

Pinus maximinoi H.E. Moore

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PINACEAE (PINE FAMILY)

P. tenuifolia Benth. *P. pseudostrobus* var. *tenuifolia* Shaw., *P. douglasiana* var. *maximinoi* (H.E. Moore) Silba. (Carbajal and McVaugh 1992, Farjon and Styles 1997, Martínez 1948, Stead and Styles 1984)

Cantaj, ocote, pino candelillo, pino canis, pino llorón, tzin (Carbajal and McVaugh 1992, Dvorak and Donahue 1988, Eguiluz-Piedra 1978, Perry 1991)

Pinus maximinoi is widely distributed in the Pacific Coast states of México and Central America; from Sinaloa, México to northern Nicaragua (Dvorak and Donahue 1992, Martínez 1948, Perry 1991). The species grows in pure stands or in association with *P. oocarpa*, *P. douglasiana*, *P. pseudostrobus*, *P. tecunumanii*, *P. michoacana*, *P. leiophylla* Schiede & Deppe, *P. montezumae*, *P. patula* var. *longipedunculata*, *P. ayacahuite*, *Abies hickelii*, *Quercus* spp., *Liquidambar styraciflua*, *Juniperus* spp., and *Arbutus* spp. (Dvorak and Donahue 1988, Eguiluz-Piedra 1978, Farjon and Styles 1997, Perry 1991).

Pinus maximinoi is a fast-growing pine, reaching 20 to 40 m in height and 40 to 100 cm d.b.h. The trunk is usually straight and clear of branches (Carbajal and McVaugh 1992, Perry 1991). This pine grows at elevations of 600 to 2400 m. However, in relation to growth and phenotypic quality, the best stands are found at 800 to 1500 m, on seaward-facing slopes, with deep and fertile well-drained soils. Topsoil pH values typically range from 4.2 to 6.5, while subsoils may reach pH 8.0. Textures are normally sandy clay loams to clays for surface soil horizons and clays for subsoil horizons (Dvorak and Donahue 1988). The species grows in climates varying from temperate-warmer to subtropical humid (Carbajal and McVaugh 1992); annual rainfall on these sites ranges from approximately 1000 to 2100 mm (Dvorak and Donahue 1988). Mean annual temperatures vary from 17 to 22 °C. Maximum temperatures reach 40 °C, and minimum temperatures drop to -1 °C (Eguiluz-Piedra 1978). *Pinus maximinoi* does not appear to tolerate freezing temperatures (Dvorak and Donahue 1988).

The wood of *P. maximinoi* is soft and light; the sapwood is pale yellowish white, and the heartwood is slightly darker (Perry 1991). Specific gravity density in trials in Colombia var-

ied from 0.32 to 0.51 and in South Africa from 0.49 to 0.50 (Wright and Baylis 1993, Wright and Osorio 1993, Wright and Wessels 1992). Its potential uses include paper, firewood, resin extracts, and hewn timbers for roof supports and doorways (Eguiluz-Piedra 1978, Perry 1991, Wright and Wessels 1992).

When planted as an exotic in Colombia, the species begins reproducing at 4 years (Osorio 1998, personal communication); in Mexico the species does not appear as precocious. The tree flowers in January and February in Mexico and in February and March in Central America (Farjon and Styles 1997; Zamora-Serrano and others 1993). Cones are long-ovoid, asymmetrical and oblique, 5 to 8 cm long and 4.5 to 7 cm wide after opening. The light brown, lustrous cones develop in groups of three or four, on oblique peduncles 10 to 15 mm long, which fall with the cone (Carbajal and McVaugh 1992, Martínez 1948, Perry 1991). The cone scales are weak, 18 to 22 mm long, and 8 to 15 mm wide. The cone scale apophysis is usually flat, 2 to 4 mm high, and indistinctly or transversely keeled; the umbo is small and depressed, with a deciduous prickle (Carbajal and McVaugh 1992, Perry 1991). Cones ripen from late December through March. Maturation is noted as the cone color changes from light green to dark green. They are ready for collection when the cone scale is soft enough to allow penetration by a fingernail and the seedwing has a brownish color. Cones open upon maturation and are soon deciduous. In the native environment, cones of *P. maximinoi* may contain up to 40 filled seeds. As an exotic planted in trials in Colombia, cones averaged four filled seeds (Arce and Isaza 1996). Seeds of *P. maximinoi* are dark brown, 5 to 7 mm long, and about 4 mm wide. The seed wings are pale yellowish-brown, articulate, and 16 to 20 mm long (Martínez 1948, Perry 1991).

Cones are collected during the first two weeks of April (Dvorak and Donahue 1988). Cones are removed from the tree using pole-mounted pruners and cutters. Cones are dried by exposing them to the sun for 1 to 2 weeks (Zamora-Serrano and others 1993). Seeds are removed from the cones by shaking in a large mechanical tumbler or shaker, or in a small manual shaker for small lots. Seeds are dewinged by rubbing or flailing and cleaned by air screen or floating in water. Care must be used with mechanical dewingers to avoid damage to the seeds. Sound seeds should be dried down to 8 to 10 percent moisture content before storage. They should be stored in dry, airtight, and cool (4 °C) conditions. Seed size follows a strong clinal variation pattern: larger in size in Honduras (55,000 seeds per kg from Tatumbla) and smaller in Mexico (100,000 seeds per kg in Oaxaca) (Dvorak and Donahue 1988). Zamora-Serrano and others (1993) report 84,200 seeds per kg in Chiapas, Mexico.

Seeds should be soaked overnight in water before sowing. Germination rates increase favorably when seeds are subjected to a cold-stratification period of 40 days at 2 °C before sowing (Moreno 1985). Seeds should be sowed at 1 cm deep in a light, sterile medium that provides good aeration and moisture. If the germination rate is more than 75 percent, 300 g per m² will provide adequate density in seedbeds (Zamora-Serrano and others 1993). The recommended temperature for optimum germination is 25 °C, but a temperature between 20 and 25 °C will provide acceptable results (Belcher 1985). Germination varies by provenance, ranging from 65 percent to 80 percent (Belcher 1985, Patiño-Valera 1973, Zamora-Serrano and others 1993). Seedlings are susceptible to damping off.

Thus, substrata must be sterile or watering with a fungicide may be needed.

ADDITIONAL INFORMATION

Cone and leaf traits are used to distinguish *P. maximinoi* from *P. pseudostrobus*. The leaf hypoderm intrusions across the chlorenchyma to the endoderm are good distinguishing characteristics of the two species (Mittak and Perry 1979, Stead 1983).

Planted as an exotic in Colombia, wood production in test plots at 5 years ranged from 17 to 30 m³ per ha per year (Dvorak and Donahue 1988, Wright and others 1992).

The size of cone crops is usually small every year compared to other hard pines (Dvorak and Donahue 1988). The interval between large cone crops is from 3 to 5 years (Zamora-Serrano and others 1993).

Leptoglossus occidentalis Heidemann, a seedbug, is the most important insect pest of conelets, cones, and seeds. *Tetyra bipunctata* Herrich-Schaeffer, a coneworm, is the primary cause of empty seeds. *Cecidomyia bisetosa* Gagné, a moth, causes cone death. Larvae of the moths *Cydia montezuma* Miller, *Dioryctria erythropasa* Dyar, *Cecidomia bisetosa*, and several seed chalcids in the genus *Megastigmus* are capable of producing serious seed losses in orchards (Cibrián-Tovar and others 1986, 1995). Applications of insecticides in early spring control *D. erythropasa*. Systemic insecticide applications have been successful in reducing *C. bisetosa* damage (Cibrián-Tovar and others 1986, 1995). Cones are also susceptible to the fungus *Cronartium conigenum* (Pat.) Heds. and Hunt and *C. comandrae* Peck. (Mead and others 1978).

