Grossulariaceae—Currant family

# *Ribes* L.

## currant, gooseberry

Robert D. Pfister and John P. Sloan

Dr. Pfister is a professor of forestry at the University of Montana, Missoula;
Mr. Sloan is at the USDA Forest Service's Lucky Peak Nursery, Boise, Idaho

**Growth habit, occurrence, and use.** The currant and gooseberry genus—*Ribes*— includes about 150 species of deciduous, (rarely) evergreen, shrubs that grow in the colder and temperate parts of North America, Europe, Asia, and South America. The unarmed species are commonly called currants; the prickly species are gooseberries. Of the more important species for which seed data are available, 16 are native to the United States and 1 was introduced from Europe (table 1). These species generally occur as rather low-growing shrubs, although 3 species can attain heights of 3 to 4 m (table 2).

Six of the more showy species—alpine, American black, golden, wax, clove, and winter currants—are cultivated for their colorful fruit, attractive flowers, and ornamental foliage. Berries are made into jam, jelly, pie, juice, and syrup. All native species are valuable as food and cover for wildlifeand many provide browse for livestock (Plummer and others 1968). Golden and clove currants have been used in shelterbelt plantings in the prairie–plains and intermountain regions. The former also has been widely planted for erosion control (Pfister 1974). Golden, wax, white-stem, and gooseberry currants are valued as ornamentals in the United States and Canada (Barnes 1986). Currants are shade tolerant (Quick 1954). Many species regenerate vegetatively as well as from seed (Dittberner and Olson 1983; Wasser 1982). Most are rhizomatous (Lotan and others 1981). Seeds of currants remain viable in soil for long periods of time (Lyon and Stickney 1976).

Germination is stimulated by disturbances such as fire (Lotan and others 1981; Morgan and Neuenschwander 1985; Young 1983). Consequently, currants are common pioneer species on hot burns occurring on xeric sites (Hopkins and Kovalchik 1983). However, their seedcoats are relatively thin and may be destroyed by severe fires. Moist mineral soil with high amounts of humus provides a good seedbed for currants. Seeds are often introduced to the seedbank by birds and mammals that cannot digest the seeds (Lyon and Stickney 1984). Moss and Wellner (1953) suggested that, in the northern Rocky Mountains, seeds are also directly deposited simply by falling to the ground below parent plants. Seeds remain viable in the soil for long periods of time (Lyon and Stickney 1976). Moss and Wellner (1953) found soil-borne seeds of prickly currant more than 200 years old.

Many species serve as alternate hosts to white pine blister rust—*Cronartium ribicola* J.C. Fischer—a disease that has severely affected forest ecology and forest management practices (Ketcham and others 1968). Wax currant has also been shown to produce allelopathic effects (Heisey 1982).

**Geographic races.** Nine of the species listed (table 1) have recognized varieties; these species are pasture, Sierra, and Missouri gooseberries, and alpine, clove, winter, wax, Hudson Bay, and sticky currants. Distinctions in the first 5 species are not clearly related to geographic races, whereas the last 4 species contain geographic races (Hitchcock and others 1955; Rehder 1940; Steyermark 1963).

**Flowering and fruiting.** Flowers are bisexual (dioecious in alpine currant), usually small and greenish, but yellow to red in some species (Rehder 1940). The flowers are borne singly or in few- to many-flowered racemes from April to June (table 3). Flowers are often wind-pollinated (Quick 1954). Fruit is a green, many-seeded, glandular or smooth berry 6 to 13 mm in diameter (figure 1) that ripens in early to late summer. Mature fruits are red in some species, from purple to black in others, and occasionally red, yellow, or black within a species (table 4). Bees are very important to pollination of some European currants (Blasse and Hofman 1988). A mature seed (figure 2) is filled with a large endosperm containing a minute, rounded embryo (figure 3). Seeds are dispersed almost entirely by birds and mammals during the summer and fall.

The earliest seedcrops produced by Sierra gooseberry and prickly and sticky currants are borne when the plants are 3 to 5 years old. Good seedcrops are borne at intervals

**Table 1**—*Ribes,* currant, gooseberry: nomenclature and occurrence

| Scientific name & synonym(s) | Common name(s) | Occurrence |
|---|---|---|
| ***R. alpinum* L.**<br>*R. opulifolium* L. | **alpine currant** | Europe to Siberia |
| ***R. americanum* P. Mill.**<br>*R. floridum* L'Herit. | **American black currant** | Nova Scotia to Alberta, S to Virginia & New Mexico |
| ***R. aureum* Pursh**<br>*Chrysobotrya aurea* (Pursh) Rydb.<br>*R. flavum* Colla; *R. tenuiflorum* Lindl. | **golden currant,**<br>slender golden currant,<br>flowering currant | E Washington to Saskatchewan & South Dakota, S to California & New Mexico |
| ***R. aureum* var. *villosum* DC.**<br>*R. odoratum* H. Wendl.<br>*Chrysobotrya odorata* (Wendl.) Rydb. | **clove currant,**<br>buffalo currant | South Dakota & Minnesota, S to Missouri, W Texas, & Arkansas |
| ***R. cereum* Dougl.**<br>*R. churchii* A. Nels & Kenn.<br>*R. inebrians* Lindl.; *R. pumilum* Nutt. | **wax currant,**<br>squaw currant | British Columbia to central Montana, S to northern Mexico |
| ***R. cynosbati* L.**<br>*Grossularia cynosbati* (L.) Mill.<br>*R. gracile* Michx. | **pasture gooseberry,**<br>eastern prickly gooseberry | Nova Scota to Alberta, S to Virginia, Nebraska, & New Mexico |
| ***R. hudsonianum* Richards.**<br>*R. petiolare* Dougl. | **Hudson Bay currant,** wild black currant, northern black currant | Alaska to Hudson Bay, S to N California, Utah, Wyoming, & Minnesota |
| ***R. inerme* Rydb.**<br>*Grossularia inermis* (Rydb.) Cov. & Britt.<br>*R. divaricatum* Dougl. var. *inerme* (Rydb.) McMinn<br>*R. purpusii* Koehne ex Blank. | **white-stem gooseberry** | British Columbia to Montana, S to California & New Mexico |
| ***R. lacustre* (Pers.) Poir.**<br>*Limnobotrya lacustris* Rydb.<br>*R. echinatum* Dougl.; *R. grossulariodes* Michx.<br>*R. parvulum* Rydb. | **prickly currant,**<br>swamp gooseberry,<br>swamp black currant | Alaska to Newfoundland, S to California, South Dakota, & Pennsylvania |
| ***R. missouriense* Nutt.**<br>*Grossularia missouriensis* (Nutt). Cov. & Britt.<br>*R. gracile* Pursh, not Michx. | **Missouri gooseberry** | Minnesota to Connecticut, S to Tennessee, Arkansas, & Kansas |
| ***R. montigenum* McClatchie**<br>*Limnobotrya montigena* McClatchie Rydb.<br>*R. lacustre* var. *molle* Gray.<br>*R. lentum* Cov. & Rose; *R. molle* Howell | **gooseberry currant,**<br>alpine prickly currant,<br>mountain gooseberry | British Columbia to Montana, S to S California & New Mexico |
| ***R. nevadense* Kellogg**<br>*R. ascendens* Eastw.; *R. grantii* Heller | **Sierra currant** | S Oregon, N California, & W Nevada |
| ***R. oxyacanthoides* ssp. *irriguum* (Dougl.) Sinnott**<br>*R. irriguum* Dougl.<br>*R. divaricatum* var. *irriguum* (Dougl.) Gray<br>*Grossularia irrigua* (Dougl.) Cov. & Britt. | **Idaho gooseberry,**<br>inland black gooseberry | British Columbia, S to NE Oregon & E to W Montana |
| ***R. roezlii* Regel**<br>*Grossularia roezlii* (Regel) Cov. & Britt.<br>*R. amictum* Greene; *R. aridum* Greene<br>*R. urlsonianum* Greene | **Sierra gooseberry** | California & Nevada |
| ***R. rotundifolium* Michx.**<br>*Grossularia rotundifolia* (Michx.) Cov. & Britt.<br>*R. triflorum* Willd. | **roundleaf gooseberry,**<br>Appalachian gooseberry | Massachusetts to New York S to North Carolina |
| ***R. sanguineum* Pursh**<br>*Calobotrya sanguinea* (Pursh) Spach<br>*Coreosma sanguinea* (Pursh) Spach<br>*R. glutinosum* Benth. | **winter currant,**<br>red flowering currant,<br>Oregon currant,<br>blood currant | W British Columbia, S to California |
| ***R. viscosissimum* Pursh**<br>*Coreosma viscosissima* (Pursh) Spach<br>*R. halli* Jancz. | **sticky currant** | British Columbia to Montana, S to California & N Arizona |

**Source:** Pfister (1974).

**Table 2**—*Ribes,* currant, gooseberry: growth habit, height at maturity and year of first cultivation

| Species | Growth habit | Height at maturity (m) | Year first cultivated |
|---|---|---|---|
| *R. alpinum* | Dense, unarmed shrub | 0.9–2.4 | 1588 |
| *R. americanum* | Unarmed shrub | 0.6–1.8 | 1727 |
| *R. aureum* | Unarmed shrub | 0.9–3.0 | 1806 |
| *R. aureum* var. *villosum* | Unarmed shrub | 0.9–3.0 | 1812 |
| *R. cereum* | Unarmed shrub | 0.3–1.5 | 1827 |
| *R. cynosbati* | Prickly shrub | 1.5 | 1759 |
| *R. hudsonianum* | Unarmed shrub | 0.3–1.8 | 1899 |
| *R. inerme* | Prickly shrub | 0.9–2.1 | 1899 |
| *R. lacustre* | Prickly shrub | 0.3–1.8 | 1812 |
| *R. missouriense* | Prickly shrub | 0.3–1.8 | 1907 |
| *R. montigenum* | Low, very prickly shrub | 0.3–0.9 | 1905 |
| *R. nevadense* | Unarmed shrub | 0.9–1.8 | 1907 |
| *R. oxyacanthoides* spp. *irriguum* | Prickly shrub | 0.3–2.4 | 1920 |
| *R. roezlii* | Prickly shrub | 0.6–1.5 | 1899 |
| *R. rotundifolium* | Low, prickly shrub | 0.9 | 1809 |
| *R. sanguineum* | Unarmed shrub | 0.9–3.6 | 1818 |
| *R. viscosissimum* | Hardy, unarmed shrub | 0.3–1.8 | 1827 |

**Source:** Pfister (1974).

**Table 3**—*Ribes,* currant, gooseberry: phenology of flowering and fruiting

| Species | Location | Fruit ripening | Flowering |
|---|---|---|---|
| *R. alpinum* | Europe | Apr–May | July–Aug |
| *R. americanum* | — | Apr–June | June–Sept |
| *R. aureum* | — | Apr–May | June–July |
| *R. aureum* var.*villosum* | Wyoming | Late May | Late Aug |
| | Kansas | Mid–Apr | June |
| | — | Apr–June | June–Aug |
| *R. cereum* | — | Apr–June | Aug |
| *R. cynosbati* | — | Apr–early June | Late July–Sept |
| *R. hudsonianum* | — | May–July | — |
| *R. inerme* | — | May–June | — |
| *R. lacustre* | — | Apr–July | Aug |
| *R. missouriense* | — | Apr–May | June–Sept |
| *R. montigenum* | — | Late June–July | Aug–Sept |
| *R. nevadense* | — | May–July | — |
| *R. oxyacanthoides* ssp. *irriguum* | — | Apr–June | — |
| *R. roezlii* | — | May–June | — |
| *R. rotundifolium* | — | Apr–May | July–Sept |
| *R. sanguineum* | Oregon | Apr–May | July–Aug |
| | — | Mar–June | — |
| *R. viscosissimum* | — | May–June | Aug–Sept |

**Sources:** Fernald (1950), Hitchcock and others (1955), Krüssmann (1960–1962), Loiseau (1945), Munz and Keck (1965), NBV (1946), Petrides (1955), Pfister (1974), Rehder (1940), Stephens (1969), Steyermark (1963), Symonds (1963), Wyman (1949).

of 2 to 3 years (Moss and Wellner 1953; Quick 1954). Clove currant, however, produces good crops annually (Pfister 1974).

**Seed collection and extraction.** The fruits should be picked or stripped from the branches as soon as they are ripe to preclude loss to birds. Unless the seeds are to be extracted immediately, fruits should be spread out in shallow layers to prevent overheating (Pfister 1974). Berries of alpine currant are often allowed to ferment in piles for a few days prior to extraction (NBV 1946). Maceration and washing are used to separate the seeds from the pulp. Dried fruits should first be soaked in water before cleaning. Small quantities of berries can be cleaned in a kitchen blender. The berries are covered with water and ground in the blender for 15 to 45 seconds. After the seeds have separated from the pulp, additional water is added to allow the sound seeds to settle. The pulp,

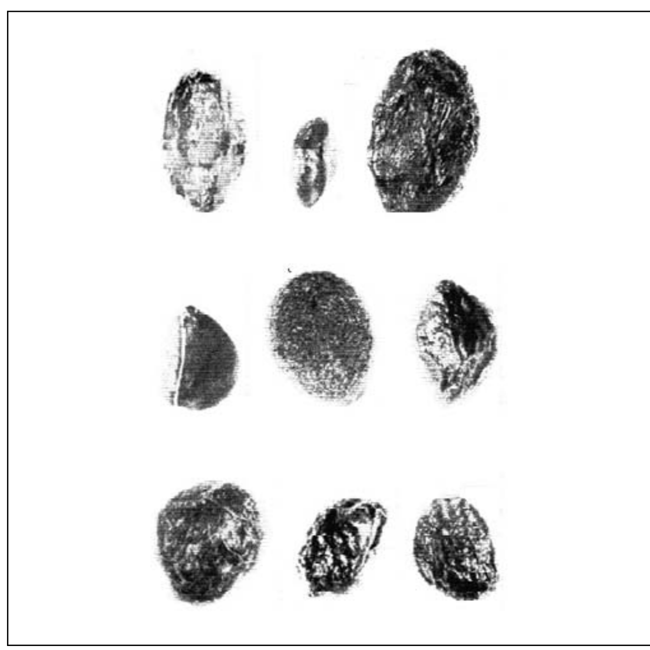
**Table 4**—*Ribes,* currant, gooseberry: fruit characteristics and seed storage conditions for air-dried seeds

| | Fruit characteristics | | | Storage conditions | | |
|---|---|---|---|---|---|---|
| **Species** | **Surface** | **Diam (cm)** | **Ripe color** | **Temp (°C)** | **Duration (yr)** | **Viability at end (%)** |
| *R. alpinum* | Glabrous | — | Scarlet | — | — | — |
| *R. americanum* | Glabrous | 0.6 | Black | 6 | 4 | 38 |
| *R. aureum* | Glabrous | 0.6 | Red, black, or yellow | 21 | 17 | 89 |
| *R. aureum* var. *villosum* | Smooth | 1.0 | Black, golden, or reddish brown | 21 | 17 | 32 |
| *R. cereum* | Glandular | 0.6 | Dull to bright red | 21 | 27 | 4 |
| *R. cynosbati* | Glandular | — | Reddish purple | 21 | 7 | 8 |
| *R. hudsonianum* | Smooth | 1.0 | Black | 21 | 17 | 40 |
| *R. inerme* | Smooth | 0.6 | Reddish purple | 21 | 11 | 80 |
| *R. lacustre* | Glandular | 0.6 | Purple to black | — | — | — |
| *R. missouriense* | Smooth | 1.3 | Purple to black | — | — | — |
| *R. montigenum* | Glandular | 0.6 | Red | — | — | — |
| *R. nevadense* | Glandular | — | Blue to black | Soil | 4 | 81 |
| | Glandular | — | Blue to black | 21 | 4 | 88 |
| *R. oxyacanthoides* ssp. *irriguum* | Smooth | 1.0 | Bluish purple | — | — | — |
| *R. roezlii* | Glandular | 1.3 | Purple or deep reddish brown | Soil | 13 | 82 |
| | Glandular | 1.3 | Purple or deep reddish brown | 2 | 12 | 45 |
| *R. rotundifolium* | Smooth | 0.6 | Purple | — | — | — |
| *R. sanguimeum* | Glandular | 1.0 | Blue to black | — | — | — |
| *R. viscosissimum* | Glandular | 1.3 | Black | 21 | 17 | 23 |
| | — | — | — | 21 | 22 | 7 |

**Sources:** Hitchcock (1955), Jepson (1925), Ketchum and others (1968), Munz (1965), Pfister (1974), Quick (1945, 1947, 1954), Rehder (1940), Stephens (1969).

**Figure 1**—*Ribes*, currant, gooseberry: berries of *R. cereum*, wax currant (**upper left**); *R. cynosbati*, pasture gooseberry (**upper right**); *R. lacustre*, prickly currant (**middle left)**; *R. montigenum*, gooseberry currant (**middle right**); *R. sanguineum*, winter currant (**bottom left**); *R. viscosissimum*, sticky currant (**bottom right**).

**Figure 2**—*Ribes*, currant, gooseberry: seeds of *R. cereum*, wax currant (**upper left**); *R. hudsonianum*, Hudson Bay currant (**upper center**); *R. oxyacanthoides* ssp. irriguum, Idaho gooseberry (**upper right**); *R. lacustre*, prickly currant (**center left**); *R. montigenum*, gooseberry currant (**center middle**); *R. nevadense*, Sierra currant (**center right**); *R. roezli*, Sierra gooseberry (**bottom left**); *R. sanguineum,* winter currant (**bottom center**); *R. viscosissimum*, sticky currant (**bottom right**).



empty seeds, and excess water can then be decanted. Seeds may be washed using a funnel lined with filter paper and then dried on the filter paper (Morrow and others 1954). Munson (1986) recommends replacing the blades in a food-processing blender or milkshake blender with a short length of plastic or rubber hose to extract the seeds. Data on the numbers of cleaned seeds per weight are listed in table 5.

Seed yields from 45 kg (100 lb) of berries was 1.8 kg (4 lb) for golden currant, 3.6 kg (8 lb) for clove currant, and 1.8 kg (4 lb) for winter currant (Pfister 1974). One liter of berries from winter currant weighs about 0.5 kg (1 bu weighs about 40 lb). Each prickly currant plant produces around 50 to 75 berries, and each berry has 8 seeds (Moss and Wellner 1953).

**Storage.** Currant seeds are orthodox and remain viable for long periods when stored in sealed containers at a low moisture content. Temperature is evidently not critical. Samples of Sierra gooseberry seeds buried in soil in inverted open containers for 13 years exhibited 70 to 94% viability (Quick 1947b). Seeds of several species stored dry at room temperature also maintained high viability for periods up to 17 years (table 4).

**Germination.** In nature, currant seeds normally germinate in spring following dispersal, although some seeds may remain dormant for many years (Moss and Wellner 1953; Quick 1954). The best seedbed appears to be mineral soil well supplied with humus. Germination is epigeal (figure 4). In the laboratory, seeds are slow to germinate except for those of Hudson Bay currant and roundleaf gooseberry. Most species require at least 1 stratification period of fairly long duration to break embryo dormancy (Rudolf 1949). Stidham and others (1980) achieved good germination of golden currant after 10 weeks of wet chilling in distilled water. Impermeable seedcoats also appear to be involved in dormancy of some seedlots of clove and American black currants (Pfister 1974). Germination rate and total can be increased by wet prechilling in sand, peat, or vermiculite or in a mixture of these media. Seed losses from damping-off fungi can be prevented by applying 646 mg of copper

**Figure 3**—*Ribes missouriense*, Missouri gooseberry: longitudinal section through a seed.

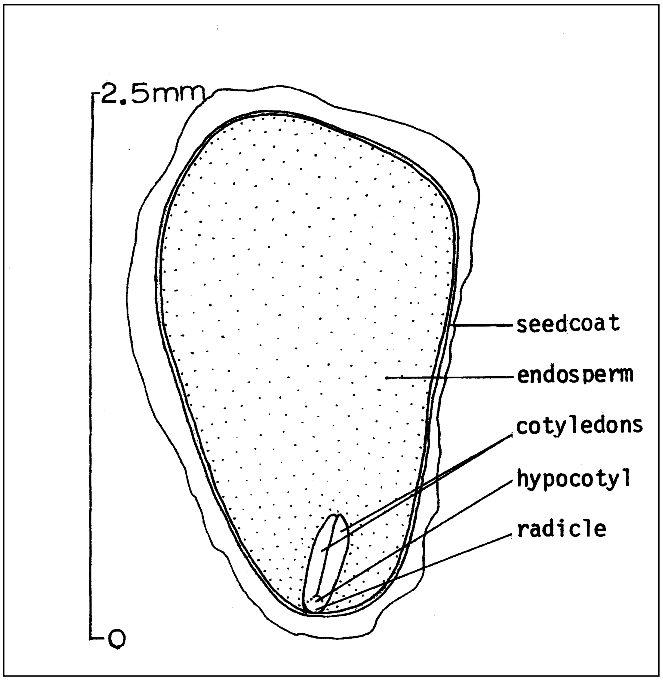
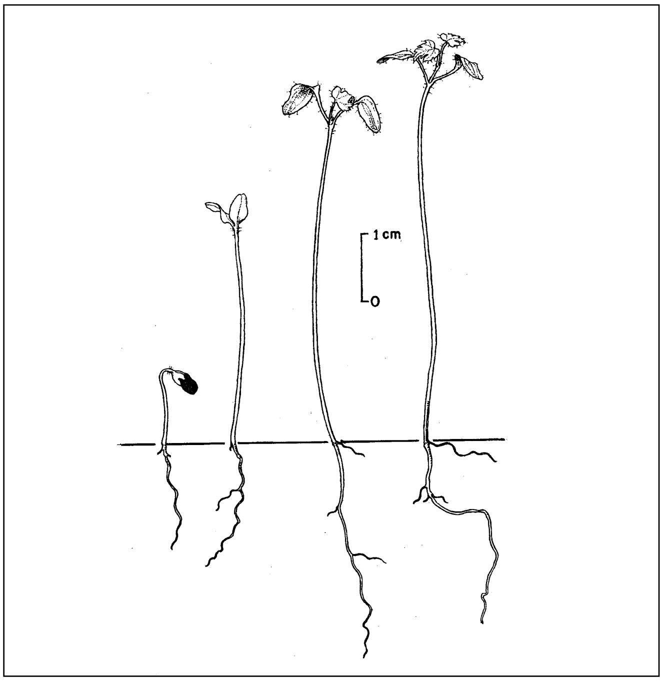



**Table 5**—*Ribes*, currant, gooseberry: seed yield data

| Species | Place collected | Cleaned seeds (x1,000)/weight: Range /kg | Range /lb | Average /kg | Average /lb | Samples |
|---|---|---|---|---|---|---|
| *R. americanum* | — | 544–741 | 247–336 | 690 | 313 | 4 |
| *R. aureum* | — | 441–628 | 200–285 | 514 | 233 | 4 |
| *R. aureum* var. *villosum* | North Dakota | 234–395 | 106–179 | 368 | 167 | 8 |
| *R. cereum* | California | 443–624 | 201–283 | 553 | 251 | 5 |
| *R. cynosbati* | — | 417–487 | 189–221 | 452 | 205 | 2 |
| *R. hudsonianum* | Idaho | 1,389–2,703 | 630–1,226 | 2,127 | 965 | 12 |
| *R. inerme* | Idaho & California | 780–877 | 354–398 | 807 | 366 | 5 |
| *R. lacustre* | California | — | — | 1,135 | 515 | 1 |
| *R. missouriense* | — | 344–370 | 156–168 | 357 | 162 | 2 |
| *R. montigenum* | Utah | — | — | 313 | 142 | 1 |
| *R. nevadense* | California | 650–935 | 295–424 | 862 | 391 | 10 |
| *R. roezlii* | California | 388–650 | 176–295 | 520 | 236 | 10+ |
| *R. sanguineum* | Oregon | — | — | 626 | 284 | 1 |
| *R. viscosissimum* | Idaho & California | 562–769 | 255–344 | 657 | 298 | 5 |

**Sources:** Pfister (1974), Quick (1936, 1954).

**Figure 4**—*Ribes missouriense*, Missouri gooseberry: seedling development at 2, 7, 23, and 44 days after germination.




oxalate per 100 $cm^2$ of culture surface (Quick 1941). Optimal temperature and duration of stratification vary by species and, to a lesser degree, between seedlots within a species. For most species, a second wet chilling and a repeat germination test are necessary to obtain complete germination of viable seed (table 6). The dormancy irregularity within a seedlot provides a natural adaptive advantage: some seeds germinate immediately and some remain dormant in the forest soil until conditions are optimal for germination and development. Many methods of breaking dormancy have been tried on various species, including acid treatment of seedcoat, warm incubation, freeze-and-thaw, and stratification with alternating temperatures (Quick 1939a&b, 1940, 1941, 1943, 1945, 1947a&b). For most species these treatments offer little advantage over normal wet chilling. A lower temperature can improve germination and reduce wet-chilling requirements (Fivaz 1931; Pfister 1974). Stidham and others (1980) used potassium nitrate to improve early germination of golden currant. Most tests were conducted in a greenhouse using sand flats moistened with Hoagland's nutrient solution (Quick 1941). Some species showed considerable germination capacity without wet chilling when

**Table 6**—*Ribes*, currant, gooseberry: pregermination treatments and germination test results

| Species | Pregermination treatment: Temp (°C) | Pregermination treatment: Days | Germination under test conditions* (%) | Germination capacity† (%) | Germination: Samples |
|---|---|---|---|---|---|
| *R. alpinum* | 0 to 10 | 90+ | 80 | — | 10 |
| *R. americanum* | –2 to 2 | 90–120 | 68 | 76 | 39 |
| *R. aureum* | –2 to 2 | 60 | 60 | 63 | 19 |
| *R. aureum* var. *villosum* | 20/0 (D/N) | 120 | 94 | 98 | 3 |
| *R. cereum* | –2 to 0 | 120–150 | 61 | 72 | 61 |
| *R. cynosbati* | –2 to 5 | 90–150 | 69 | 72 | 19 |
| *R. hudsonianum* | NP | NP | 57 | 85 | 116 |
| | 0 to 2 | 90–120 | 69 | 76 | 42 |
| *R. inerme* | 0 | 120–200 | 60 | 74 | 54 |
| *R. lacustre* | 0 | 120–200 | 48 | 61 | 64 |
| *R. missouriense* | –2 to 5 | 90+ | 73 | — | 3 |
| *R. montigenum* | 0 | 200–300 | 53 | — | 6 |
| | 0 | 120–150 | 8 | 33 | 15 |
| *R. nevadense* | 0 | 120 | 78 | 87 | 43 |
| *R. oxyacanthoides* ssp. *irriguum* | 0 to 5 | 90 | 79 | 81 | 11 |
| *R. roezlii* | 0 | 100–150 | 80 | 87 | 200 |
| *R. rotundifolia* | –2 to 0 | 90+ | 80 | 81 | 10 |
| *R. sanguineum* | 0–2 | 100–140 | 61 | 64 | 55 |
| *R. viscosissimum* | –2 to 0 | 140 | 58 | 67 | 88 |

**Sources:** NBV (1946), Pfister (1974), Quick (1939, 1940, 1941, 1943, 1945, 1947).
**Note:** D/N = day/night, NP = no pretreatment.
* Virtually all of the tested seeds were stratified and germinated in sand moistened with nutrient solution. The germination tests were conducted under greenhouse conditions for periods of 30 to 40 days.
† Germination capacity was determined by retrial stratification and a repeat germination test with conditions about the same as used initially.

investigators alternated diurnal temperatures (25 and 5 or 10 °C)—for example, prickly currant (Miller 1931), clove currant (Quick 1941), roundleaf gooseberry (Fivaz 1931), and sticky currant (Miller 1931). For these tests, 5 minutes of soaking in 2 to 10% sulfuric acid solution improved germination of prickly and sticky currant seeds (Miller 1931). Each species has its own unique germination characteristics, so that no procedure is best for all species. Additional work is needed to fully understand the dormancy mechanisms in the Ribes genus.

**Nursery practice.** Currant seeds are normally sown in fall, although they can be stratified and sown in spring. Few tests have been conducted to determine which species can be sown in spring without stratification; Hudson Bay currant may be one of these (table 6). Fall-sowing is recommended, especially if seedcoat dormancy is present (Heit 1968). However, Sierra gooseberry seeds must be dried before they are sown because fresh seeds will not germinate, even after stratification (Quick 1939). If fall-sowing is not possible, the seeds should be stratified before spring-sowing using the procedures summarized in table 6. Seeds should be sown at a rate of 646 to 860/m$^2$ (60 to 80/ft$^2$) (NBV 1946) or 130 viable seeds/m of row (40/ft) and covered to a depth of 3 to 6 mm ($^1/_8$ to $^1/_4$ in) (Pfister 1974). Seeds of Sierra gooseberry and wax and Sierra currants may be covered up to 1.3 cm (1/2 in) (Quick 1939a, 1940).

The only reported experience in nursery stock production is for clove currant (Pfister 1974). Seedbeds are fall-sown, mulched to a depth of 5 to 8 cm (2 to 3 in) and covered with snow fence. About 20,000 seedlings are produced per kilogram of seeds (9,000/lb) and the normal outplanting age is 2 years. Most species can be propagated readily from hardwood cuttings taken in autumn (Pfister 1974).

## References


Barnes HW. 1986. Five *Ribes* species of the U.S. and Canada Rocky Mountains. Plant Propagator 32(2): 9–10.

Blasse W, Hofman S. 1988. Studies on the biology of fertilization in *Ribes rubrum* L. and *Ribes nigrum* L. Archiv für Gartenbau 36(7): 437–448.

Dittberner PL, Olson MR. 1983. The plant network data base (PIN): Colorado, Montana, North Dakota, and Wyoming. FWS/OBS-83/86. Washingotn, DC: USDI Fish and Wildlife Service. 786 p.

Fernald ML. 1950. Gray's manual of botany. 8th ed. New York: American Book Co. 1632 p.

Fivaz AE. 1931. Longevity and germination of seeds of *Ribes*, particularly *R. rotundifolium*, under laboratory and natural conditions. Tech. Bull. 261. Washington, DC: USDA. 40 p.

Heisey RM. 1982. Allelopathic effects of *Trichostema lanceolatum* (Labiatae) [PhD thesis]. Davis: University of California. 156 p.

Heit CE. 1968. Propagation from seed: 15. Fall planting of shrub seeds for successful seedling production. American Nurseryman 128(4): 8–10.

Hitchcock CL, Cronquist A, Ownbey M, Thompson JW. 1955. Vascular plants of the Pacific Northwest: 3. Saxifragaceae to Ericaceae. Seattle: University of Washington Press. 614 p.

Hopkins WE, Kovalchik BL. 1983. Plant associations of the Crooked River National Grassland. R6-Ecol 133-1983. Portland, OR: USDA Forest Service, Pacific Northwest Region. 98 p.

Jepson WL. 1925. A manual of the flowering plants of California. Berkeley, CA: Associated Students Store. 1238 p.

Ketcham DE, Wellner CA, Evans SS Jr. 1968. Western white pine management programs realigned on northern Rocky Mountain National Forests. Journal of Forestry 66: 329–332.

Krüssmann G. 1960–1962. Handbuch der Laugbehölze. 2 volumes. Berlin: Parey. 495 & 608 p.

Loiseau J. 1945. Les arbres et la forêt. Volume 1. Paris: Vigot. 204 p

Lotan JE, Alexander ME, Arno SF, French RE, Langdon OG, Loomis RM, Norum RA, Rothermel RC, Schmidt WC, Van Wagtendonk JW. 1981. Effects of fire on flora: a state-of-knowledge review. Gen. Tech. Rep. WO-16. Washington, DC: USDA Forest Service. 71 p.

Lyon JL, Stickney PF. 1976. Early vegetal succession following large northern Rocky Mountain wildfires. In: Proceedings, Tall Timbers Fire Ecology Conference #14 and Intermountain Fire Council and Land Management Symposium; 1974 October 8–10; Missoula, MT. Tallahassee, FL: Tall Timbers Research Station 14: 355–375.

Miller DR. 1931. *Ribes* seed germination studies. In: Blister rust control work in the Far West. Annu. Rep. 1931. Washington, DC: USDA Bureau of Entomology and Plant Quarantine, Division of Blister Rust Control. 431 p.

Morgan P, Neuenschwander LF. 1985. Modeling shrub succession following clearcutting and broadcast burning. In: Loran JE, Brown JK, eds. Fire's Effects on Wildlife Habitat: Symposium Proceedings. Gen. Tech. Rep. INT-186. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station: 83–90.

Morrow EB, Darrow GM, Scott DH. 1954. A quick method of cleaning berry seed for breeders. Proceedings of the American Society of Horticultural Science 63: 265.

Moss VD, Wellner CA. 1953. Aiding blister rust control by silvicultural measures in the western white pine type. Circ. 919. [Washington, DC]: USDA. 32 p.

Munson RH. 1986. Extracting seeds from fleshy fruits. Plant Propagator 32(2): 14–15.

Munz PA, Keck DD. 1965. A California flora. Berkeley: University of California Press. 1651 p.

NBV [Nederlandsche Boschbouw Vereeniging]. 1946. Boomzaden: handleiding insake het oogsten, behandelen, bewaren en uitzaaien van boomzaden. Wageningen, The Netherlands: Ponsen & Looijen. 171 p.

Petrides GA. 1955. A field guide to trees and shrubs. Boston: Houghton Mifflin. 431 p.

Pfister RD. 1974. *Ribes* L., currant, gooseberry. Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: USDA Forest Service: 540–542.

Plummer AP, Christensen DR, Monsen S. 1968. Restoring big-game range in Utah. Pub. 68-3. Salt Lake City: Utah Division of Fish and Game. 183 p.

Quick CR. 1936. Experimental germination of *Ribes* seeds, 1934–35. Serial 80. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 55 p.

Quick CR. 1939a. Experimental germination of *Ribes* seed, 1937. Serial 100. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 30 p.

Quick CR. 1939b. Experimental germination of *Ribes* seeds, 1935, with a report of cultural methods now used. Serial 101. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 52 p.

Quick CR. 1940. Experimental germination of *Ribes* seeds, 1939. Serial 107. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 52 p.

Quick CR. 1941. Experimental germination of *Ribes* seed, 1940. Serial 111. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 29 p.

Quick CR. 1943. Experimental germination of *Ribes* seed, 1942. Serial 116. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 23 p.

Quick CR. 1945. Experimental germination of *Ribes* and pine seeds, 1944. Serial 125. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 32 p.

Quick CR. 1947a. Experimental germination of *Ribes* and pine seeds, 1945. Serial 135. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 35 p.
Quick CR. 1947b. Some experimental aspects of *Ribes* seed longevity. Serial 137. Berkeley, CA: USDA Bureau of Entomology and Plant Quarantine. 8 p.
Quick CR. 1954. Ecology of the Sierra Nevada gooseberry in relation to blister rust control. Circ. 937. Washington, DC: USDA. 30 p.
Rehder A. 1940. Manual of cultivated trees and shrubs. 2nd ed. New York: Macmillan. 2996 p.
Rudolf PO. 1949. First the seed, then the tree. In: USDA Yearbook of Agriculture (1948): Trees. 127–135.
Stephens HA. 1969. Trees, shrubs, and woody vines in Kansas. Lawrence: University Press of Kansas. 250 p.
Steyermark JA. 1963. Flora of Missouri. Ames: Iowa State University Press. 1725 p.
Stidham ND, Ahring RM, Claypool PL. 1980. Chemical scarification, moist prechilling, and thiourea effects on germination of 18 shrub species. Journal of Range Management 33(2): 115–118.
Symonds GWD. 1963. The shrub identification book. New York: M. Barrows and Co. 379 p.
Wasser CH. 1982. Ecology and culture of selected species. In: Revegetating Disturbed Lands in the West. FWS/OBS-82/56. Washington, DC: USDI Fish and Wildlife Service: 263–265.
Wyman D. 1949. Shrubs and vines for American gardens. New York: Macmillan. 442 p.
Young RP. 1983. Fire as a vegetation management tool in rangelands of the Intermountain region. In: Monsen SB, Shaw N, eds. Managing Intermountain Rangelands: Improvement of Range and Wildlife Habitats. Gen. Tech. Rep. INT-157. Ogden, UT. USDA Forest Service, Intermountain Forest and Range Experiment Station: 18–31.