

Casuarina Rumph. ex L.

casuarina

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Growth habit, occurrence, and use. The genus *Casuarina* (the only genus in the Casuarina family) comprises about 50 species, chiefly Australian, with a few having native ranges extending from Bangladesh to Polynesia. Casuarina trees are evergreen angiosperms, resembling conifers, with thin crowns of drooping branches and leaves reduced to scales (Little and Wadsworth 1964; Little 1949). Three species of this genus have been introduced successfully into continental United States, Hawaii, and Puerto Rico (table 1) (Bailey 1949; Rockwood and others 1990). Beach she-oak, especially, is planted as a windbreak throughout its native and introduced ranges and as an ornamental in parks and gardens (Parrotta 1993; Rockwood and others 1990). It was first introduced into Hawaii in 1882 (Neal 1965). The bark has been used in tanning, in medicine, and for the extraction of dye (Parrotta 1993). The fruits are made into novelties and Christmas decorations (Little and Wadsworth 1964). The wood is hard and heavy and is difficult to work, hence the common name Aironwood. It was once heavily used for building poles and firewood but now is seldom used commercially in the United States (Parrotta 1993). Beach and gray she-oaks are considered invasive pests in southern Florida and gray she-oak in Hawaii.

Flowering and fruiting. Casuarinas are monoecious or dioecious. Minute male flowers are crowded in rings among grayish scales. Female flowers lack sepals but have pistils with small ovaries and threadlike dark red styles (Little and Wadsworth 1964). The multiple fruit is conelike, about 8 to 20 mm in diameter (figure 1), and composed of numerous individual fruits. Each fruit is surrounded by 2 bracteoles and a bract that splits apart at maturity and releases a 1-winged light brown samara (figures 1 and 2). The immature fruits of the genus are green to gray-green, becoming brown to reddish brown when ripe (Neal 1965). In warm climates, flowering and fruiting occur throughout the year. Consequently, time of seed collection varies from place to place (Little and Wadsworth 1964; Olson and Petteys 1974). In Hawaii, Florida, and Puerto Rico, the peak of the flowering period appears to be April through June, with fruiting from September through December (Magini and Tulstrup 1955; Neal 1965; Olson and Petteys 1974; Rockwood and others 1990). Minimum seed-bearing age is 2 to 5 years, and good seed crops occur annually (Magini and Tulstrup 1955; Olson and Petteys 1974; Parrotta 1993).

Collection, extraction, and storage. The multiple fruits may be picked from the trees or shaken onto canvas or plastic sheets. Seeds reach maximum weight and germinability 18 weeks after anthesis, or when cones change in color from green to brown (Rai 1990). The samaras, which are used as seeds, may be separated from the fruits by shaking and screening (Olson and Petteys 1974). Cones placed in trays, covered by a thin cloth, and dried under full sunlight will soon begin to release their seeds, usually within 3 days (Kondas 1990). A kilogram of fruits (about 250 cones) yields between 20 and 60 g of seeds (1 lb of cones yields 1.5 to 2.4 oz of seeds). There are about 650 to 760 seeds/g (300,000 to 350,000 seeds/lb) (Kondas 1990; Turnbull and Markensz 1990). The application of an insect repellent effective against ant predation is advisable during the drying process (Kondas 1990). Seeds do not retain their viability for more than 3 months at ambient temperatures (Kondas 1990), but appear to be orthodox in storage behavior (Jones 1967). Seeds stored at subfreezing (-7 °C) or close to freezing (3 °C) temperatures, with moisture contents ranging from 6 to 16%, retain viability for up to 2 years (Turnbull and Markensz 1990). In Hawaii, seeds have been successfully stored in sealed polyethylene bags at 1 °C (Olson and Petteys 1974).

Germination. Germination in beach she-oak is epigeal, takes place 4 to 22 days after sowing and is optimized

at 30 °C under well-lighted conditions (Parrotta 1993). Casuarina seeds are usually sown without pretreatment (Magini and Tulstrup 1955; Olson and Petteys 1974), although soaking seeds for 36 hours in a 1.5% solution of potassium nitrate reportedly enhances germination (Rai 1990). Germination ranges from 40 to 90% for fresh seeds and from 5 to 25% for seeds stored in airtight containers at 4 °C for 1 year (Parrotta 1993). Official test prescriptions for casuarina species call for a 14-day test at alternating temperatures of 20/30 °C on the top of moist blotter paper (AOSA 1993). In the Philippines, germination of seeds collected from different trees within a single plantation ranged from 33 to 75% for fresh seeds (Halos 1983). A significant positive relationship between cone size and seed germination rate was also noted in this study.

Nursery practice. In the nursery, seeds are generally germinated in trays under full sunlight at an optimal density of 1,000 to 7,500 seeds (weighing 2 to 10 g)/m² (93 to 700 seeds/ft²), covered with about 0.5 cm of soil (Olson and Petteys 1974; Parrotta 1993). In South Africa, seedling yield averages are 18,000 plants/kg (8,200/lb) of river she-oak seeds (Magini and Tulstrup 1955). Nursery soils should be light textured, optimally sandy loams or a mixture of sand and peat moss. Seedlings are transferred from germination trays to containers when they reach a height of 10 to 15 cm (4 to 6 in), usually within 6 to 10 weeks after germination. Seedling containers measuring approximately 15 cm (6 in) in diameter and 20 cm (8 in) in depth are recommended. Seedlings may also be transplanted to new beds at densities of 100 to 400 seedlings/m² (9 to 37/ft²) to obtain bareroot planting stock. Seedlings should be kept under partial shade until shortly before outplanting. Seedlings reach plantable size of 20 to 50 cm (8 to 20 in) in height in 4 to 8 months (Parrotta 1993). It is recommended that seedlings be inoculated in the nursery with pure cultures of effective strains of *Frankia* (a nitrogen-fixing actinomycete) or an inoculum from a nodule suspension prepared from fresh, healthy *Frankia* nodules collected in the field. Roots can be inoculated by dipping them into the suspension or by directly applying the suspension to the soil. Alternatively, crushed, fresh nodules, leaf litter, or soils from the vicinity of effectively inoculated trees may be incorporated directly into the nursery potting mix (Parrotta 1993)

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Table 1C *Casuarina*, casuarina: nomenclature, occurrence, and uses

& synonym	Common name	Scientific name (native & introduced)	Occurrence
<i>cunninghamiana</i> Miq. <i>C. tenuissima</i> Hort.	river she-oak , river-oak casuarina, Cunningham beefwood ironwood	Australia & New Caledonia; Hawaii, S US, & California	C.
<i>C. equisetifolia</i> L. <i>C. litorea</i> L.	beach she-oak , Australian pine, horsetail casuarina, horsetail beefwood	Burma through Australia & Polynesia; Hawaii, Florida, & Puerto Rico	
<i>Casuarina glauca</i> Sieb. ex Spreng.	gray she-oak , longleaf casuarina, longleaf ironwood	Australia; Hawaii	

Sources: Olson and Petteys (1974), Parrotta (1993).