RosaceaeCRose family

Cercocarpus Kunth

mountain-mahogany

Stanley G. Kitchen

Mr. Kitchen is a botanist at the USDA Forest Service=s Rocky Mountain Research Station, Shrub Sciences Laboratory, Provo, Utah.

Growth habit, occurrence, and use. The mountain-mahoganiesCgenus *Cercocarpus*Care 8 to 10 species of moderately to intricately branched shrubs or small trees that are endemic to dry coastal and interior mountains of the western United States and Mexico (Stutz 1990). Leaves are generally persistent and stems are unarmed. Two of the most widely distributed and utilized species are described here (table 1).

Curlleaf mountain-mahogany populations demonstrate considerable variability in height (Davis 1990; Stutz 1990). In some areas, the species occurs as a medium-statured shrub of 1 to 2 m. More commonly, it is a small tree of 4 to 10 m at maturity. Trunk diameter of mature trees measures 30 to 100 cm (Johnson 1970). Schultz and others (1990) estimated the mean age of trees in central and western Nevada stands to be 352 years. Mean plant age in Utah stands (85 years) is less than that in Nevada stands but greater than that in Oregon and Montana stands (Davis 1990).

True mountain-mahogany is a deciduous shrub of 1 to 5 m. Both species occur as components of mixed communities and as dominants in extensive stands and are important cover and browse species for wildlife, especially big game (Davis 1990). When burned, true mountain-mahogany resprouts from the crown, resulting in relatively rapid stand recovery following fire. Recovery of curlleaf mountain-mahogany stands following fire is from seed only and can be extremely slow. Because they are long-lived, produce an extensive root system, and survive well on dry steep slopes, mountain-mahogany plants play an important role in erosion control. Nitrogen fixation in root nodules has been described for both curlleaf (Lepper and Fleschner 1977) and true mountain-mahoganies (Hoeppel and Wollum 1971), suggesting a significant role by these species in improving fertility in otherwise infertile soils. The wood of curlleaf mountain-mahogany is extremely dense and heavy and has had limited use, primarily as fuel wood (Johnson 1970).

Geographic races and hybrids. Two distinct subspecies or varieties of curlleaf mountain-mahogany occur in the western United States (Stutz 1990). Although considerable overlap in distribution exists, *C. ledifolius* spp. *ledifolius* (formerly spp. *intercedens*) has a more northeastern distribution, whereas the distribution of spp. *intermontanus* is centered to the west of its sister taxon. In northern Idaho, northern Wyoming, and southern Montana, spp. *ledifolius* is the only mountain- mahogany taxon present (Stutz 1990). The leaves of spp. *ledifolius* plants differ from those of spp. *intermontanus* in being narrower, more strongly involute, and densely pubescent ventrally. The leaves of spp. *intermontanus* are broadly elliptic and glabrous. Habit of spp. *ledifolius* is more shrubby (or less tree-like) than that of spp. *intermontanus*, especially in its northern

distribution. Although it is treated as a separate species, littleleaf mountain-mahogany—*C. intricatus* Wats.—is taxonomically and phenotypically close to curlleaf mountain-mahogany spp. *ledifolius.* It is distinguished by its smaller leaves and stature, fewer stamens, and shorter style on mature fruits (Stutz 1990). The evolutionary processes that produced littleleaf mountain-mahogany are still proceeding and intermediates between the 2 taxa are common.

As reflected in its taxonomy, true mountain-mahogany is also quite variable across its range. *C. montanus* ssp. *montanus* has the most widespread distribution (Stutz 1990). Separate taxa have been described for parts of the Pacific Coast (spp. *betuloides* Nutt.) and in the Southwest (spp. *paucidentatus* S. Wats and *argenteus* Rydb). *Cercocarpus mexicanus* Hendrickson, *C. rzedowski* Hendrickson), and *C. fothergilloides* Kunth. are closely related Mexican species.

Inter-specific hybrids are common between curlleaf and true mountain-mahoganies (Stutz 1990). Fertility in hybrids of true mountain-mahogany and curlleaf mountain-mahogany spp. *ledifolius* is good in contrast to the low fertility encountered in hybrids of true mountain-mahogany × curlleaf mountain-mahogany spp. *intermontanus* (Stutz 1990). Hybrids between true and littleleaf mountain-mahoganies are rare.

Flowering and fruiting. Small perfect flowers bearing no petals are borne individually or in small clusters. Flowering for these wind-pollinated shrubs occurs some time between late March and early July depending on latitude, elevation, and aspect. Fruits are cylindrical achenes bearing a single seed and are distinguished by a 3 to 10 cm plumose style that facilitates wind dispersal (figure 1). Ripened fruits disperse from July through October. Abundant fruit production occurs at 1 to 10 year intervals (Plummer and others 1968); however, a high percentage of nonviable (empty) fruits is not uncommon. Plants may reach reproductive maturity in 10 to 15 years (Deitschman and others 1974).

Fruit collection. Fruit maturation within a stand is generally somewhat asynchronous. Because of this and because fruits will not dislodge before they are fully ripe, harvests are most productive when delayed until the fruits on a majority of plants ripen. Optimal timing for harvest varies between July and September. Delays may result in diminished or lost harvests due to wind dispersal. Fruits of several plants must be examined for fill and insect damage before starting collection. Ripe, dry mountain-mahogany fruits are easily shaken from branches onto tarps or hand-held hoppers using a beating stick. During harvest and handling, short hairs dislodge from the fruits. These hairs cause considerable discomfort to eyes and skin, thus the cowboy epithet of "hell feathers" (Plummer and others 1968). Fruits may collect in harvestable depths on the ground during years of superior production. However, collections from ground accumulations are often of poor quality due to the removal of viable seeds by rodents.

Cleaning and storage. Highest purity values are obtained by removing most broken branches from fruits during collection. For large collections, empty fruits, styles, and fine hairs are best removed using a variable-speed debearder and a 2-screen fanning mill (figure 2). Hammermilling causes excessive breakage and should not be used. Minimum standards accepted by the Utah Division of Wildlife Resources for both species are purity, 95%, and viability, 85% (Jorgensen 1995).

Cleaned-fruit sizes differ by species, ecotype, and year of collection. In one study, average number of fruits per weight for curlleaf (8 collections) and true mountain-mahoganies (10 collections) was 106,000 and 88,000/kg (48,000 and 40,000/lb), respectively (Kitchen and others

1989a, b). These fruit weights were either equivalent to or somewhat heavier than those previously reported (Deitschman 1974). Curlleaf and true mountain-mahogany fruits stored under warehouse conditions experienced no significant loss of viability during 15 and 7 years, respectively (Stevens and others 1981).

Germination. Reported germination responses to moist chilling for curlleaf mountain-mahogany range from no response after 12 weeks (Young and others 1978), to good germination with 4 weeks (Heit 1970). In most of these studies, interpretation of results is difficult because fruit fill percentage was not determined. Dealy (1975) reported 20% germination in response to 60 days of moist chilling (4 ˚C) followed by 30 days at 20 ˚C for a 2-year old Oregon source that had tested 78% viable. He also observed germination during extended chilling (75 to 270 days). Kitchen and Meyer (1990) found the length of wet chilling (1 to 2 ˚C) required to make 90% of viable seeds germinable at 15 ˚C ranged from 6 to 10 weeks for 6 fresh collections from Utah, Idaho, and Nevada. They observed that cold-temperature germination began at about 8 weeks. Chemical treatments that have provided limited success in breaking dormancy with curlleaf mountain-mahogany seeds include: gibberellins (GA_3), thiourea, hydrogen peroxide, and sulfuric acid (Dealy 1975; Stidham and others 1980; Young and others 1978).

Some collections of true mountain-mahogany seeds have tested largely nondormant (Deitschman and others 1974). More typically, 2 to 12 weeks of moist chilling are required to break dormancy (Kitchen and Meyer 1990). Kitchen and Meyer (1990) found that cold-temperature germination (1 to 2 ˚C) for 9 Colorado and Utah collections began after 7 to 10 weeks of moist chilling.

Consistent estimations of embryo viability using standard TZ (tetrazolium) staining procedures are difficult to obtain for both species (Kitchen and others 1989a, 1989b). This is because the embryo is held tightly in the cylindrical pericarp and is difficult to extract for staining and examination (figure 3). Technical experience with mountain-mahogany TZ evaluations appears to be a major factor in accuracy of test results.

Nursery and field practice. Curlleaf and true mountain-mahoganies were first cultivated in 1879 and 1872, respectively (Deitschman and others 1974). Bareroot and container nursery stock are commercially available for both species, generally as 1- or 2-year-old stock. Unless nondormant collections are used, cleaned fruits are either prechilled or fall-sown. Seedbeds should be kept moist until seeds have germinated (Deitschman and others 1974). Deep-rooting containers filled with a minimum of 0.2 liter (13 in^2) standard potting mix is recommended for container stock production (Landis and Simonich 1984). With optimum rearing conditions a minimum of 4 to 6 months is required to develop an adequate root system. Figure 4 illustrates a seedling with well-developed secondary leaves. Direct seeding of mountain-mahogany should be carried out in fall or early winter in conjunction with seedbed preparations that minimize competition to first-year seedlings (Plummer and others 1968).

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Figure 1C*Cercocarpus,* mountain-mahogany: achenes with feathery style; the size of the achene varies greatly within each species, × 1.

Figure 2C*Cercocarpus montanus,* true mountain-mahogany: achene with style removed (cleaned seed), × 4.

Figure 3C*Cercocarpus ledifolius*, curlleaf mountain-mahogany: longitudinal section through an achene, × 8.

Figure 4C *Cercocarpus montanus,* true mountain-mahogany: seedling with primary leaves and well-developed secondary leaves, × 2.

Table 1C *Cercocarpus,* mountain-mahogany: nomenclature and occurrence

Scientific name	Common name	Occurrence
***C. ledifolius* Nutt.**	**curlleaf mountain-mahogany**, curlleaf cercocarpus, curlleaf mahogany, desert mahogany	Washington & Oregon E to Montana & Wyoming, S to Arizona, California, & Mexico (Baja)
***C. montanus* Raf.** C. betuloides Nutt. *C. parvifolius* Nutt. *C. flabellifolius* Rydb.	**true mountain-mahogany,** mountain cercocarpus, birchleaf cercocarpus, birchleaf mountain-mahogany, alderleaf mountain-mahogany, blackbrush, deerbrush, tallowbrush	Oregon E to South Dakota S to Mexico, incl. parts of Wyoming, Colorado, Nebraska, Kansas, Texas, New Mexico, Arizona, Utah, & California