RosaceaeCRose family

Holodiscus (K. Koch) Maxim.

ocean-spray

Nancy L. Shaw, Emerenciana G. Hurd, and Peter F. Stickney

Drs. Shaw and Hurd are botanists at the USDA Forest Service=s Rocky Mountain Research Station, Forestry Sciences Laboratory, Boise, Idaho; Dr. Stickney retired from the USDA Forest Service=s Intermountain Research Station.

Growth habit, occurrence, and use. *Holodiscus* is a taxonomically complex genus and includes about 6 species of western North America and northern South America (Hitchcock and others 1961; Ley 1943). The 2 generally recognized North American species (table 1)Ccreambush ocean-spray and gland ocean-sprayCare deciduous, multi-stemmed shrubs with simple, alternate, deciduous, toothed to shallowly lobed, exstipulate leaves.

Creambush ocean-spray grows from 1 to 6 m in height, with slender, arching branches and grayish red exfoliating bark. It is a prolific root sprouter, capable of recovering from fire, grazing, or mechanical damage by resprouting from perennating buds in the root crown. Growing at elevations from sea level to 2,150 m, it is most abundant in coastal areas from British Columbia to southwestern California. It also occurs eastward to Montana in drier conifer types of the interior Pacific Northwest. A dominant shrub in a number of forested communities, creambush ocean-spray is also common in riparian areas and on rocky talus slopes (Halversen and others 1986; Topik and others 1986). Remnant stands are found on higher peaks of Great Basin mountain ranges (Hitchcock and others 1961; USDA FS 1937).

Gland ocean-spray is a low, intricately branched shrub that is 0.1 to 3 m tall (Harrington 1954). It differs from creambush ocean-spray in its more compact growth habit, leaves with decurrent petioles, and leaf lobes or teeth without secondary teeth. Gland ocean-spray grows east of the Cascade Mountains and the Sierra Nevada, from north central Oregon to Chihuahua, Mexico, at elevations ranging from 1,400 to 3,350 m (Harrington 1954; Mozingo 1987; USDA FS 1937). Although gland ocean-spray is found in a variety of plant communities, its most characteristic habitats are talus slopes, rock outcrops, slickrock plateaus, and dry, rocky desert areas.

Palatability and forage value of both ocean-spray species vary geographically but are generally low for livestock and big game. However, in the absence of more palatable shrubs, substantial quantities are browsed by deer and elk on low-elevation winter ranges. In some areas, ocean-sprays are important year-round (USDA FS 1937). Both shrubs may increase on summer ranges where other forage species are browsed preferentially (Ferguson 1983). Gland ocean-spray is browsed in summer by bighorn sheep and both species are browsed by rabbits (Sutton and Johnson 1974; Todd 1975; van Dersal 1938).

Ocean-spray has considerable potential for re-vegetating a variety of disturbed areas. Populations capable of growing on dry, rocky, well-drained sites may be particularly useful (Stark 1966; Sutton and Johnson 1974). Ocean-spray has been recommended for use in nonintensive highway plantings, riparian areas, windbreaks, erosion control projects, wildlife habitat improvement projects, and conservation plantings (Antieau 1987; Atthowe 1993; Flessner and others 1992). Because of their growth habits, showy inflorescences, and fall coloration, both species are attractive ornamentals. Creambush ocean-spray was first cultivated in 1827 and gland ocean-spray in 1853 (Rehder 1940).

Native Americans made digging sticks and arrow shafts from the hard wood and straight branches of ocean-spray (Anderson and Holmgren 1969; Daubenmire 1970; Hopkins and Kovalchik 1983). Fruits of gland ocean-spray were eaten by Native Americans of the Great Basin, and pioneers made nails from its wood.

Both North American ocean-sprays are tetraploid, with 2X = n = 18 (Antieau 1986; Goldblatt 1979; McArthur and Sanderson 1985), and both exhibit considerable morphological variation. A genetic basis for variability in such characteristics as growth habit, growth rate, leaf morphology, and flower abundance in creambush ocean-spray is suggested by common garden studies (Flessner and others 1992).

Flowering and fruiting. Although the showy terminal panicles and floral buds of both species develop in early spring, flowering is delayed until late spring to mid-summer. Fruits ripen in late summer and are dispersed by wind and gravity through November (Hitchcock and others 1961; Stickney 1974) (table 2). The insect-pollinated flowers are small, creamy-white, perfect, and perigynous (Hitchcock and others 1961; McArthur 1984). The entire disk lining the hypanthium gives the genus its name (Greek: *holo* = whole and *diskos* = disk). Each flower produces 5 villous, light-yellow achenes that are about 2 mm long (figures 1 and 2). Seeds are broadly oblong and contain a thin endosperm and an embryo with ovate cotyledons (Ley 1943) (figure 1).

Collection, cleaning, and storage. Ocean-spray achenes are among the smallest of shrub fruits. Estimates of the number of cleaned achenes per weight exceed 11,000,000/kg (5,000,000/lb) for each species (King 1947; Link 1993). Achene collection is tedious, and supplies are rare and costly. In addition, the achenes are difficult to handle because of their pubescence and small size. Achenes are hand-stripped from inflorescences in late summer or autumn (table 2) (Monsen 1996). Large debris in air-dried collections can be removed with a fanning mill. Small lots may be cleaned by hand-rubbing and sieving (Link 1993).

Sound achenes are identified by examining imbibed achenes through a dissecting microscope for the presence of an embryo. Using this method, King (1947) found that only 7% of ocean-spray achenes collected were sound. In creambush ocean-spray seeds collected in northern Idaho, only 7% were sound. In creambush ocean-spray from British Columbia, viability was greater for achense collected in October or November than for those collected in August or September (Marchant and Sherlock 1984).

Storage requirements for ocean-spray have not been examined. The achenes appear to be orthodox in storage behavior and can probably be stored for several years at low water contents and temperatures.

Germination. Germination of creambush ocean-spray seeds is enhanced by wet

prechilling at 2 to 5 ˚C for 15 to 18 weeks (King 1947; Marchant and Sherlock 1984). King (1947) obtained 84% germination in 22 days when seeds were prechilled for 18 weeks before incubation at 20 to 24 ˚C.

Germination of gland ocean-spray has received little study. There are no official testing prescriptions for this genus, and effective pretreatments have not been reported. Link (1993) reported that 16 weeks of wet prechilling failed to release dormancy in this species. Effective treatments have not been reported.

Viability of ocean-spray seeds may be tested by tetrazolium chloride staining. After 3 hours of imbibition in water at room temperature, seeds are excised from the achene and the seedcoat is pricked or slit near the center of the seed. Seeds are then imbibed in 1% tetrazolium chloride for 4 hours at room temperature. Stained embryos may be read in place, as the seedcoat is very thin (Hurd 1996; King 1947). Staining should be evaluated as described by Grabe (1970) for dicotyledonous seeds other than legumes.

Nursery practice. Ocean-sprays may be propagated as bareroot or container stock (Everett 1957). Achenes should be fall-sown or artificially prechilled and spring-sown in bareroot nurseries (Flessner and others 1992). Marchant and Sherlock (1984) obtained successful plantings only when freshly harvested achenes were planted in fall. Cleaned achenes of both species can be drilled at reasonably uniform spacings within rows (Shaw and Monsen in press). They may also be broadcast and covered by dragging a lightweight chain over the seedbed. Seedlings develop slowly and may be lifted as 1+0 or 2+0 stock, depending upon size specifications and growing conditions.

Container seedlings are propagated by planting several wet-prechilled achenes in each container and thinning or by planting germinants. Kruckeberg (1982) reported that ocean-spray can be propagated by fall-sowing achenes in boxes outdoors and covering them lightly with soil. Flessner and others (1992) planted wet prechilled (4 months at 4 ˚C) creambush ocean-spray achenes in shallow flats in a greenhouse. Seedlings emerged after 16 to 30 days of incubation at a minimum temperature of 21 ˚C. Developing seedlings were fertilized and treated with a fungicide as necessary. After 2 months they were transferred to larger containers in a lathhouse where they were held overwinter for planting as 1+0 stock.

Kruckeberg (1982) reported that creambush ocean-spray planting stock is easily obtained by potting up wildlings, which he found were often abundant. Morgan and Neuenschwander (1988) observed high densities of creambush ocean-spray wildlings following severe burns, but Wright and others (1979) and Stickney (1996) concluded that the species exhibits poor seedling regeneration following fire in sagebrush and conifer communities of the Intermountain and northern Rocky Mountain regions.

Ocean-spray can be grown from cuttings, but rooting of both species varies widely among clones, cutting types, and propagation techniques (Antieau 1987; Link 1993). Softwood cuttings may be treated with rooting hormones and propagated in a greenhouse with a mist system (Antieau 1987; Marchant and Sherlock 1984). Success with semi-hardwood cuttings has been variable (Everett and others 1978; Kruckeberg 1982). Fall-harvested hardwood cuttings are cut to 15-cm (6-in) lengths and treated with 0.8% indole-3-butyric acid (IBA) powder and a fungicide (Macdonald 1986). Hardwood cuttings stored in straw-bale bins or cold frames will develop

calluses (Macdonald 1986; Marchant and Sherlock 1984). When fall-planted, these cuttings root rapidly. Layers and suckers have been propagated successfully (Kruckeberg 1982).

Field practice. Fresh achenes broadcast over a rough seedbed in fall are covered by natural soil sloughing (Shaw and Monsen in press; Van Dersal 1938). Achenes may be mixed with seeds of other shrub species, but they should not be sown with more competitive grasses or forbs. Planting areas should be selected carefully to make the best use of seed supplies, as seeding results are often erratic. Native creambush ocean-spray seedlings develop slowly and are poor competitors (Wright and others 1979).

Creambush ocean-spray can be established by transplanting. Youtie (1992) reported good survival of rooted cuttings on biscuit scablands in Oregon=s Columbia River Gorge. Marchant and Sherlock (1984) found that planted seedlings grew slowly the first year. Low survival on western Montana roadcuts was attributed to poor soils and unhealthy planting stock (Hungerford 1984).

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Figure 1C*Holodiscus*, ocean spray: achenes.

Figure 2C*Holodiscus dumosus*, gland ocean-spray: longitudinal section through an achene.

Figure 3C*Holodiscus dumosus*, gland ocean-spray: seedling development.