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Sterculiaceae—Sterculia family

Fremontodendron Coville

fremontia, flannelbush

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Growth habit, occurrence, and use. The genus *Fremontodendron* is endemic to California and adjacent areas of Arizona and Baja California. It includes 2 common and 1 rare species (table 1) (Kelman 1991). Fremontias are shrubs or small trees with evergreen leaves that are alternate, entire to lobed, and covered with characteristic stellate hairs. They are components of chaparral vegetation and are able to resprout abundantly after fire. The resprouts are valuable forage for deer and domestic livestock (Nord 1974). Fremontias are handsome plants that are used extensively in California for roadside and residential landscaping and are becoming known as native garden plants (Holmes 1993). Interspecific hybrids such as *F. mexicanum* × *F. californicum* 'California Glory' have been developed for horticultural use. Fremontias are drought-tolerant and have been successfully planted for watershed protection in wildland settings (Nord 1974).

Flowering and fruiting. The large, perfect, yellow to copper-colored flowers appear on the plants from April through June. They have a single perianth series that is fused into a saucer shape, 5 stamens fused into a staminal column, and a superior ovary. The flowers produce abundant nectar and are pollinated mostly by large native bees (Boyd 1994). Much of the seedcrop may be destroyed by insect larvae prior to dispersal, at either the flower bud or the immature fruit stage (Boyd and Serafini 1992). The large, bristly, 4- to 5-chambered capsules ripen from July to September and split open at the tip. The numerous reddish brown to black seeds are cast from the capsules by wind, hail, or animal disturbances (Nord 1974). The seeds have a more or less well-developed caruncle or elaiosome at the micropylar end (figure 1), and there is good evidence of dispersal by harvester ants, at least for eldorado fremontia (Boyd 1996). In that species, the testa is much thicker under the elaiosome than at other positions on the seed (figure 2), apparently as a protection from the ant dispersers that eat the elaiosomes. These ants act as predators on seeds that do not possess an elaiosome "bribe."

Seed collection, cleaning, and storage. Fremontias grow rapidly and reach reproductive age the second season

Figure 1—*Fremontodendron californicum*, California fremontia: seeds.

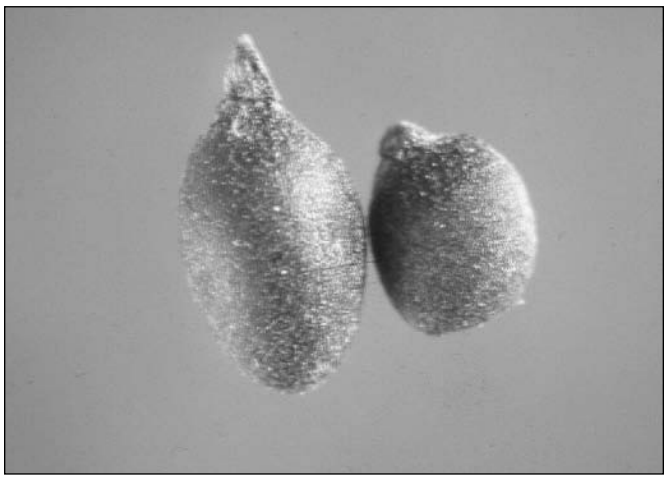
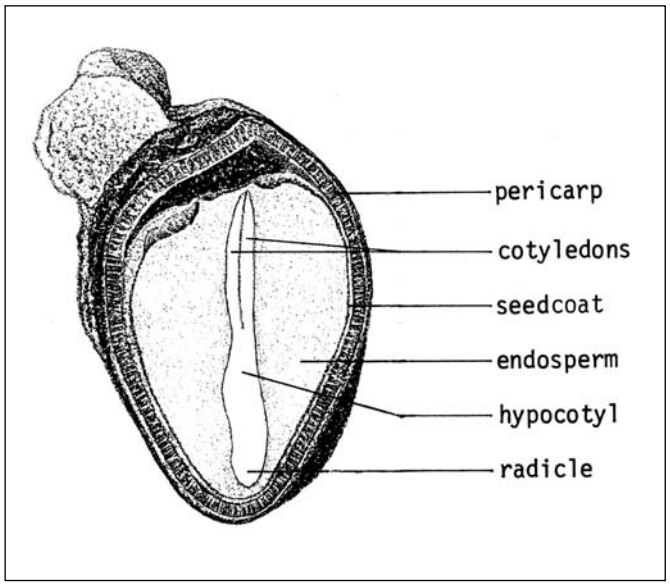


Table 1—*Fremontodendron,* fremontia: common names and occurred

Scientific name	Common name(s)	Distribution
***F. californicum* (Torr.) Coville**	**California fremontia,** flannelbush	N to S California & central Arizona
***F. decumbens* R. Lloyd**	**eldorado fremontia,** California flannelbush	One location in Eldorado Co., California
***F. mexicanum* A. Davids.**	**Mexican fremontia,** Mexican flannelbush	San Diego Co., California & N Baja California

Source: Kelman (1991).

Figure 2—*Fremontodendron californicum*, California fremontia: longitudinal section through a seed



after emergence. Seed production is reportedly better in cultivated than in naturally occurring individuals (Nord 1974). The ripened seed may be retained in the capsule for up to a month, but it is best to collect seeds when the first capsules begin to split open (Nord 1974). Capsules are collected by hand stripping or beating into containers. Gloves are recommended to protect hands against the irritating capsule bristles. Capsules that do not open soon after collection should be soaked in water for a few minutes, then dried before extraction. Capsules may be broken up in a hammermill or other threshing device, and the seeds cleaned out by screening and fanning (Nord 1974). Seed weight varies among and within species (table 2). Fremontia species form persistent seed banks in the field and are probably long-lived in storage (orthodox). In field seed bank experiments with eldorado fremontia, there was little loss of viability over a 7-year period (Boyd and Serafini 1992).

Germination and seed testing. Fremontia seeds are not permeable to water and must be scarified, either mechanically or by heat, in order for them to imbibe the water (Boyd and Serafini 1992; Emery 1988; Nord 1974). For nursery propagation, the seeds are given a hot water treatment, that is, immersion in hot water (85 to 95 °C) that is then allowed to cool for 12 to 24 hours. In nature, wildfire provides the heat stimulus. Most, if not all, recruitment of new plants takes place after fire. Seedlings from plantings into mature chaparral using artificially scarified seed were destroyed by herbivores or succumbed to drought (Boyd and Serafini 1992). Although scarification is a requirement for imbibition, it may not be sufficient to induce germination. Seed collections of California fremontia and some collections of Mexican fremontia may also require a 2- to 3-month chilling treatment at 5 °C (Emery 1988; Nord 1974). In a study by Keeley (1987), a collection of California fremontia responded only minimally to heat shock treatments, perhaps because the chilling requirement was not fully met. For eldorado fremontia, scarification with chilling produced no significant increase in seedling emergence over scarification alone, whether the scarification was mechanical or heat-induced (Boyd and Serafini 1992). A heat treatment of 5 minutes at 100 °C plus incubation with charate from chamise (*Adenostoma fasciculatum* Hook. & Arn.) charcoal produced significantly higher emergence than heat shock scarification alone (72 vs. 58%). Charate-stimulated germination has been reported for other chaparral species and represents an adaptation for detecting the occurrence of fire (Keeley 1987, 1991).

Seed quality evaluation for fremontia may be carried out using tetrazolium staining (Boyd and Serafini 1992). The testa is first nicked and the seeds allowed to imbibe water overnight. They are then immersed in 1% tetrzolium chloride for 6 hours and bisected longitudinally for evaluation. The embryo is linear and is embedded in abundant endosperm (Nord 1974). Germination testing is difficult

Table 2—*Fremontodendron*, fremontia: seed yield data

Species	Seeds/weight /kg	Seeds/weight /lb	Maximum Fill %	Maximum germination %
F. californicum	30,870–55,125	14,000–25,000	53	50
F. decumbens	26,460	12,000	100	72
F. mexicanum	44,100–66,150	20,000–30,000	100	55

Sources: Boyd (1966), Keeley (1991), Nord (1974).

because the period of germination is apparently relatively long even for scarified and chilled seeds (Boyd and Serafini 1992; Nord 1974).

Field seeding and nursery practice. Direct-seeding in the fall using hot-water scarified seed has been successful for California fremontia (Nord 1974). Because of the relatively large seed size, spot-seeding or drilling with a rangeland drill at a depth of 10 to 25 mm (0.4 to 1 in) gave much better results than hydroseeding or broadcasting. Successful spring seedings required the use of chilled seed.

Fremontia species have been produced as container stock using the hot water soak plus chilling protocol for seed germination described above (Emery 1988; Nord 1974). They are also readily produced from stem cuttings (Nord 1974).

References

Boyd RS. 1994. Pollination biology of the rare shrub *Fremontodendron decumbens* (Sterculiaceae). Madroño 41: 277–289.

Boyd RS. 1996. Ant-mediated seed dispersal in the rare chaparral shrub *Fremontodendron decumbens* (Sterculiaceae). Madroño 43: 299–315.

Boyd RS, Serafini LL. 1992. Reproductive attrition in the rare chaparral shrub *Fremontodendron decumbens* Lloyd (Sterculiaceae). American Journal of Botany 79: 1264–1272.

Emery DE. 1988. Seed propagation of native California plants. Santa Barbara: Santa Barbara Botanic Garden. 107 p.

Holmes R, ed. 1993. Taylor's guide to natural gardening. Boston: Houghton Mifflin: 158, 338.

Keeley JE. 1987. Role of fire in seed germination of woody taxa in California chaparral. Ecology 68: 434–443.

Keeley JE. 1991. Seed germination and life history syndromes in the California chaparral. Botanical Review 57: 81-116.

Kelman WM. 1991. A revision of *Fremontodendron* (Sterculiaceae). Systematic Botany 16: 3–20.

Nord EC. 1974. *Fremontodendron* Cov., fremontia. In: Schopmeyer CS, tech. coord. Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: USDA Forest Service: 417–419.