed flourishing in Alfred Bircher’s Garden at El Saff, Giza (Täckholm and Drar, 1969). The tree wasn't recorded by the authors in 2024.

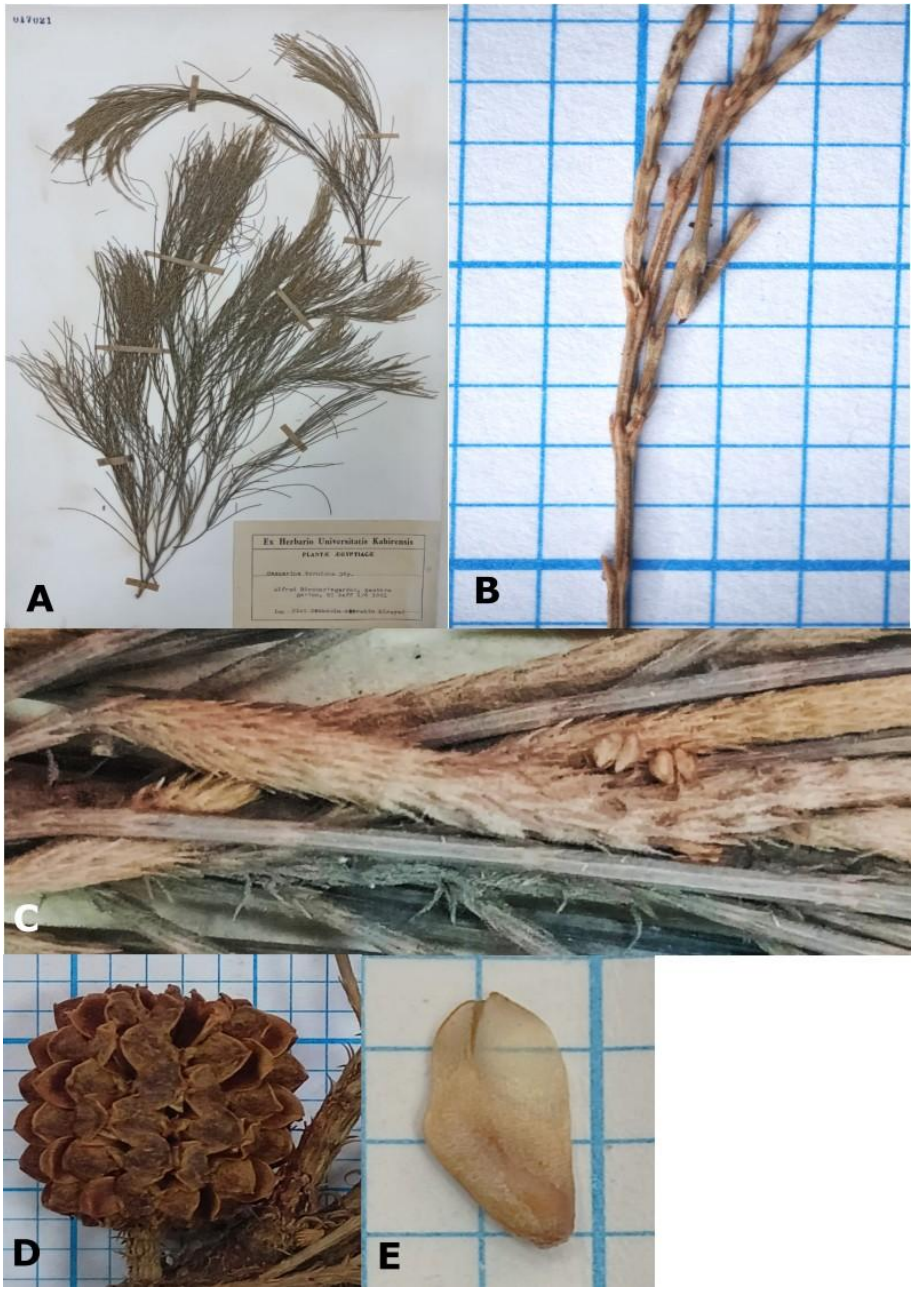

Plate (1): Field photograph of *Allocasuarina torulosa*; (A) Sheet, (B) Branchlet, (C) Male inflorescence, (D) female inflorescence (cone), (E) Samara.

Section 2. Amorphopitys L.A.S. Johnson, Fl. Australia 3: 191 (1989)
Dioecious trees; penultimate with branchlets woody. Bark scaly or corky. Branchlets occasionally waxy; elongate articles and numerous, terete, verruculose, or smooth; teeth not overlapping or marcescent. Male spikes are elongate; bracteoles are persistent. Cone bracts are somewhat thickened but inconspicuous; bracteoles have a protuberance 4–8 parted. Samara glabrous and very dark- brown to black.
Type: *A. fraseriana* (Miq.) L.A.S.Johnson

Allocasuarina fraseriana (Miq.) L.A.S. Johnson, J. Adelaide Bot. Gard. 6: 75 (1982). 'Western she-oak'
Synonyms: = *Casuarina fraseriana* Miq., Nieuwe Verh. Eerste Kl. Kon. Ned. Inst. Wetensch. Amsterdam, ser. 2, 13: 59 (1848).
= *Casuarina stricta* var. *fraseriana* (Miq.) Miq., Flora 48: 20 (1865).
= *Casuarina torulosa* Miq., J.G.C. Lehmann, Pl. Preiss. 1: 639 (1845), nom. illeg.
= *Casuarina nana* Schltdl., Linnaea 20: 574 (1847), nom. illeg.
Description: Tree 5–12 m high. Bark fissured reddish, and thick. Branchlets ascending, dark green, slender, striped, up to 30 cm long; articles 5-7 x 0.6–0.9 mm, occasionally strongly waxy; phyllichnia rounded, verruculose or smooth; teeth 6–8, somewhat spreading, 0.7–1.2 mm long. Male spikes 3–8 cm long, 5 or 6 whorls per cm; anther 0.7–1.2 mm long. Cones coarse, sessile or subsessile, usually cylindrical, warty, pubescent at least when young, peduncle up to 4-6 mm long; cone body 20-25 x 19-22 mm; valves thickened at apex into a large truncate protuberance and placed side by side on the same level; bracteoles broadly acute to obtuse, protuberance slightly shorter than bracteole body and divided into 4–8 bodies, pungent or obtuse. Samara with 5-8 mm in length. Seed with 2-3 mm length, brown, and warty; wing with 4-6 mm in length, broad, warty, obtuse and whitish. Timber reddish, strong, and fairly tough with nice oak grain (Pl. 2).
Global distribution: Indigenous to SW. Australia (POWO, 2025).
Herbarium specimens examined: Kirdasa, 8. xii.1928, Simpson 5707 (CAIM); Giza, 4.v.1952, M. Drar 017499 (CAIM); Giza, 22. vii.1959, M. Drar s.n. (CAI); Orman Garden, v.1961, V. Tãckholm s.n. (CAI).

Notes: Until 1952, it was cultivated in Egypt along a canal in the Faculty of Agriculture at Cairo University in Giza. Specimens of this plant are housed in the Agricultural Museum in Doqqi. In 1969, several trees were found in Alfred Bircher's El Saff gardens in Giza and one tree was present in the Orman garden (Täckholm and Drar, 1969). In 2024, the authors did not record any remaining trees.

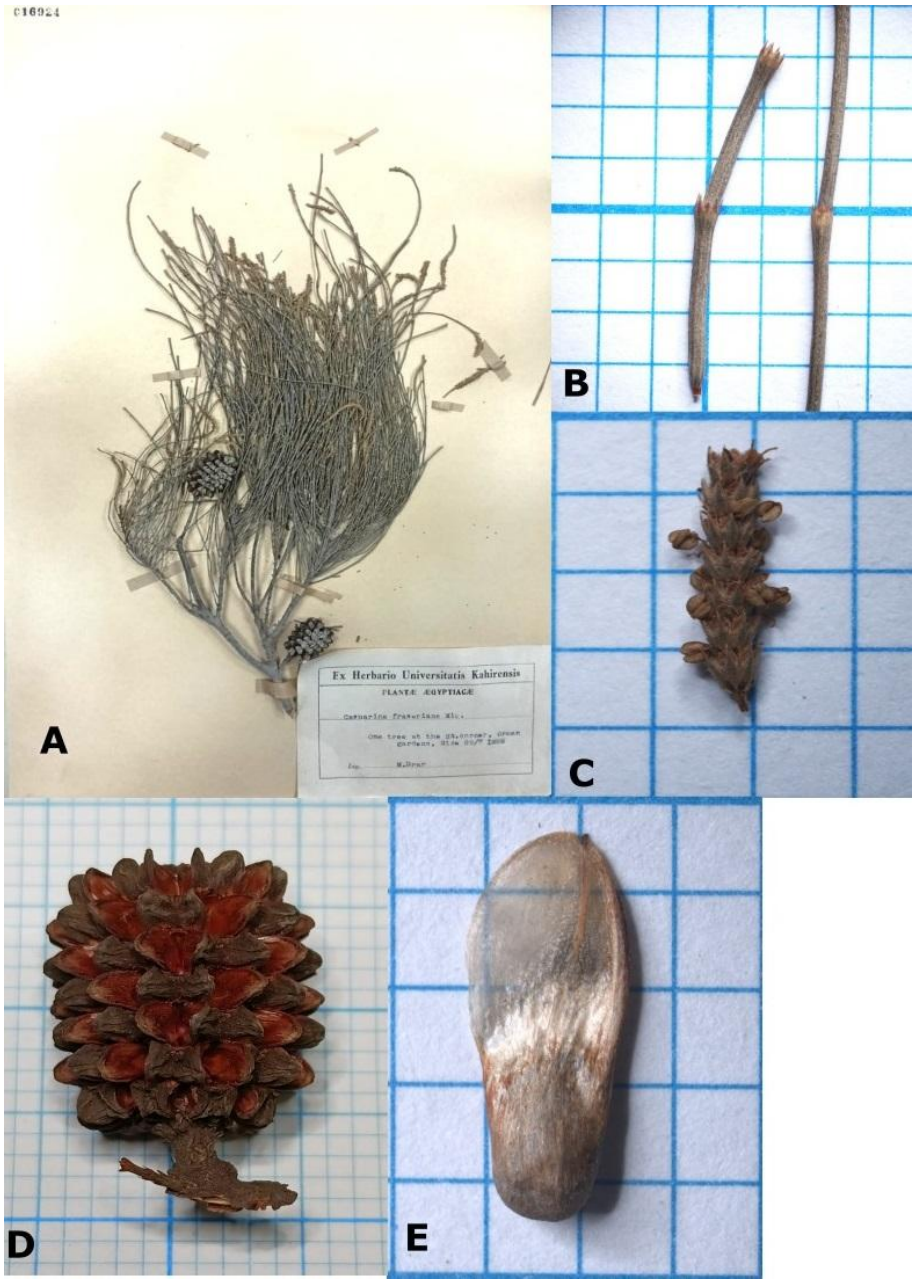

Plate (2): Field photographs of *Allocasuarina fraseriana*; (A) Sheet, (B) Branchlet, (C) Male inflorescence, (D) female inflorescence (cone), (E) Samara.

Section 3. Cylindropitys L.A.S. Johnson, Fl. Australia 3:191(1989)
Description: Dioecious or monoecious shrubs or trees; penultimate branchlets woody. Bark smooth or fissured. Branchlets occasionally with a waxy bloom; elongate articles numerous, terete, smooth or occasionally verruculose; teeth may be overlapping and marcescent. Male spikes elongate, occasionally only shortly so; bracteoles persistent or rarely deciduous individually. Cone bracts inconspicuous; bracteoles have a protuberance that is entire or rarely 2- or 3-parted. Samaras are glabrous, and red-brown to black.
Type: *A. littoralis* (Salisb.) L.A.S. Johnson.

Allocasuarina littoralis (Salisb.) L.A.S. Johnson, J. Adelaide Bot. Gard. 6: 76 (1982). 'Black she-oak'
Synonyms: = *Casuarina littoralis* Salisb., Prodr. Stirp. Chap. Allerton: 2 (1796)
= *Casuarina ramuliflora* Otto & A.Dietr., Allg. Gartenzeitung 9: 163 (1841)
= *Casuarina suberosa* Otto & A.Dietr., Allg. Gartenzeitung 9: 155 (1841)
= *Casuarina leptoclada* Miq., Nieuwe Verh. Eerste Kl. Kon. Ned. Inst. Wetensch. Amsterdam, ser. 2, 13: 41 (1848).
= *Casuarina moesta* F.Muell. ex Miq., Ned. Kruidk. Arch. 4: 98 (1856)
= *Casuarina miquelii* Hook.f. ex Miq., A.P.de Candolle, Prodr. 16(2): 337 (1868)
= *Casuarina elegans* Gentil, Pl. Cult. Serres Jard. Bot. Brux.: 48 (1907)
= *Casuarina filiformis* Gentil, Pl. Cult. Serres Jard. Bot. Brux.: 48 (1907)

Description: Tree 7–12 m high. Bark fissured, greyish, and thick. Branchlets ascending, slender, glabrous, up to 20 cm long; articles 4–10 x 0.4–1 mm, smooth, and pubescent in furrows; phyllichnia angular or rounded with median ridge; teeth 6–8, erect or rarely spreading, not overlapping, 0.3–0.9 mm long, usually not marcescent. Male spikes 2–5 cm long, 6–12 whorls per cm; bracteoles persistent anther 0.4–0.8 mm long. Cones cylindrical, rarely broader than long, pubescent at least when young; peduncle 8-10 mm long; cone body 10–20 x 8–15 mm; valves prominent, glabrous with a thick scale-like transverse dorsal outgrowth baselly; bracteoles thin, broadly acute to obtuse, thick pyramidal protuberance shorter than bracteole body, occasionally with two lateral bodies. Samara 4–8 mm long, dark brown to black. Seed pale brown, glabrous, 1.5-2 mm long; wing pale brown, glabrous, entire, and obtuse, with 3-5 mm in length. Timber brownish, coarse-grained, hard, and tough (Pl. 3).

Global distribution: Indigenous to E. and SE. Australia (POWO, 2025).
Herbarium specimens examined: Dakhalia, Aga, 16.vi.1928, *E. Greiss* s.n. (CAI); Cairo, Basatin, 30.vii.1959, *M. Drar* s.n. (CAI).

Notes: From the Agriculture and Stock Department in Hobart, Tasmania, it was brought to Egypt in 1923 by the Department of Horticulture, Ministry of Agriculture (Täckholm and Drar, 1969). In 2024, the tree had not been observed by the authors.

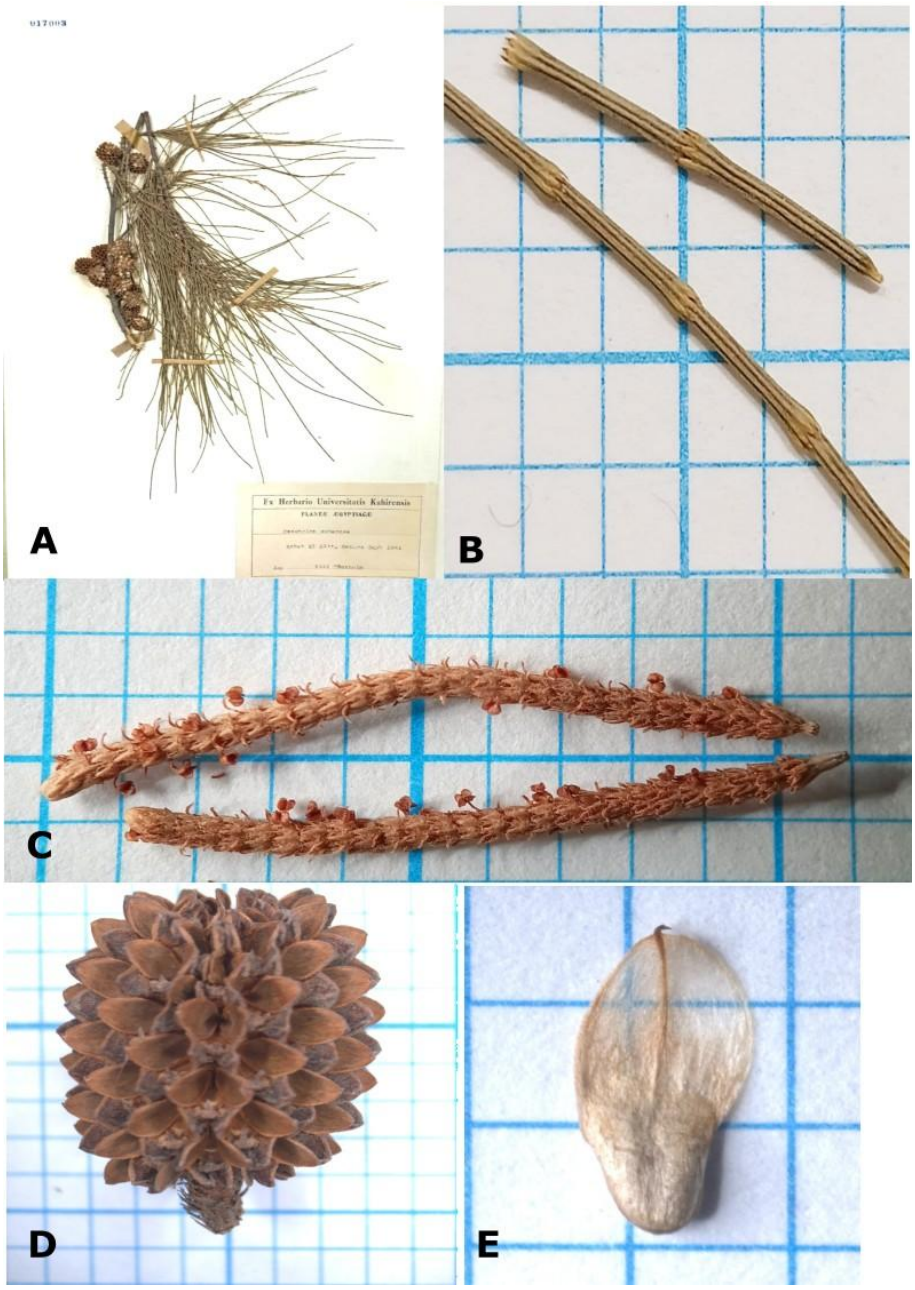

Plate (3): Field photographs of *Allocasuarina littoralis*; (A) Sheet, (B) Branchlet, (C) Male inflorescence, (D) Female inflorescence (cone), (E) Samara.

II- *Casuarina* L., Amoen. Acad. 4:143 (1759)
Trees dioecious or monoecious. Young persistent branchlets differ from deciduous branchlets by having shorter articles and shape or size of leaves ('teeth'). Articles terete and smooth; furrows deep and closed, concealing stomates. Leaves in whorls of 5–20. Male inflorescences simple elongate spikes; bracteoles persistent. Female inflorescences on short lateral branchlets ('peduncles') differ in appearance from the vegetative branchlets. Cones borne among or below assimilatory branchlets, pedunculate, and pubescent at least when immature; bracts thin in the exposed portion, not vertically expanded; bracteoles protrude from cone surface, never considerably thickened and always lacking a dorsal protuberance. Samara body glabrous, pale yellow-brown or greyish, dull.

Type species: *C. equisetifolia* L.
The native range of this genus is Tropical Asia to W. Pacific (POWO, 2025).

Casuarina equisetifolia L., Amoen. Acad. 4: 143 (1759)
Description: Tree 6–35 m high. Bark scaly, grey-brown, and thick. New shoots have erect teeth. Branchlets prominent, drooping, pubescent, up to 30 cm long; articles 5–10 x 0.7–1.0 mm; furrows usually densely pubescent; phyllichnia angular or occasionally flat in older growth, glabrous or pubescent; teeth 6-8, erect, 0.3–0.8 mm long, ciliate at margin, acute, not marcescent. Male spikes 20–40 mm long, 7–11 whorls per cm; anther 0.6–0.8 mm long. Cones sparsely pubescent to tomentose; peduncle 8–13 mm long; cone body 10–20 x 9–13 mm; bracteoles acute, pubescent. Samara 5-8 mm long. Seed brown, glabrous, and 1-2 mm; wing acute, pubescent, entire, brown, 3-5 mm long. Timber dark, coarse-grained, and hard.

In Egypt, *Casuarina equisetifolia* tends toward subsp. *incana* characterized by articles 0.7–1 mm in diameter; phyllichnia prominently angular to flat in older growth, often on the same branchlet, usually densely pubescent (Pl. 4).

Casuarina equisetifolia L. subsp. ***incana*** (Benth.) L.A.S. Johnson, J. Adelaide Bot. Gard. 6: 79 (1982).'Coastal she-oak; horsetail she-oak; ironwood; beach she-oak; beach casuarina; whistling tree'
Synonyms: ≡ *Casuarina equisetifolia* var. *incana* Benth., Fl. Austral. 6: 197 (1873)
= *Casuarina incana* A.Cunn. ex Benth., Fl. Austral. 6: 197 (1873)

Global distribution: Indigenous to E. Australia, Vanuatu to New Caledonia (POWO, 2025).
Herbarium specimens examined: Giza, Saqiet Mekki, 3.i.1928, Simpson 5484 (CAIM); Cairo, Spring 1952, S. El-sisi s.n. (CAI); Faculty of Agriculture gardens, ix.1953, N. El Hadidi s. n. (CAI); Cairo, Basatin, 30.vii.1959, M. Drar s.n. (CAI); Suez, 31. viii.1959, V. Täckholm and M. Drar s.n. (CAI); El Saff, Alfred Bircher's garden, 15. v.1961, V.Täckholm and Ibrahim El Sayed s.n. (CAI); Behiera, Ezbet El Sitt , 30.viii.1961, V. Täckholm s.n. (CAI); Giza, Horticultural Department, 5.ix.1961, V. Täckholm s.n. (CAI); Abou Rawash sewage farm, 19.xi.1961, V. Täckholm and I. El Sayed s. n. (CAI); Abu Simbel, ii.1963, M. Abdallah (CAIM); Giza, Faculty of Pharmacy garden, Boulaq El Dakrour, 15.x.1963, M. El Mahdi s.n. (CAI); Ras El Hekma, 4.v.1966, V. Täckholm s.n. (CAI); Cairo, Gezira Aquarium garden,

Zamalek, 19.iv.1976, J. Chrtek s.n. (CAI); Alexandria, Spring.1976, J. Chrtek s.n. (CAI); Aswan, 12. vii. 2003, H. Rofaeel 29400 (CAIM); The Aquarium garden, 6.ix.2023, F. Sami 2700 (CAIM); Damietta, Central garden, 28.ix.2024, R. Hamdy s.n. (CAI); Cairo, Maadi club, 1.x.2024, R. Hamdy s.n. (CAI).

Note: Before the mid-19th century, it was brought to Egypt. It was also reintroduced in 1923 under the name *C. muricata* from the Taj Mahal and other Government gardens in Agra, India. In 1961, specimens were observed growing in many locations, including Suez, Burg el Arab, Cairo's Ezbekiya Garden, the Horticultural Department in Giza, Gebl Asfar Sewage Farm, Inshas Estate, etc. (Täckholm and Drar,1969). Today, it has successfully established and spread throughout Egypt.

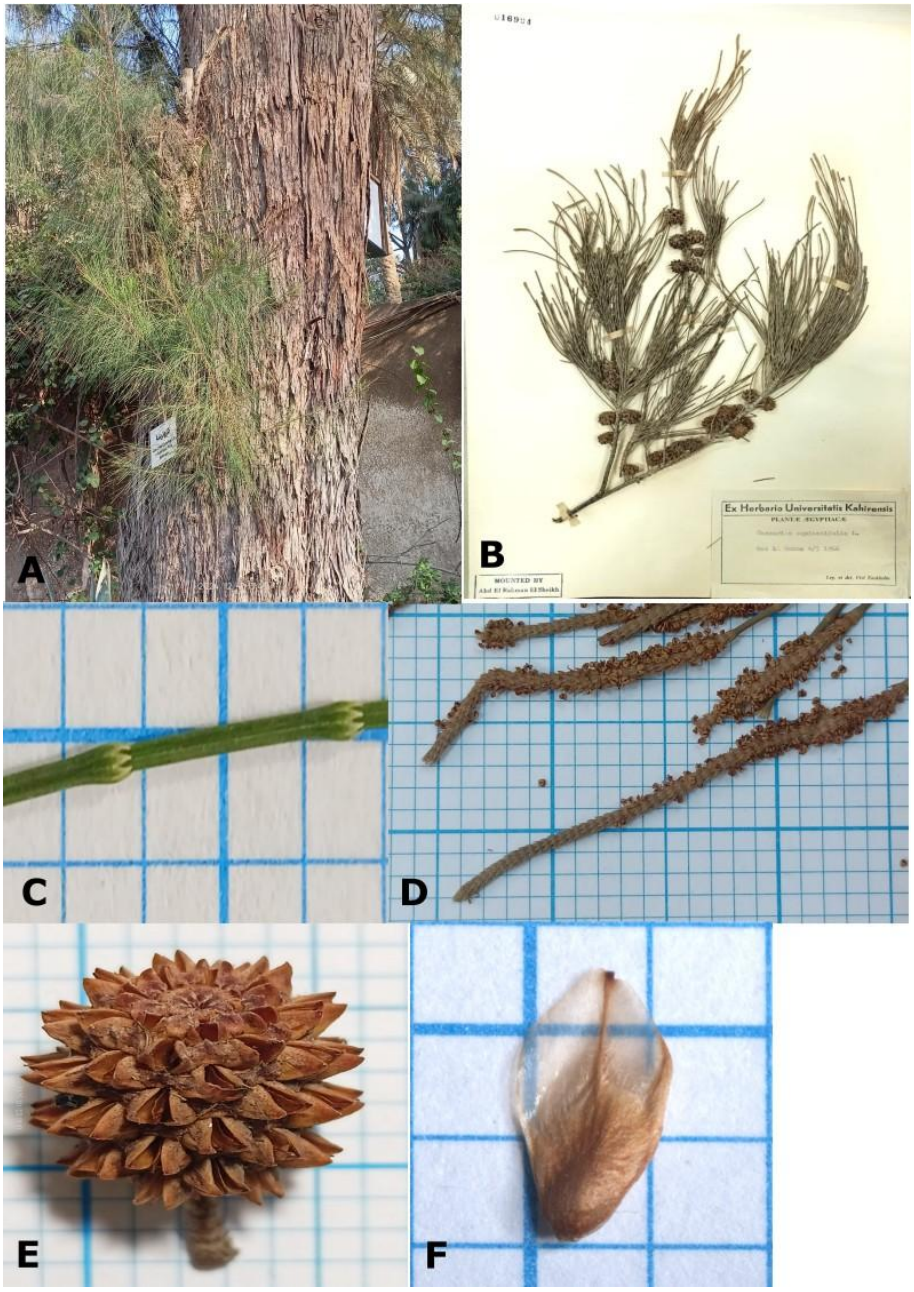

Plate (4): Field photographs of *Casuarina equisetifolia*; (A) Trunk, (B) Sheet from Egypt, (C) Branchlet showing erect, large light grey teeth without a transverse band at the base, (D) Male inflorescence, (E) Female inflorescence (cone), (F) Samara.

Casuarina cunninghamiana Miq., Nieuwe Verh. Eerste Kl. Kon. Ned. Inst. Wetensch. Amsterdam, ser. 2, 13: 56 (1848). **'**River oak; river she-oak; creek oak'
In Egypt, *Casuarina cunninghamiana* tends toward subsp. *cunninghamiana* characterized by teeth 8–10, yellow baselly, dark brown towards the apex, marcescent, phyllichnia prominently angular, and cone bracteoles with broadly acute.
Synonym: = *Casuarina equisetifolia* var. *microcarpa* F. Muell., Fragm. 6: 17 (1867)

Description: Tree 15–35 m high. Bark scaly, grey-brown, and thick. Branchlets ascending, slender, fairly ribbed; articles 4–9 x 0.4–0.7 mm, mostly glabrous; edges of furrows often marked by a slight ridge; phyllichnia angular to flat with a median rib; teeth 8–10, 0.3–0.5 mm long, erect, marcescent. Male spikes with 20–40 mm in length, 11–13 whorls per cm; anther 0.4–0.7 mm long. Cones are sparsely pubescent; peduncle 2–9 mm long; cone body 7–12 x 4–6 mm; bracteoles broadly acute, prominent with dorsal keel. Samara with 3–4 mm in length. Seed pubescent, brown, 0.4–0.5 mm long; wing pubescent, brown, obtuse, entire, 0.8–1 mm long. Timber pale brown, hard, and coarse-grained (Pl. 5).

Global distribution: Native to SE. New Guinea to E. Australia (POWO, 2025).
Herbarium specimens examined: El Khanka, 26.i.1923, Simpson 5484 (CAIM); Kirdasa, 10. xi.1926, G. Täckholm s.n. (CAI); Giza pyramids, 1. i.1927, G. Täckholm s.n. (CAI); Kirdasa, 5. xii.1927, Simpson 5602 (CAIM); Dokki field, Giza, vi.1951, M. Drar 17496 (CAIM); Faculty of Agriculture, Giza, ix.1953, N. El Hadidi s.n. (CAI); Faculty of Agriculture, Giza, xii. 1953, N. El Hadidi s.n. (CAI); Minya El Qameh, Sharkia, 11,x,1957, S. Ibrahim s.n. (CAI); Met Yazid, along Banha-Zagazig road, 11.X.1957, S. Ibrahim s.n. (CAI); Kom Aushim, Faiyum, 21. i.1959, V. Tãckholm s.n. (CAI); Port Tawfik, Suez, 31.viii.1959, V. Tãckholm and M. Drar s.n. (CAI); Cairo-Alexandria desert road near Mena House, 7.9.1959., V. Tãckholm s.n. (CAI); Barrage, 7.ix. 1959, V. Täckholm s.n. (CAI); Kirdasa is not far from the Pyramids and Basatin Gardens, 7. ix.1959, V. Täckholm s.n. (CAI); Helwan near the cement factory, 23.x.1959, V. Täckholm s.n. (CAI); Rod El Farag School, 11.x.1960, Youssef Mousaa s.n. (CAI); Abu Rawash sewage farm, 19.x.1961, V. Täckholm and Ibrahim El Sayed s.n. (CAI); Basatin, 19. xii. 1961, V. Täckholm s.n. (CAI); Aswan, 3.i.1998, H. Rofaeel, 29342 (CAIM); Manial Palace, 13. viii.2023, F. Sami 704 (CAIM); The Aquarium garden, 6.ix.2023, F. Sami 712 (CAIM); Dokki, 17.ix.2023, F. Sami (CAIM)720 ; El-Saff, Giza, 13.xi.2023, F. Sami 722 (CAIM); Cairo, Horreyah garden, 15.xi.2023, F. Sami (CAIM); Belbeis, El-Sharkiah, 23.xi.2023, F. Sami 722 (CAIM); Damietta, 28.ix.2024, R. Hamdy s. n. (CAI); El Maadi, 4.xii.2024, R. Hamdy s.n. (CAI); El Maadi, 14. i. 2025, R. Hamdy s.n. (CAI).

Notes: In 1919 and 1927, the Department of Horticulture, Ministry of Agriculture, brought it to Egypt from the Forest Department in Cape Town, South Africa, and the Botanic Garden in Saharanpur, India, respectively (Täckholm and Drar, 1969). In Egypt, it is the most prevalent species of *casuarina.*

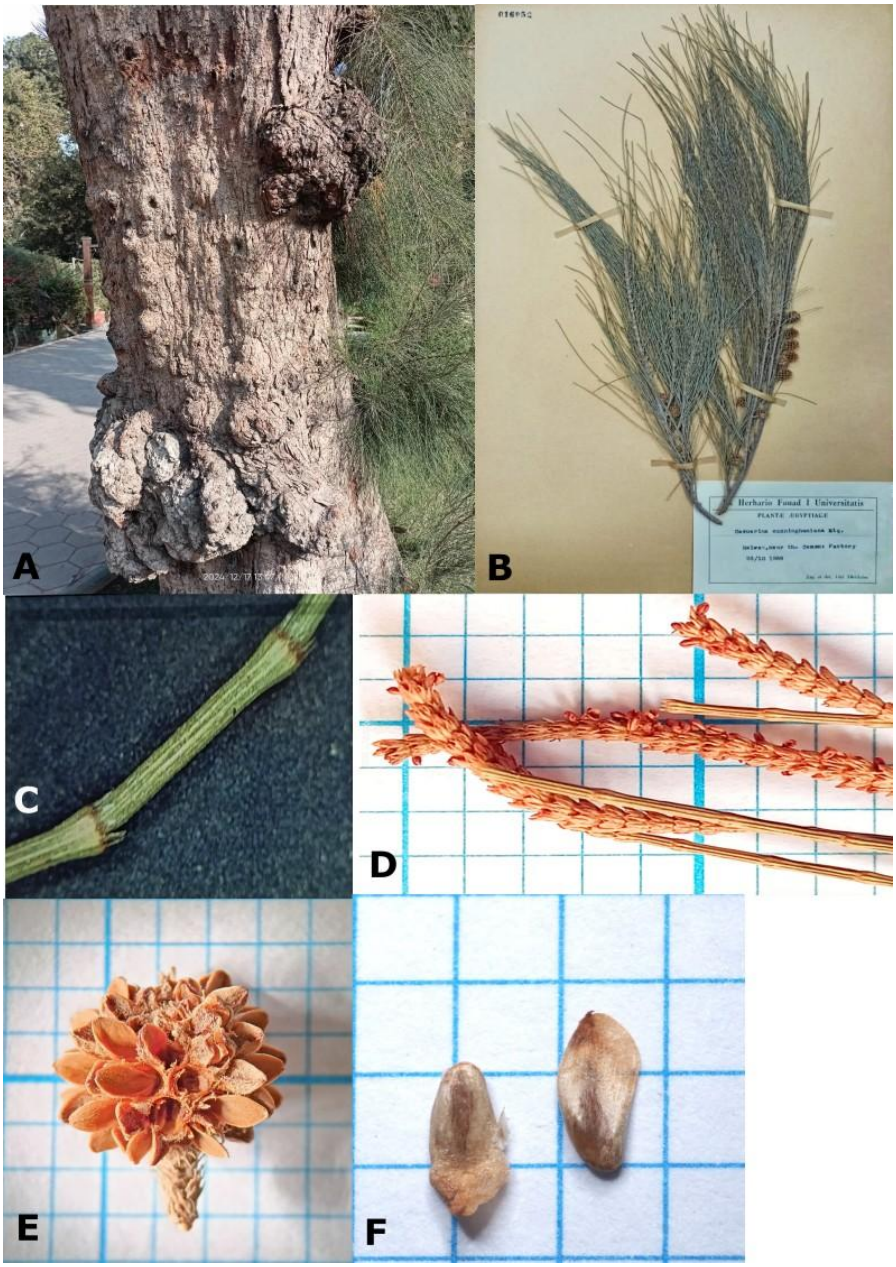

Plate (5): Field photographs of *Casuarina cunninghamiana*; (A) Trunk, (B) Sheet from Egypt, Helwan, near the cement factory, 23.x.1959, V. Täckholm (CAI), (C) Branchlet showing erect yellowish-green teeth that have grayish tips with brown transverse band halfway between the tip of teeth and their base, (D) Male inflorescence, (E) Female inflorescence (cone), (F) Samara.

Casuarina glauca Sieber ex Spreng., Syst. Veg., ed. 16. 3: 803 (1826). 'Swamp Oak'
Synonyms: = *Casuarina obtusa* Miq. in A.P.de Candolle, Prodr. 16(2): 334 (1868)
= *Casuarina torulosa* Miq., Nieuwe Verh. Eerste Kl. Kon. Ned. Inst. Wetensch. Amsterdam, ser. 2, 13: 75 (1848), nom. illeg.

Description: Tree 8–20 m high, frequently producing root suckers. Bark scaly, grey-brown, and thick. Branchlets thick, erect, glaucous, up to 38 cm long; articles 8–20 x 0.9–1.2 mm, glabrous, occasionally waxy; phyllichnia flat to slightly rounded. Teeth on new shoots long-recurved, 12–20, erect, 0.6–0.9 mm long, usually marcescent. Male spikes with 1.2–3 cm in lenghth, 7–10 whorls per cm; anther 0.8 mm long. Cones ovoid, white-pubescent, becoming glabrous; peduncle 3–12 mm long; cone body 9–18 x 7–9 mm; bracteoles broadly acute, with dorsal keel. Samara with 3.5–5.0 mm in length. Seed 0.8-1 mm long, pale brown, glabrous; wing 3-5 mm long, glabrous, emarginated, entire. Timber brown, close-grained, and very hard (Pl. 6).

Global distribution: Indigenous to E. Australia (POWO, 2025).
Herbarium specimensexamined: English Co. Ezba S of Giza Pyramids, 1. i.1927, G. Täckholm s. n. (CAI); Aga, 16.vi.1928, E. Greiss s. n. (CAI); Northern Beni Suef, 25.ix.1952, L. Boulos s. n. (CAI); Basatin, 6. vii.1952, M. Drar 017500 (CAIM); Faculty of Agriculture, Giza, x.1952, N. El Hadidi s. n. (CAI); Faculty of Agriculture, Giza, viii.1953, N. El Hadidi s. n. (CAI); Faculty of Agriculture, Giza, ix.1953, N. El Hadidi s. n. (CAI); Ras El Hekma, 3.iii.1956, M. Imam s. n. (CAI); Giza, 1.iv.1956, S. El Sisi s. n. (CAI); Basatin, Cairo, 30.vii.1959, M. Drar s. n. (CAI); Cairo-Alexandria desert road near Mena House, 7.ix.1959, V. Täckholm s. n. (CAI); Kirdasa, 7.ix.1959, V. Täckholm s. n. (CAI); Kom Aushim, Faiyum, 21.ix.1959, V. Täckholm s. n. (CAI); Helwan near the cement factory, 23.x.1959, V. Täckholm s. n. (CAI); Barrage medicinal garden, 8.i.1961, V. Täckholm and Ibrahim El Sayed s. n. (CAI); Alfred Birchers garden, El Saff, 23.vi.1961, V. Täckholm and Ibrahim El Sayed s. n. (CAI); Horticulture Dept., Giza, 5.ix.1961, V. Täckholm s. n. (CAI); Giza, Basatin, 25.ix.1961, M. Drar s.n. (CAI); Giza, Basatin, 25.ix.1961, V. Täckholm and M. Drar s.n. (CAI); Giza, Basatin, 19/12/1961, V. Täckholm s. n. (CAI); Giza, Basatin (Horticultural Department), 9. iii.1966, M. El Mahdi s. n. (CAI); Wadi El Natroun, 6.iii.1968, N. El Hadidi s. n. (CAI); Garawla between El Alamein and Mersa Matruh, 22. iii.1974, V. Täckholm, N. El Hadidi, Ayyad and Mahdi s. n. (CAI); Cairo-Alexandria road 90 Km, 7. iii.1978, M. Muller *et al*. s. n. (CAI); Cairo, Aquarium garden, 6. ix.2023, F. Sami 712 (CAIM); Giza, El-Saff, 13. xi.2023, F. Sami 722 (CAIM); Wadi El Natroun, 3. iii.2024, R. Hamdy s.n. (CAI); Damietta, 28.ix.2024, R. Hamdy s. n. (CAI); El Maadi, 4.xii.2024, R. Hamdy s.n. (CAI).

Notes: It was introduced in 1922 by the Ministry of Agriculture's Horticultural Department, Egypt, from the Botanic Gardens in Sydney, Australia. It is one of the species that has fared the best among all casuarinas. It grows incredibly well (Täckholm and Drar, 1969). Its cultivation is expanding quickly and is currently found throughout the country.

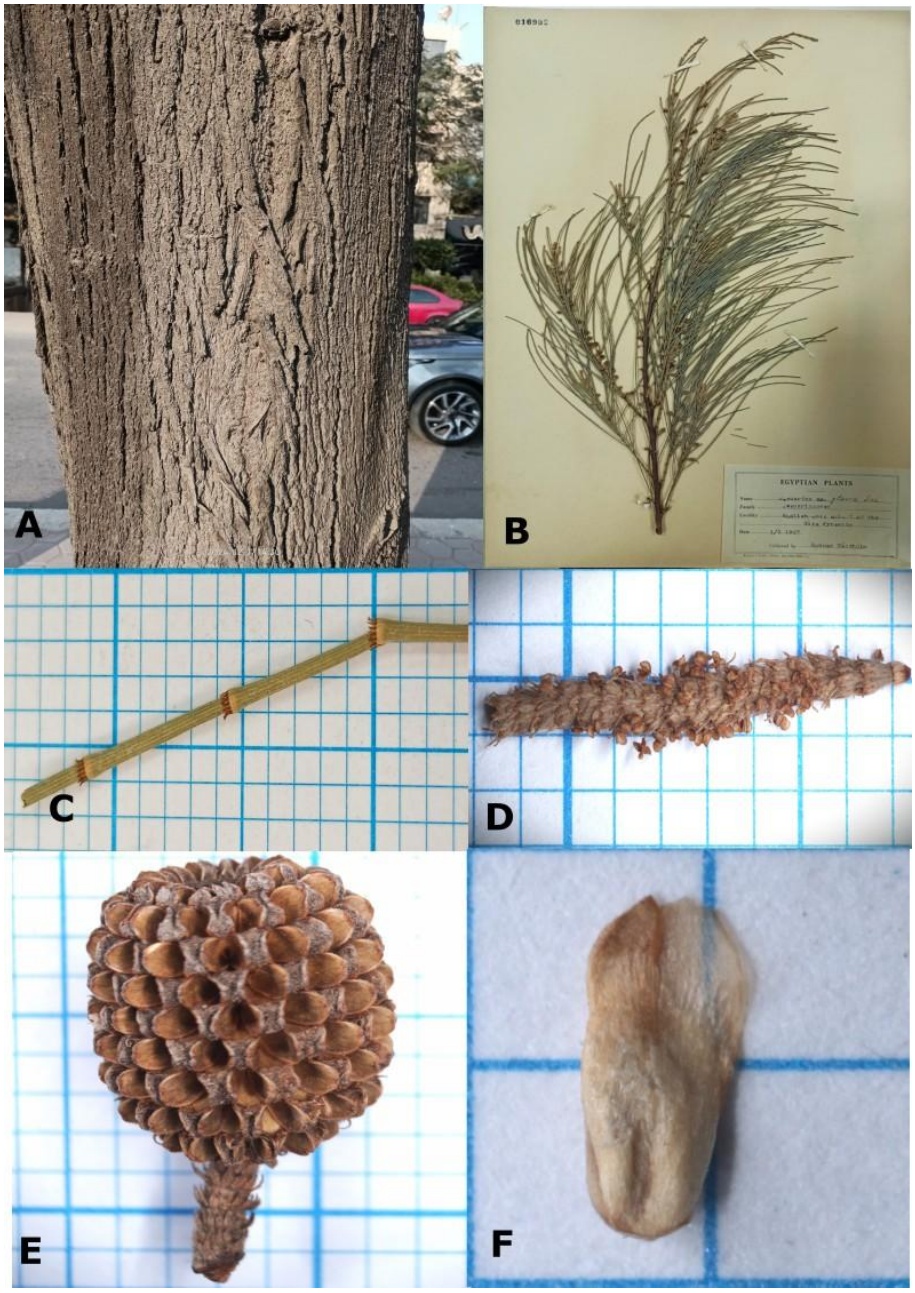

Plate (6): Field photographs of *Casuarina glauca*; (A) Trunk, (B) Sheet, (C) Branchlet showing erect, large light grey teeth without a transverse band at the base, (D) Male inflorescence, (E) Female inflorescence (cone), (F) Samara.

Casuarina cristata Miq., Nieuwe Verh. Eerste Kl. Kon. Ned. Inst. Wetensch. Amsterdam, ser. 2, 13: 70 (1848). **'**Belah'.

Synonyms: ≡ *Casuarina quadrivalvis* var. *cristata* (Miq.) Miq. in Flora 48: 18 (1865)
= *Casuarina lepidophloia* F.Muell. in Fragm. 10: 115 (1877)
= *Casuarina cambagei* R. T. Baker in Proc. Linn. Soc. New South Wales 24: 605 (1900)

Description: Tree up to 10–15 m high, producing suckers. Bark is scaly, grey-brown, and thick. Branchlets are ascending, fairly ribbed, spreading to 25 cm long. Articles are usually slightly wrinkled, 8–17 x 0.6–0.9 mm, somewhat waxy; phyllichnia flat or with slight median groove, often masked by wax; teeth 8–12, erect, 0.5–0.7 mm long, marcescent. Male spikes with 2–5 cm in length, 6–10 whorls per cm; anther 0.8–1.1 mm long. Cones pubescent when young, nearly glabrous at maturity; peduncle 1–4 mm long; cone body 13–18 x 10–16 mm; bracteoles acute. Samara with 4-6 mm in length. Seed 1- 2 mm in length, pale brown, smooth; wing length 3-4 mm, glabrous, acute, entire, 0.8-1 mm long. Timber brown, straight, and tough (Pl. 7).

Global distribution: Indigenous to E. Australia (POWO, 2025).

Herbarium specimens examined: Abu Rawash, 19. i.1956, N. El Hadidi s.n. (CAI); Orman Garden, Giza, 22.vii.1959, M. Drar s.n. (CAI); Barrage, 7.ix.1959, V. Täckholm s.n. (CAI); Kirdasa, 7.ix.1959, V. Täckholm s.n. (CAI); Kom Aushim, Faiyum, 21.ix.1959, V. Täckholm s.n. (CAI); Alfred Birchers garden, El Saff, 23.vi.1961, V. Täckholm and Ibrahim El Sayed s.n. (CAI); Orman Garden, Giza, vii.1961, V. Täckholm s.n. (CAI); Birket Dahshour, 19.ix.1961, V. Täckholm and Ibrahim El Sayed s.n. (CAI); Giza, Basatin, 25.ix.1961, V. Täckholm and M. Drar s.n. (CAI); El Saff, Alfred Bircher's garden, Western Garden, 4.i.1962, V. Täckholm and Ibrahim El Sayed s.n. (CAI); El Maadi Club, 4.xii. 2024, R. Hamdy s.n. (CAI).

Notes: In 1929, the Department of Agriculture and Stock in Brisbane, New South Wales, Australia, transferred it to the Department of Horticulture under the Ministry of Agriculture. Only one specimen was observed in 1961, flourishing in the Orman Garden in Giza (Täckholm and Drar, 1969). At present, we have recorded it once in Cairo.

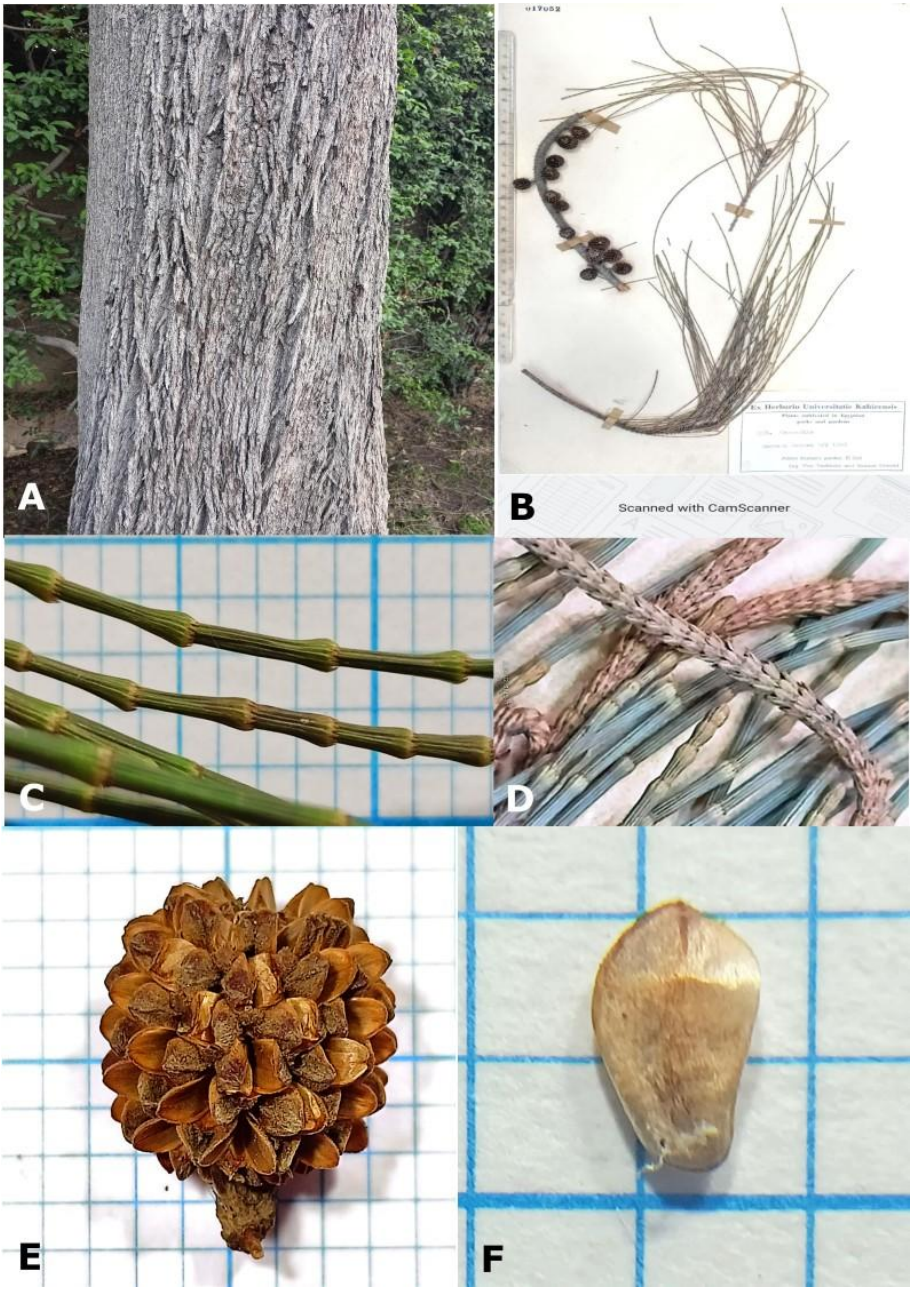

Plate (7): Field photographs of *Casuarina cristata*; (A) Trunk, (B) Sheet, (C) Branchlet showing erect, large light grey teeth without a transverse band at the base, (D) Male inflorescence, (E) Female inflorescence (cone), (F) Samara.

Statistical analysis

Statistical analysis is significant for documenting and discovering new morphological characters and character states. Many studies have been conducted to understand taxonomic relationships in different groups of plants (Soladoye *et al.*, 2010; Rahman and Rahman, 2012). In the present study, two genera and seven species were evaluated using a data matrix generated from 43 characters through numerical analysis. The complete data matrix for the studied taxa, including the characters and character states and their values for each taxon, is listed in Table (2). The Proximity matrix shows the similarity values among the studied species of *Casuarina* and *Allocasuarina, as* shown in Table (3). The numerical taxonomy of the studied taxa was determined based on the phenogram resulting from the UPGMA clustering.

Table (2): Summary table and data coding of macro-morphological characters of the studied taxa.

No.	Characters	***A. fraseriana*** (Miq.) L.A.S. Johnson, 1982	***A. litoralis*** (Salisb.) L.A.S. Johnson, 1982	***A. torulosa*** (Salisb.) L.A.S. Johnson, 1982	***C. cristata*** Miq., 1848	***C. cunninghamiana*** Miq., 1848	***C. equisetifolia*** L., 1759	***C. glauca*** Sieber. ex Spreng., 1826
1	Type: dioecious [1]/ monoecious [2]	1	1	1	2	2	2	2
2	Habit: shrub [1]/ tree [2]	2	1	2	2	2	2	2
3	Height: tall (> 30 m) [1]/ short (< 30 m) [2]	2	2	2	2	1	1	2
4	Root suckers: present [1]/ absent [2]	2	2	2	2	2	2	1
5	Bark thickness: thick [1]/ thin [2]	1	1	2	2	1	1	1
6	Bark shape: scaly [1]/ fissured [2]	2	2	2	1	1	1	1
7	Bark color: reddish-brown [1]/ greyish or brown [2]	1	2	1	2	2	2	2
8	Branchlets length: short (up to 20 cm) [1]/ long (> 20 cm) [2]	2	2	1	1	2	2	2
9	Branchlets colour: dark green [1]/ green [2]/ glaucous [3]	1	1	2	2	2	2	3
10	Branchlets direction: ascending [1]/ drooping [2]/ erect [3]	1	1	2	1	1	2	3
11	Branchlets thickness: slender [1]/ thick [2]	1	1	1	1	1	1	2
12	Branchlets shape: stripped [1]/ not so [2]	1	2	2	2	2	2	2
13	Branchlets texture: glabrous [1]/ pubescent [2]	1	1	1	1	2	2	1
14	Teeth shape: marcescent [1]/ not marcescent [2]	2	2	2	1	1	2	1
15	Teeth No.: up to 8 [1]/ 8-12 [2]/ 12-20 [3]	1	1	1	2	2	1	3
16	Teeth length: short (up to 0.5 mm)	2	2	1	2	1	2	2

	[1]/ long (0.5-0.9 mm) [2]							
17	17- Teeth direction: erect [1]/ recurved [2]	1	1	1	1	1	1	2
18	Article length: very short (up to 9 mm) [1], short (9-13 mm) [2], long (13-20 mm) [3]	3	2	1	3	1	2	3
19	Article diameter: thin (up to 0.7 mm) [1], thick (0.7-1.2 mm) [2]	2	2	1	2	1	2	2
20	Article texture: glabrous [1], pubescent [2], waxy [3]/ wrinkled [4].	3	1	1	4	2	2	1
21	Phyllichnia shape: rounded [1], angular [2], flat [3]	1	2	1	3	3	3	3
22	Phyllichnia texture: glabrous [1], pubescent [2], waxy [3]	1	1	1	3	1	2	1
23	Male spike length: very short (up to 3 cm) [1], short (3-5 cm) [2], long (> 5cm) [3]	3	2	1	2	2	2	1
24	Male spike (No. of whorls/cm): 5-6 [1], 6-13 [2]	1	2	2	2	2	2	2
25	Anther length: short (up to 0.8 mm) [1], long (> 8 mm) [2]	2	1	1	2	1	1	2
26	Cone shape: cylindrical [1], ovoid [2]	1	1	1	2	2	2	2
27	Cone texture: glabrous [1], pubescent [2]	2	2	2	1	2	2	1
28	Peduncle length: very short (up to 4 mm) [1], short (4-13 mm) [2], long (> 13 mm) [3]	1	3	3	1	2	2	2
29	Cone length: short (up to 20 mm) [1], long (> 20 mm) [2]	2	2	2	1	1	1	1
30	Cone diameter: thin (up to 16 mm) [1], thick (> 16 mm) [2]	2	2	2	1	1	1	1
31	Bracteole apex: acute [1], obtuse [2]	1	1	1	1	1	1	2
32	Samara length: short (up to 5 mm) [1], long (> 5 mm) [2]	2	2	2	2	1	2	1
33	Samara color: dark brown [1], light brown [2]	1	1	1	2	2	2	2
34	Seed color: brown [1], pale brown [2]	1	1	1	2	1	1	2
35	Seed texture: glabrous [1], warty [2]/ pubescent [3]	2	1	1	1	3	1	1
36	Seed length: short (up to 2 mm) [1], long (> 2 mm) [2]	1	1	1	2	1	1	1
37	Wing colour: whitish [1], pale brown [2], brown [3]	1	2	2	1	3	3	1
38	Wing texture: glabrous [1]/ warty [2].	2	1	1	1	2	1	1
39	Wing apex: acute [1], obtuse [2], emarginate [3]	2	2	2	1	1	1	3
40	Wing length: short (up to 3.5 mm) [1], long (> 3.5 mm) [2]	2	2	2	2	1	1	2
42	Timber texture: strong [1], tough and rigid [2].	1	1	1	2	2	2	2
43	Timber grain: coarse-grain [1], oak-grain [2], close-grain [3]	2	1	3	2	2	2	3

Table (3): The proximity matrix shows the degrees of similarity among the studied species of Casuarinaceae in Egypt. This is an absolute similarity matrix.

Species	Absolute correlation between vectors of values						
	A. fraseriana	***A. Litoralis***	***A. torulosa***	***C. cristata***	***C. cunning.***	***C. equisetifolia***	***C. glauca***
A. fraseri-ana	1.000	0.422	0.262	0.015	0.073	0.025	0.181
A. litoralis	0.422	1.000	0.466	0.109	0.029	0.123	0.072
A. torulosa	0.262	0.466	1.000	0.264	0.073	0.101	0.022
C. cristata	0.015	0.109	0.264	1.000	0.031	0.147	0.239
C. cunning.	0.073	0.029	0.073	0.031	1.000	0.777	0.018
C. equise-tifolia	0.025	0.123	0.101	0.147	0.777	1.000	0.046
C. glauca	0.181	0.072	0.022	0.239	0.018	0.046	1.000

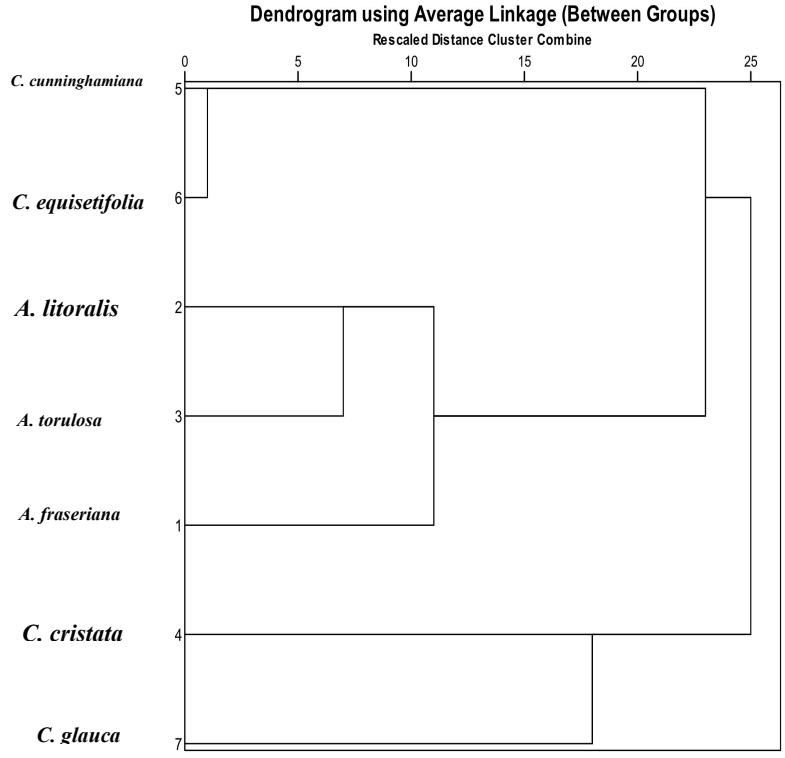

Diagram (1): Dendrogram shows the degree of similarity among the studied species of the family Casuarinaceae in Egypt.

Numerical analysis

The dendrogram resulting from the examination of the morphological traits of the Casuarinaceae species under investigation (Tab. 3, Fig. 1) showed that the studied species were divided into two groups. Group one was further divided into two subgroups. The first subgroup included *C. cunninghamiana* Miq. subsp. *cunninghamiana* and *C. equisetifolia* L. subsp. *incana*, while the second subgroup included *A. fraseriana, A. litoralis,* and *A. torulosa.* The second group included *C. cristata* and *C. glauca*.

C. cunninghamiana Miq. subsp. *cunninghamiana* and *C. equisetifolia* L. subsp. *incana* exhibited the highest similarity value (77.7 %), followed by 46.6 % between *A. litoralis* and *A. torulosa* and 42.2% between *A. litoralis* and *A. fraseriana.* The lowest similarity value was 15 % between *C. cristata* and *A. fraseriana* and 18 % between *C. cunninghamiana* Miq. subsp. *Cunninghamiana* and *C. glauca*. The numerical analysis supported the simultaneous separation of Allocasuarina and Casuarina, while indicating a significant similarity between them.

CONCLUSIONS

This study demonstrated the importance of morphological traits in the taxonomic evaluation among the studied species of Casuarinaceae in Egypt. Qualitative and quantitative traits provided considerable information to distinguish among the species of Casuarinaceae. The present study, based on the morphological characters, revealed some similarities among the studied species and confirmed the placement of species in each group. The numerical analysis results supported the separation of *Casuarina* into two genera: *Allocasuarina* and *Casuarina*. Fifteen species were introduced into Egypt in the 19th century, but this number was reduced to eight (Tăckholm and Drar, 1969). In 2025, only four taxa have been recorded.

CONFLICTS OF INTEREST STATEMENT

There is no conflict of interest for the researchers.

LITERATURE CITED

Ascherson, P. and Schweinfurth, G. 1887. Illustration de la flore d'égypte. *Mémoire institut d'Égypte*, 2: 23-260.

Badran, O. A., EI-Lakany, M. H., EI-Osta, M. L. and Abu-Gazia, H. A. 1976. Breeding and improving of *Casuarina* trees. I. Taxonomy and morphological characteristics of *Casuarina* grown in Egypt. *Alexandria Agricultural Research*, 24: 683-694.

Barbey-Boissier, C. and Barbey, W. 1882. Herborisations au Levant: Égypte, Syrie et Méditerranée. Georges Bridel Editeur, Lausanne, 81 pp. [CrossRef]

Beadle, N. C. W. 1981. The vegetation of Australia. Cambridge University Press, Cambridge, 690 pp.

Beentje, H. J. 2016. Tropical African floras: progress, gaps, and future. *Symbolae Botanicae Upsalienses*, 38: 101-119.

Bircher, W. H. 1960. Gardens of the Hesperides. The Anglo-Egyptian Bookshop, Cairo, Egypt, 875pp. [Click here]

Blomfield, R. M. 1901. Liste des plantes cultivées en Egypt. Alexandria Horticultural Society publication, Alexandria.

Bonaparte, G. 1904. The growth of timber trees in Egypt. *Journal of the Khedivial Agricultural Society and the School of Agriculture*, 6(5):169-177.

Brenan, J. P. M. 1949. Check-lists of the Forest Trees and Shrubs of the British Empire: Tanganyika Territory, part 2, issue 5. Imperial Forestry Institute, 653 pp.

Brown, W. 1917. Tree Planting on Agricultural Estates and Roads Ministry of Agriculture, Egypt, Horticultural Section, Leaflet no. 11, Cairo.

Crisp, M. 1991. Samaras and feathers, or Casuarinas on the wing? *Australian Systematic Botanical Society News*, 1 (67): 23-25.

Dale, A. and Greenway, G. 1961. Kenya Trees and Shrubs, 130pp.

Delchevalerie, G. 1871. Les plantes exotiques cultiveés en Egypte. An updated English version. *Taeckholmia*, 18:1-111.

Delchevalerie, G. 1875. Exposition Internationale d'Horticulture et d'Agriculture à Cologne. Catalogue raisonné des produits de 'horticulture et de l'agriculture exposés par la direction des domaines du khédive d'Egypte, Cologne.

Delchevalerie, G. 1897. Le parc public de l'Ezbékieh au Caire suivi de considérations générales sur les plantations et les anciens jardins vice-royaux et khédiviaux d'acclimatation en Égypte sous la dynastie de Méhémet-Aly au dix-neuvième siècle de J.-C. et d'une notice sur les curiosités horticoles de la Vallée du Nil (en francés), Gand: Impr. & Lithogr. C. Annoot-Braeckman, Ad. Hoste, Succr, 16pp.

Delchevalerie, G. 1899. Les promenades et les jardins du Caire: avec un catalogue général détailé et les noms scientifiques français et Égyptiens des plantes, arbres et arbustes utiles et d'ornement cultivés dans les champs et les jardins et notamment dans les anciens jardins vice-royaux et khédiviaux de l'Égypte sous la dynastie de méhémet aly jusqu'au xixe siècle de j.-c.; chaumes (s. et m.), Paris, France, 179 pp.

Dorothy, A. S., Karen, L., Wilson, B. and Robert, S. H. 2003. Using matK sequence data to unravel the phylogeny of Casuarinaceae. *Molecular Phylogenetics and Evolution*, 28: 47-59.

Draper, W. 1898. Le Jardinage en Egypt. Le Caire, 180 pp.

El-Lakany, M. H. 1983a. A review of breeding drought-resistant *Casuarina* for shelterbelt establishment in arid regions with special reference to Egypt. *Forest Ecology and Management*, 6(2): 129-137.

El-Lakany, M. H. 1983b. Variation in seed germinability, seedling growth, and biomass between provenances of *Casuarina cunninghamiana* Miq. and *C. glauca* Sieb. *Forest Ecology and Management*, 6(3): 201-216.

Fairhurst, W. 2004. Flowering Plants of Ascension Island, Higham Press, Shirland, Alfreton, England, 300 pp.

Figari, A. 1865. Studii Scientifici sull' Egitto e sue Adiacenze, compresa la penisola dell'Arabia Petrea: con accompagnamento di carta geografico-geologica, Volume 2, Tip. di G. Giusti, Lucca, 724 pp.

Girmansyah, D. 2013. Flora of Bali: An annotated checklist. Herbarium Bogoriense, Indonesia, 158 pp.

George, A. S., Orchard, A. E. and Hewson, H. J. 1993. Flora of Australia Volume 50, Oceanic Islands 2, Australian Government Publishing Service, Canberra, 642 pp.

Govaerts, R. 1999. World Checklist of seed plants. Volume 3, part 1, Royal Botanic Gardens, Kew, 567 pp.

Hamdy, R., Abd El-Ghani, M., Youssef, T. and El-Sayed, M. 2007. The floristic composition of some historical botanical gardens in the metropolitan of Cairo, Egypt. *African Journal of Agricultural Research*, 2(11): 610-648.

Hamdy, R. 2010. A study of plant distribution in nine historic gardens in Egypt. *Garden History*, 38(2): 267-314.

Hokche, O., Berry, P. E. and Huber, O. 2008. Nuevo Catálogo de la Flora Vascular de Venezuela. Fundación Instituto Botánico de Venezuela, 859 pp.

Hwang, Y. H. 1990. The Casuarinaceae: a palynological review. *Australian Systematic Botanical Society News*, 1 (62): 4-9.

Hwang, Y. H. 1991a. The Casuarinaceae: a biogeographic-based theory. *Australian Systematic Botanical Society News*, 1 (68): 14-16.

Hwang, Y. H. 1991b. The Casuarinaceae: a few problematic fossil records. *Australian Systematic Botanical Society News*, 1 (66): 15-16.

Hwang, Y. H. 1992. The Casuarinaceae: *Allocasuarina* is unsupported. *Australian Systematic Botanical Society News,* l (70): 16-18.

Iwatsuki, K., Boufford, D. E. and Ohba, H. 2006. Flora of Japan IIa, Kodansha Ltd., Tokyo, 550 pp.

Johnson, L. A. S. 1980. Notes on Casuarinaceae. *Telopea*, 2 (1): 83-84.

Johnson, L. A. S. 1982. Note on Casuarinaceae II. *Journal of the Adelaide Botanic Gardens*, 6(1): 73-86.

Johnson, L. A. S. 1988. "Notes on Casuarinaceae III: The new genus *Ceuthostoma*." *Telopea*, 3 (2): 133-137.

Johnson, L. A. S. 1991. Casuarinaceae—some clarifications. *Australian Systematic Botanical Society News*, l (67): 25-26.

Johnson, L. A. S. and Wilson, K. L. 1989. Casuarinaceae: A synopsis. *In*: Crane, P. R. and Blackmore, S. (Eds.), Evolution, Systematics, and Fossil History of the Hamamelidae, Volume 2: Higher Hamamelidae. Systematics Association Special Volume 40B, Clarendon Press, Oxford, p.167-188.

Jones, M. 1991. A checklist of Gambian plants: 1-33. Michael Jones, The Gambia College.

Maggia, L. and Bousquet, J. 1994. Molecular phylogeny of the actinorhizal Hamamelidae and relationships with host promiscuity towards Frankia. *Molecular Ecology*, 1(3): 459-467.

Metcalfe, C. R. and Chalk, L. 1979. Anatomy of the dicotyledons. Systematic anatomy of the leaf and stem, 2nd ed., Oxford Calderon Press, Oxford, p. 451-466.

Muer, T., Sauerbier, H. and Calixto, C. F. 2020. Die Farn- und Blütenpflanzen Madeiras. Verlag und Versandbuchhandlung Andreas Kleinsteuber Books, 792pp.

Muschler, R. A. 1912. Manual Flora of Egypt, Volume 2, Friedlaender, Berlin, Germany, 650 pp.

Oppenheimer, H. 2011. New Hawaiian plant records for 2009. *Bishop Museum Occasional Papers*, 220: 5-10.

POWO. 2025. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. [Click here]

Pusalkar, P. K., Mao, A. A. and Inge, P. 2022. Flora of India. *Botanical Survey of India*, 24: 1-688.

Rahman, M. Z. and Rahman, M. O. 2012. A morphometric analysis of *Desmodium* Desv. (Fabaceae) in Bangladesh. *Bangladesh Journal of Botany*, 41(2): 143-148.

Sickenberger, E. 1901. Contribution à la Flore d' Egypte. *Mémoire Institut Égyptien*, 4(2): 167-332.

Sneath, H. A. and Sokal, R. R. 1973. Numerical Taxonomy, the principles and practice of numerical taxonomy. Freeman and Co., San Francisco, USA, 359 pp.

Sogo, A., Setoguchi, H., Noguchi, J., Jaffree, T., and Tobe, H., 2001. Molecular phylogeny of Casuarinaceae based on rbcL and matK gene sequences. *Journal of Plant Research*, 114: 259-464.

Soladoye, M. O., Onakoya, M. A., Chukwuma, E. C. and Sonibare, M. A. 2010. Morphometric study of the genus Senna Mill. in South-western Nigeria. *African Journal of Plant Sciences*, 4(3): 44-52.

Sykes, W. R. 1970. Contributions to the flora of Niue. New Zealand Department of Scientific and Industrial Research 200: 1-321, Wellington.

Täckholm, V. and Drar, M. 1969. Flora of Egypt, vol. IV. Cairo University Press, p. 278- 323.

Thiers, B. 2020. Index herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. [Click here]

Turnbull, J. W. 1990. Taxonomy and genetic variation in Casuarinas. *In*: El-Lakany M.H., Turnbull, J. W. and Brewbaker, J. L. (eds). Advances in *Casuarina* research and utilization. Proceedings of the second International *Casuarina* Workshop, Desert Development Center, American University in Cairo, Cairo, p. 1-11.

White, F. 1962. Forest Flora of Northern Rhodesia. First edition, Oxford University Press, London, 482pp. [Click here]

Wilmot-Dear, C. M. 1985. Casuarinaceae. *In*: Polhill, R. M. (Ed.) Flora of Tropical East Africa, Royal Botanic Garden, Kew.

Wilson, K. L. and Johnson L. A. S. 1989. Casuarinaceae. *In*: George A. S. (Ed.) Flora of Australia vol. III, Hamamelidales to Casuarinales, Australian Government publishing service, Canberra, p. 100-203.

Wilmot-Dear, C. M. 1991. Flora Zambesiaca, volume 9, part 6, p. 116., Royal Botanic Gardens, Kew.

Woodroffe, C. D. 1985. Vegetation and flora of Nui Atoll, Tuvalu. *Atoll Research Bulletin*, 283: 1-18.

Youssef, T. L. and Hamdy, R. S. 2013. Timber trees: cultivated in gardens and planted forests in Egypt. Egypt: Ministry of Agriculture and Land Reclamation Undersecretariat for Afforestation and Environment, 193pp.

Bull. Iraq nat. Hist. Mus.
(2025) 18 (3): 577-610.

مراجعة تصنيفية للفصيلة الكازورينية Casuarinaceae R. Br., 1814 ، رتبة البلوطيات Fagales في مصر

فاطمة سامي محمد * ، ريم حمدي** و عصام مصطفي عبد القادر***

* قسم بحوث الفلورة و تصنيف النباتات، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر.

** قسم النبات و الميكروبيولوجي، كلية العلوم، جامعة القاهرة، الجيزة، مصر.

*** قسم بحوث الأشجار الخشبية، معهد بحوث البساتين، مركز البحوث الزراعية، **الجيزة**، **مصر**.

الاستلام: 2025/1/20، المراجعة: 2025/4/11، القبول: 2025/4/13، النشر: 2025/6/20

الخلاصة

أجريت هذه المراجعة التصنيفية على الفصيلة الكازورينية لتسجيل عدد الأنواع الموجودة حاليا في مصر ودراسة الوضع التصنيفي لها، استند هذا التقييم على الصفات المظهرية لجميع أجزاء النبات،مثل الورقة، السلامية، السنبلة المذكرة، السنبلة المؤنثة، الثمرة و البذرة حيث تم تسجيل وجود أربع أنوع فقط وكلهم ينتموا لجنس الكازورينا. من ناحية آخرى أوضحت العينات المعشبية المحفوظة بكل من معشبة قسم بحوث الفلورة وتصنيف النباتات بمركز البحوث الزراعية ومعشبة كلية العلوم -جامعة القاهرة عن وجود سابق لثلاث أنواع تنتمي لجنس الألو كازوارينا. ومع ذلك لم يتم العثورعلى أي منها لازال مزروعا. شملت هذه الدراسة مراجعة تصنيفية لكل من السبعة أنواع، حيث تم دراسة العلاقات التصنيفية بينها لتحديد أوجه الاختلاف والتشابه بينهم وتحديد الصفات المميزة لكل نوع. تم تمثيل نوعي *Casuararina cunninghamiana* و *Casuarina equisetifolia* بتحت نوع *cunninghamiana* , *incana* على التوالي.

تم عمل وصف تفصيلي للفصيلة و الأجناس و الأنواع مع إضافة صور فوتوغرافية وكتابة المرادفات لكـل نوع. علاوة على ذلك، تم تضمين مفتاح تعريفي مصمم لأنواع

العائلة الكازورينية المتواجدة حاليا بمصر و الأنواع المسجل وجودها في الماضي حسب العينات المعشبية المحفوظة والتي لم يسجل وجودها حالياً بمصر.

أظهرت نتائج هذه الدراسة أهمية الصفات المظهرية للتقييم التصنيفي بين الأنواع المدروسة. وقد أيد التحليل العددي للصفات المظهرية تقسيم جنس الكازوارينا إلى جنسين الألو كازوارينا و الكازوارينا.