

RhamnaceaeCBuckthorn family

Rhamnus L.

true buckthorn

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Growth habit, occurrence, and use. Until recently, the true buckthorn genus *Rhamnus* and the closely related genus *Frangula* have been treated as the single genus *Rhamnus* consisting of more than 125 species of evergreen or deciduous shrubs and trees with alternate branches and simple leaves with prominent pinnate veins (Hickman 1993). Kartesz and Gandhi (1994), however, used floral morphology and leaf venation, as well as anatomical features of xylem vessels to support segregation of *Frangula* (PLANTS 2001). Under their treatment, true buckthorns have winter buds protected with bud scales and arcuate leaf nerves. Both *Rhamnus* and *Frangula* are native to the temperate regions of North America, Europe, and Asia, and also occur in the Neotropics and southern Africa as shrubs and trees up to 1.5 m dbh and over 60 m tall (Johnston and Johnston 1978; Krüssmann 1985). The common name buckthorn, which is shared by both genera, may have arisen in Europe, where some of the species are thorny (Mozingo 1987; USDA 1937). *Rhamnus* is the Latinized form of the ancient Greek name for the genus. At least 14 species and subspecies are distributed within the United States (table 1).

European buckthorn, native to Europe and temperate Asia and widely naturalized in the northeastern United States, is a common old-field invader (Gill and Marks 1991) that grows to about 4 m in height with branches that may end in sharp thorns. The bark yields yellow and saffron-colored dyes. The black fruits have been collected for over a thousand years as the source of a strong cathartic and laxative that is so potent that its purgative properties may be retained in the flesh of animals that have consumed the fruit (Mozingo 1987).

Alder buckthorn has perhaps the broadest distribution of all the species native to North America. The specific epithet refers to its similarity to alder (*Alnus*) in leaf shape. The leaves are deciduous, and the wood has been used as a source of the finest charcoal for gun powder (Everett 1982). It grows to a height of 1.5 m on moist mountain slopes and streambanks.

Spiny, hollyleaf, and island redberries are evergreen shrubs or small trees of California chaparral. The fruits of spiny and hollyleaf redberries may be preferred browse of deer (Conrad 1987).

Alder buckthorn and European buckthorn are alternate hosts for crown rust (*Puccinia coronata* Corda) which causes yellow leaf spot in the aecial stage. Economic damage by crown rust is confined to heavy damage in fields of oats grown in close proximity to hedges and fence-rows of buckthorns (Ziller 1974).

The earliest known cultivation of species native to North America includes 1778 for alder buckthorn and the mid-1800's for spiny redberry (Krüssmann 1985).

Flowering and fruiting. The inconspicuous flowers are either perfect or imperfect and are borne in small axillary racemes, fascicles, or occasionally reduced to single flowers in alder buckthorn and spiny, hollyleaf, and island redberries. The shallow to deeply campanulate

hypanthium is rimmed with 4 deltoid, thin and spreading sepals, with the upper part of the hypanthium falling after maturity and the lower part remaining around the developing fruit (Hitchcock and others 1961; Kartesz and Gandhi 1994). White to greenish white petals are equal to the sepals in number and alternating, or lacking. There are 4 stamens, and the anthers are shorter than filaments. The ovary has 2 to 4 cells. Flowers are unisexual in spiny, hollyleaf, and island redberries; alder buckthorn and European buckthorn plants may be dioecious. Flowers appear in the spring and fruits ripen several weeks to months later (Hubbard 1974).

Fruits are drupaceous, the berrylike pulpy mesocarp embedding several free 1-seeded stones (Johnston and Johnston 1978). Fruits are 6 to 8 mm in diameter; they are generally black in alder buckthorn and red in spiny, hollyleaf, and island redberries. Spiny, hollyleaf, and island redberries have 2 stones per fruit; alder buckthorn has 3 stones per fruit; and European buckthorn has 3 or 4 stones per fruit. Stones are grooved on the outside (Kartesz and Gandhi 1994). Dispersal is mostly by birds. Good seedcrops for all species are likely to occur in most years. Regeneration of spiny and hollyleaf redberries is primarily by stump-sprouting after fire (Conrad 1987, Keeley 1981).

The reproductive biology of a few non-North American species has been investigated, including (1) the obligatory re-sprouting of *R. palaestina* Boiss. in Israel (Naveh 1974); (2) population sex ratio, flowering phenology, and between-sex differences in reproductive allocation in Italian buckthorn (*R. alaternus* L.), a dioecious shrub of the Mediterranean region (Guitián 1995a); (3) the population sex ratio, pollen-to-ovule ratio, and flowering and fruiting phenology in *R. legionensis* Rothm., a dioecious shrub restricted to limestone areas in the León Province of northwest Spain (Guitián 1995b); and (4) the partitioning of dry mass and nitrogen between flesh and stone in European buckthorn (Lee and others 1991).

Collection, extraction, and storage. Fruits can be collected from the shrubs and trees when ripe, although collection timed to occur about 2 weeks before the fruit is fully ripe may limit losses to birds (Hubbard 1974). Fruits can be run through a macerator with water soon after collection; full seeds can then be cleaned of other material by repeated decantation. Data on yield of seeds are scant and based on limited samples; yields are about 105 seeds/g (2,975 seeds/oz) for spiny redberry (Keeley 1987) and 95 seeds/g (2,690 seeds/oz) for European buckthorn (Lee and others 1991).

Seed storage guidelines have not been developed for buckthorn species, but it appears that seeds can be stored adequately for several years if they are kept in sealed containers at low temperatures (Hubbard 1974).

Pregermination treatment. Considerable variability seems to exist in the need for pregermination treatments of buckthorn seed. Fresh seeds of alder buckthorn and spiny redberry apparently have no innate germination requirements (Hubbard 1974, Keeley 1987). During laboratory tests involving 1 month of stratification at 5 EC, however, more than 75% of the total germination occurred after 7 days of incubation at 23 EC in the dark. Germination increased to 90% when seeds were incubated with an initial heat treatment of 100 EC for 5 minutes and seeds were placed on soil containing 0.5 g powdered charred wood (charate) of the chaparral shrub chamise or greasewood *Adenostoma fasciculatum* Hook. & Arn. Ca treatment designed to simulate conditions after a chaparral fire (Keeley 1987). Seeds of spiny redberry germinated best after 1 month of cold stratification followed by an initial heating treatment of 100 EC for 5 minutes and incubation at 23 EC in charate-enriched soil under a 12-hour photoperiod of 350 Fmol/m²/sec. Seeds germinated slowly, with more than 75% of the total germination delayed until a second cycle of stratification and incubation (Keeley 1987). Seeds of European buckthorn

have been stratified for 2 to 3 months in moist peat at 5 EC (Dirr 1990). Soaking European buckthorn seeds in concentrated sulfuric acid treatment for 20 minutes to break dormancy was found to be harmful (Hubbard 1974).

There are no officially prescribed germination tests procedures for buckthorns. Viability tests by tetrazolium staining have been suggested for European species (Enescu 1991). Seeds should be soaked in water for 24 hours, cracked open in a vise, then re-soaked overnight. Staining should take place in a 1% tetrazolium solution for 24 hours at 30 EC (Dirr 1990). To be considered viable, the embryos must be completely stained, with the exception of the extreme third of the distal ends of the radicle and cotyledons.

Nursery and field practice. Detailed nursery techniques have not been developed for most buckthorn species. The available information suggests that for most of the species, the seeds should be sown in the spring at a depth of 10 to 40 mm (0.4 to 1.6 in) after they have been treated to break dormancy (Hubbard 1974). Germination is epigeal with thin, usually curved cotyledons (Kartesz and Gandhi 1994). Some buckthorns also are propagated by layering and by cuttings or by grafting (Hubbard 1974).

References

- Conrad CE. 1987. Common shrubs of chaparral and associated ecosystems of southern California. Gen. Tech. Rep. PSW-99. Berkeley, CA: USDA Forest Service, Pacific Southwest Forest and Range Experiment Station. 86 p.
- Dirr MA. 1990. Manual of woody landscape plants: their identification, ornamental characteristics, culture, propagation and use. Champaign, IL: Stipes Publishing Co. 1007 p.
- Enescu V. 1991. The tetrazolium test of viability. In: Gordon AG, Gosling P, Wang BSP, eds. Tree and shrub seed handbook. Zurich: International Seed Testing Association: 9.1B9.19.
- Everett TH. 1982. The New York Botanical Garden illustrated encyclopedia of horticulture. New York: Garland Publishing. 3601 p.
- Gill DS, Marks PL. 1991. Tree and shrub seedling colonization of old fields in central New York. Ecological Monographs 61: 183B205.
- Guitián J. 1995a. Sex ratio, reproductive investment and flowering phenology in dioecious *Rhamnus alaternus* (Rhamnaceae). Nordic Journal of Botany 15: 139B143.
- Guitián P. 1995b. Reproductive biology of *Rhamnus legionensis* Rothm., a dioecious species endemic to the northwest Iberian peninsula. Flora (1995) 190: 345B352.
- Hickman JC, ed. 1993. The Jepson manual: higher plants of California. Berkeley: University of California Press. 1400 p.
- Hitchcock CL, Cronquist A, Ownbey M, Thompson JW. 1961. Vascular plants of the Pacific Northwest: Volume 3, Saxifragaceae to Ericaceae. Seattle: University of Washington Press. 614 p.
- Hubbard RL. 1974. *Rhamnus*, buckthorn. In: Schopmeyer CS, tech. coord. Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: USDA Forest Service: 704-708.
- Johnston MC, Johnston LA. 1978. Flora Neotropica. Monograph 20. New York: New York Botanical Garden. 96 p.
- Kartesz, JT, Gandhi, KN. 1994. Nomenclatural notes for the North American Flora. XIII. Phytologia 76: 441B457.

- Keeley JE. 1981. Reproductive cycles and fire regimes. In: Mooney HA, Bonnicksen TM, Christensen NL [and others], tech. coords. Proceedings, Fire Regimes and Ecosystem Properties Conference; 1978 December 11B15; Honolulu, HI. Gen. Tech. Rep. WO-26. Washington, DC: USDA Forest Service: 231B277.
- Keeley JE. 1987. Role of fire in seed germination of woody taxa in California chaparral. *Ecology* 68: 434B443.
- Krüssmann G. 1985. Manual of cultivated broad-leaved trees and shrubs. Volume III. Portland, OR: Timber Press. 510 p.
- Lee WG, Grubb PJ, Wilson JB. 1991. Patterns of resource allocation in fleshy fruits of nine European tall-shrub species. *Oikos* 61: 307B315.
- Mozingo H. 1987. Shrubs of the Great Basin: a natural history. Reno: University of Nevada Press. 342 p.
- Naveh Z. 1974. The ecology of fire in Israel. Proceedings Annual Tall Timbers Fire Ecology Conference 13: 131B170.
- PLANTS. 2001. The PLANTS Database, Version 3.1 (<http://plants.usda.gov>). Baton Rouge, LA: USDA National Resources Conservation Service, National Plant Data Center.
- USDA FS [USDA Forest Service]. 1937. Range plant handbook. Washington, D.C.
- Ziller WG. 1974. The tree rusts of western Canada. Pub. 1329. Victoria, BC: Department of the Environment, Canadian Forestry Service. 272 p.

Table 1 *Rhamnus*, buckthorn: nomenclature and occurrence

Scientific names & synonym(s)	Common name	Occurrence
<i>R. alnifolia</i> L'Hér.	alder buckthorn	Transcontinental in S Canada, Maine to Virginia, Tennessee, W to Utah, California
<i>R. arguta</i> Maxim.	C	Introduced in Indiana
<i>R. cathartica</i> L.	European buckthorn, waythorn, common buckthorn	Europe & Asia; naturalized from Nova Scotia, Maine, S to Virginia, W to Montana, Wyoming, Utah, & California
<i>R. crocea</i> Nutt. <i>R. pilosa</i> (Trel.) Abrams	spiny redberry, redberry buckthorn	California to Baja California Sur, Arizona, & New Mexico
<i>R. davurica</i> Pallas	Dahurian buckthorn	Siberia to N China; introduced in Rhode Island, Pennsylvania, North Carolina, E to North Dakota, Nebraska
<i>R. davurica</i> Pallas ssp. <i>nipponica</i> (Makino) Kartesz & Gandhi	Dahurian buckthorn	Introduced in Rhode Island
<i>R. ilicifolia</i> Kellogg <i>R. crocea</i> Nutt. ssp. <i>ilicifolia</i> (Kellogg) C.B. Wolf <i>R. crocea</i> Nutt. var. <i>ilicifolia</i> (Kellogg) Greene	hollyleaf redberry	Oregon, California, Nevada, & Arizona
<i>R. japonica</i> Maxim.	Japanese buckthorn	Japan: introduced in Illinois
<i>R. lanceolata</i> Pursh ssp. <i>glabrata</i> (Gleason) Kartesz & Gandhi <i>R. lanceolata</i> Pursh var. <i>glabrata</i> Gleason	lanceleaf buckthorn	Virginia, Ohio, Tennessee, Alabama, W to South Dakota, Arkansas, Texas
<i>R. lanceolata</i> Pursh ssp. <i>lanceolata</i>	lanceleaf buckthorn	Pennsylvania, Virginia, W to Wisconsin, Indiana, Missouri, Tennessee, Alabama
<i>R. pirifolia</i> Greene <i>R. crocea</i> Nutt. var. <i>pirifolia</i> (Greene) Little <i>R. crocea</i> Nutt. ssp. <i>pirifolia</i> (Greene) C.B. Wolf	island redberry	S California to Mexico
<i>R. serrata</i> Humb. & Bonpl. ex J.A. Schultes <i>R. fasciculata</i> Greene <i>R. smithii</i> Greene ssp. <i>fasciculata</i> (Greene) C.B. Wolf	sawleaf buckthorn	Arizona, New Mexico, Texas
<i>R. smithii</i> Greene <i>R. smithii</i> Greene ssp. <i>typica</i> C.B. Wolf	Smith buckthorn	Colorado & New Mexico

***R. utilis* Dcne.**

Chinese buckthorn

E China; introduced in Michigan & Illinois