Taxodiaceae—Redwood family

Metasequoia glyptostroboides Hu & W.C. Cheng

dawn-redwood

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Growth habit, occurrence, and use. Dawn-redwood—*Metasequoia glyptostroboides* Hu & W.C. Cheng—is the only known living example of its genus (Hu and Cheng 1948). It is often called a "living fossil" because until 1946 it was known only from the fossil record (Hu 1948; Merrill 1945; Shao 1982). The natural range is quite restricted: a few trees are found near the village of Mo-tao-chi in eastern Szechuan Province and the bulk of the native groves are found in Shui-hsa-pa Valley (south of Mo-tao-chi) in the northwestern corner of Hupeh Province, People's Republic of China (Chu and Cooper 1950; Shao 1982). It has been introduced to many other parts of China, as well as the United States, and Europe, for a total of 50 other countries (Shao 1982).

Since its introduction into the United States in 1948, this deciduous conifer has mostly been planted as an ornamental, especially at museums and in arboreta. The wood is soft, weak, and brittle, so it has little value as a source of lumber (Wyman 1968), although in China it is used for building timbers (Shao 1982). Pulping characteristics are similar to, and its fibers are stronger than, southern pines (Wyman 1968). In the United States, Wyman (1968) reported height growth was as much as 18 m in 20 years. In China, Shao (1982) described 4-year-old dawn-redwood trees averaging 7 m tall and 11 cm in diameter at breast height. In its natural range, dawn-redwood grows in the submontane zone at elevations between 100 and 1500 m. The species is hardy in Massachusetts, where the winter temperatures may drop to !34 EC, and thrives in Placerville, California, where summer temperatures often exceed 35 EC and there is usually no summer rainfall (Johnson 1974).

Geographic races. Although great phenotypic diversity exists between planted trees, no geographic races are known to exist. Several cultivars have been described (Broekhuizen and Zwart 1967; DeVos 1963). Of the 6 trees growing at the USDA Forest Service's Institute of Forest Genetics at Placerville, California, half are of the normal single-stemmed conifer shape and the others are bush-shaped with no single branch showing dominance. Johnson (1974) speculates that some of the seeds may have come from self-pollinated trees. According to Shao (1982), dawn-redwood shows a strong apical dominance and produces a straight stem.

Flowering and fruiting. Dawn-redwood is monoecious. Trees that produce female cones begin to do so several years before trees of the same age produce male cones (Em 1972; Li 1957; Wyman 1968). Female trees do not begin to produce seeds until they are 25 to 30 years old and bear heavily until they are 40 to 60 years old, when production diminishes (Shao 1982).

Male cone buds form in leaf axis or on branch tips and become visible in the fall just prior to leaf drop. At this time, they are about 2.5 mm long. Female cones are borne singly, opposite along branches (rarely terminal). Male and female buds begin to grow in late January and are readily seen by early- or mid-February. Pollination takes place in March before the tree puts on needles (Hwa 1945, 1948). This early emergence of the cones makes them susceptible to late winter frosts, which can destroy the cone crop.

Male cone buds are 4 to 6 mm long when closed and 6 to 10 mm long when expanded and shedding pollen. Each staminate strobilus has 20 to 30 distichously arranged microsporophylls with 3 microsporangia per sporophyll. Pollen grains are wingless and covered with a sticky substance that causes them to clump together in masses (Johnson 1968). Female cones have 16 to 26 distichously arranged scales, with 5 to 8 seeds per scale. Mature cones are pendulous (with a 10- to 30-mm peduncle), subquadrangular, and shortly cylindrical; they ripen the same year they are pollinated. Cones ripen in early December and shed their seeds in late December and early January.

Collection, extraction, and storage. Mature cones are light brown, but color is not a good indication of ripeness. Cones should be collected late in the year just before they begin to open. Cones picked when they first turn from green to light brown do not open and the scales must be pried apart. But cones picked when the scales naturally begin to separate will readily open with 1 to 2 weeks of drying at room temperature. Tumbling is necessary because some seeds are firmly welded to the scales. Because seed wings are minute, de-winging is unnecessary (Johnson 1974).

Seedcoats of dawn-redwood are thin and fragile. Seeds with wings attached are light brown, 5 to 6 mm long, 2 to 4 mm wide, obovate (rarely orbicular-oblong), and notched at the apex (figure 1) (Johnson 1974; Nakai and Furuno 1974). Wings are adnate and appear as tegumentary extensions of the seed (Sterling 1949). Average weight per seed is 8 mg (0.0003 oz) (Nakai and Furuno 1974). Nakai and Furuno (1974) found an average of 70 to 90 seeds per cone, with a range of 50 to 110. One kilogram of cones contains 430,00 to 560,000 seeds (1 lb contains 195,000 to 254,000 seeds) (Shao 1982). Dawn-redwood often produces a high proportion of hollow seeds (CDF 1977). Presumably, seeds can be stored in the same manner as those of other genera in Taxodiaceae such as redwood (*Sequoia*) and arborvitae (*Thuja*). Storage of dry seeds in airtight containers at 1 to 4 EC has been satisfactory for these genera (Johnson 1974).

Mechanical separation of seeds is not recommended. Hollow and filled seeds can be identified with x-radiography, but a simpler and more efficient method is to use a light table. The seeds should be scattered 1-layer thick on a light table and then back-lit with the room lights off. The hollow seeds can be picked out with tweezers. However, this method is feasible only on a small scale. If large quantities of seeds become available, all seeds should be stored and then sown, making allowances for seed-fill when the seeding rate is calculating (Johnson 1974).

Germination and nursery practice. Seeds of dawn-redwood do not require chilling (Johnson 1968; Shao 1982; Smith 1950). Germination takes 4 to 8 days (Nakai and Furuno 1974) and is epigeal. After germination, the seedcoat sheds in 3 to 5 days, exposing the cotyledons (Johnson 1974). There are no official testing prescriptions for this species.

Seeds sown directly on soil and mulched with fine sand or Sponge Roc® begin germinating within 5 days (Johnson 1968). During the first 5 weeks of growth, the tender succulent seedlings

are particularly susceptible to damping-off (Johnson 1974; Shao 1982). Losses can be minimized by sowing on heat-sterilized or fumigated soil. Young seedlings thrive in high humidity like that found in a greenhouse equipped with automatic overhead sprinklers. In hot climates the young seedlings should be shaded during the first growing season (Johnson 1974).

Because seeds of dawn-redwood are scarce, the species is often propagated from cuttings. Although cuttings are very easy to root (Johnson 1968; Mirov and Blankensop 1955; Shao 1982), growing stock can be produced faster from seeds than from cuttings (Johnson 1974). Cuttings root best when they are taken in early summer through late fall. Rooting is promoted by treatment with 50 ppm of α-naphthalene acetic acid (NAA). Rooting capability of cuttings decreases with increasing age of the mother plant (Shao 1982).

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Figure 1—*Metasequoia glyptostroboides*, dawn-redwood: hollow seed, H 8.