CornaceaeCDogwood family

Cornus L.

dogwood

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Growth habit, occurrence, and use. About 40 species of dogwoodC*Cornus* L.Care native to the temperate regions of the Northern Hemisphere, and 1 is found in Peru. Most species are deciduous trees or shrubs (2 are herbs) useful chiefly for their ornamental qualitiesCflowers, fruit, foliage, or color of twigs. Many varieties have been developed for a number of the species for their landscape or horticultural value. The wood of flowering dogwood, the most commercially important species in the United States, is hard and heavy and was used extensively by the textile industry earlier in the century for shuttle blocks. Today the species is widely known due to its popular use as an ornamental landscape tree. Some species produce edible fruits (Edminster 1950; Edminster and May 1951), and the bark of others contains a substitute for quinine. Roots and bark of several species have long been known to have medicinal properties that can be used to fight fevers. Distribution data and chief uses of 17 species of present or potential importance in the United States are listed in table 1.

Flowering and fruiting. The small, perfect flowersCwhite, greenish white, or yellow in colorCare borne in terminal clusters in the spring. In flowering and Pacific dogwoods, the clusters are surrounded by a conspicuous enlarged involucre of 4 to 6 white or pinkish petal-like, enlarged bracts. Fruits are globular or ovoid drupes 3 to 6 mm in diameter, with a thin succulent or mealy flesh containing a single 2-celled and a 2-seeded bony stone (figures 1 and 2). However, in many stones, only 1 seed is fully developed, but larger stones generally have 2 developed seeds. The fruits ripen in the late summer or fall (table 2). Data on minimum seed-bearing age and fruiting frequency are limited (table 3). Stones are dispersed largely by birds and animals.

Collection of fruits. Dogwood fruits should be collected when the fruit can be squeezed and the stone will pop out. To reduce losses to birds, fruits should be collected as soon as they are ripe by stripping or shaking them from the branches. Short ladders may be useful for collecting fruits from the taller species, but ordinarily this can be done from the ground. Fruits of flowering dogwood should not be collected from isolated trees because these seem to be self-sterile, and a high percentage of the stones will be empty (Mugford 1969).

Extraction and storage of seeds. The stones can be readily extracted by macerating the fruits in water and allowing the pulp and empty stones to float away (see chapter 3 on seed processing) (Brinkman 1974; Mugford 1969). Stone yields and weights are summarized in table 4. If the fruits cannot be extracted immediately after fruits are collected, they should be spread out in shallow layers to prevent excessive heating; however, slight fermentation facilitates removal of the fruit pulp (Brinkman 1974; NBV 1946). Clean air-dried stones may be stored in sealed containers at

3 to 5 °C (Heit 1967; Mugford 1969; Sus 1925; Swingle 1939). Stones of flowering dogwood have been successfully stored at 4% moisture content at –7 °C for 7 years by the Georgia Forestry Commission with only a 1% decrease in viability (Brock 1997), thus demonstrating the orthodox nature of seeds of this genus. Brinkman (1974) wrote that dogwood stones could be sown without extracting them from the fruit and that stones were cleaned when storage was required and that commercial seedlots may or may not have the dried fruit attached. Presently, however, all commercial lots of dogwood seeds now are cleaned (table 4) and some nursery managers report that if the stones are not cleaned, the fruit may inhibit germination (Brock 1997). After the fruits are collected and cleaned, the stones may be sown immediately or stratified for spring-planting.

Pregermination treatments. Natural germination of most species occurs in the spring following seedfall, but some seeds do not germinate until the second spring. Germination is epigeal (figure 3). Seeds of all species show delayed germination due to dormant embryos; in most species, hard pericarps also are present. Where both types of dormancy exist warm stratification for at least 60 days in a moist environment followed by a longer period at a much lower temperature is required (table 5). A more complicated procedure has been recommended for Cornelian-cherry by Tylkowski (1992). The warm phase of treatment is at alternating temperatures (15/25 °C) on 24-hour cycles for 18 weeks, then a cold phase at 3 °C for 15 to 18 weeks or until the first germination is observed. Immersion in concentrated sulfuric acid for 1 to 4 hours or mechanical scarification can be used in place of warm stratification for most species. Soaking stones in gibberellic acid for 24 hours also has been successful for roughleaf (Furuta 1960) and flowering dogwoods (Litvinenko 1959). In species having only embryo dormancy, this can be broken by low-temperature stratification.

Germination tests. Official testing rules for dogwoods call for germination tests for some species, but rapid tests, such as tetrazolium (TZ) staining or excised embryos, are also recommended (AOSA 1993; ISTA 1993). Flowering and western dogwoods can be tested on the top of moist blotters or creped paper for 28 days at alternating temperatures of 30 °C (day) and 20 °C (night). Excised embryo testing is an alternate method for flowering dogwood, and TZ is an alternate method for western dogwood (AOSA 1993). TZ staining is recommended for the European species Cornelian-cherry and bloodtwig dogwood (ISTA 1993). The seeds must be soaked in water for 48 hours, then cut transversely on the ends and soaked for another 6 hours. The TZ incubation should be for 48 hours in a 1% solution; presence of any unstained tissues is cause to consider the seeds non-viable (ISTA 1993).

Germination tests using 400 properly pretreated seeds per test can be performed using sand, soil, paper, or blotters, but long stratification periods of 3 to 5 months are usually required. The same diurnally alternated temperatures of 30/ 20° C appear to be satisfactory for all species (table 6), although Heit (1968a) recommended 30 and 10 °C for silky dogwood. Estimating the viability of dogwood seed lots by TZ staining is the common practice at the USDA Forest Service=s National Tree Seed Laboratory and at other seed testing facilities. In many cases, this is the preferred testing method of seed collectors and dealers, nursery managers, and seed testing laboratories. TZ tests performed by trained personnel will provide accurate, reliable data that are comparable to field germination. A TZ test only takes a few days to conduct as compared to a germination test, which requires several months of stratification before the germination period. The quicker TZ test will provide nursery managers with more time to secure different seedlot for either fall-sowing or stratification if the first seedlot is substandard or dead. Excised embryos also have been used (Flemion 1948; Heit 1955).

Nursery practices. Best results for most species are obtained when freshly collected stones are sown in the fall as soon after cleaning as possible (Heit 1968a; Stevenson 1969). Seeds of most species will germinate the following spring. Seeds of species that require a warm-cold pretreatment (table 5) can be planted in the summer but should be left in the ground until the second spring because many will not germinate the spring following planting (Murphy 1997). Dry-stored stones probably should be soaked in water and sown before October (Heit 1968a). Fruit collected too late for fall sowing should be cleaned, stored over winter and spring, stratified in summer and sown in the fall (NBV 1946; Shumilina 1949). An alternate procedure is to stratify the seeds at about 4° C for 3 to 4 months during the winter and sow them in the spring (Goodwin 1948; Shumilina 1949; Sus 1925). Seeds in nursery beds should be covered with 6 to 13 mm (3 to 2 in) of soil (Brinkman 1974; Heit 1968b; Mugford 1969; NBV 1946; Stevenson 1969). Seeds sown in the fall should be mulched during the winter with 13 to 25 mm (2 to 1 inch) of sawdust (Heit 1968a; Mugford 1969; Stevenson 1969).

References

Adams J. 1927. The germination of the seeds of some plants with fleshy fruits. American Journal of Botany 14: 415B428.

AOSA [Association of Official Seed Analysts]. 1993. Rules for testing seeds. Journal of Seed Technology 16(3): 1B113.

Asakawa S. 1969. Correspondence, June 17 and November 27, 1969. Tokyo: Japanese Ministry of Agriculture and Forestry.

Billington C. 1943. Shrubs of Michigan. Cranbrook Institute of Science Bulletin 20: 1B249.

Brinkman KA. 1974. *Cornus*. L., dogwood. In: Schopmeyer CS, tech. coord. Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: USDA Forest Service: 503B504.

Brock S. 1997. Personal communication. Macon: Georgia Forestry Commission.

Dirr MA. 1990. Manual of woody landscape plants: their identification, ornamental characteristics, culture propagation and uses. Champaign, IL: Stipes Publishing Co.

Dirr MA, Heuser CW. 1987. The reference manual of woody plant propagation: from seed to tissue culture. Athens, GA: Varsity Press. 239 p.

Edminster FC. 1947. The ruffed grouse: its life story, ecology and management. New York: Macmillan. 385 p.

Edminster FC. 1950. Use of shrubs in developing farm wildlife habitat. North American Wildlife Conference Transactions 15: 519B550.

Edminster FC, May RM. 1951. Shrub plantings for soil conservation and wildlife cover in the Northeast. Circ. 887. Washington, DC: U.S. Department of Agriculture. 68 p.

Emery D. 1988. Seed propagation of native California plants. Santa Barbara, CA: Santa Barbara Botanic Garden. 115 p.

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

Flemion F. 1948. Reliability of the excised embryo method as a rapid test for determining the germinative capacity of dormant seeds. Contributions of the Boyce Thompson Institute 15(4): 229B242.

Forbes RD, ed. 1956. Forestry handbook, Sect. 9. New York: Ronald Press: 28B31.

Furuta T. 1960. Alabama study evaluates production methods, polyethylene packing. Florist Exchange 135(1): 22B24, 26B27, 29B30, 32.
Goodwin RH. 1948. How to grow dogwood from seed. Plants and Gardens 4(4): 236B238.
Gordon AG, Rowe DCF. 1982. Seed manual for trees and shrubs. For. Comm. Bull. 59. London: United Kingdom Forestry Commission. 132 p.
Gorshenin NM. 1941. Agrolesomelioratsiya [in Russian: Agro-forest melioration]. 392 p.
Guan KL, Fan X, Zhen G. 1989. [in Chinese: Causes of seed dormancy of *Cornus officinalis* and conditions for germination]. Plant Physiology Communications 5: 24B27 [Seed Abstracts 1992; 15(12): 3972].
Heit CE. 1955. The excised embryo method for testing germination quality of dormant seed. Proceedings of the Association of Official Seed Analysts 45: 108B117.
Heit CE. 1967. Propagation from seed: 11. Storage of deciduous tree and shrub seeds. American Nurseryman 126(10): 12B13, 86B94.
Heit CE. 1968a. Propagation from seed: 15. Fall planting of shrub seeds for successful seedling production. American Nurseryman 128(4): 8B10, 70B80.
Heit CE. 1968b. Thirty-five years' testing of tree and shrub seed. Journal of Forestry 66: 632B634.
Heit CE. 1969. Correspondence, Feb. 14. Geneva, NY: Cornell University, New York State Agricultural Experiment Station Department of Seed Investigations.
Holweg AW. 1964. Some shrubs and vines for wildlife food and cover. New York Conservation 19(2): 22B27.
ISTA [International Seed Testing Association]. 1993. Rules for testing seeds: rules 1993. Seed Science and Technology 21 (Suppl.): 1B259.
Jack RA. 1969. Personal communication.. Silverton, OR: Silver Falls Nursery.
Lakela O. 1965. A flora of northeastern Minnesota. Minneapolis: University of Minnesota Press. 541 p.
Litvinenko SN. 1959. The Ukrainian gibberellin, an effective growth stimulant. Doklady Akademii Nauk SSSR Seriya Biologiya 126: 1368B1370.
McKeever DG. 1938. The effect of various methods of treatment on germination of seeds of some plants valuable for game and erosion purposes [unpublished MS thesis]. Moscow, ID: University of Idaho.132 p.
McMinn HE. 1951. An illustrative manual of California shrubs. Berkeley: University of Califfornia Press. 663 p.
Mirov NT, Kraebel CJ. 1939. Collecting and handling seeds of wild plants. For. Publ. 5. Washington, DC: Civilian Conservation Corps. 42 p.
Mugford D. 1969. Personal communication. Licking, MO: Missouri Conservation Department, George White Nursery.
Murphy K. 1997. Personal communication. Planis, MT: Lawyer Nursery.
NBV [Nederlandsche Boschbouw Vereeniging]. 1946. Boomzaden: Handleiding inzake het oogsten, behandelen, bewaren en uitzaaien van boomzaden. Wageningen, The Netherlands: Ponsen and Looijen. 171 p.
Nichols GE. 1934. The influence of exposure to winter temperatures upon seed germination in various native American plants. Ecology 15: 364B373.
Ohwi J. 1965. Flora of Japan. Washington, DC: Smithsonian Institution.1067 p.

Pammel LH, King CM. 1921. Studies in the germination of some woody plants. Proceedings of the Iowa Academy of Science 28: 273B282.
Peterson RA. 1953. Comparative effect of seed treatments upon seedling emergence in seven browse species. Ecology 34: 778B785.
Rehder A. 1940. Manual of cultivated trees and shrubs hardy in North America. New York: Macmillan. 996 p.
Rosendahl CO. 1955. Trees and shrubs of the Upper Midwest. Minneapolis: University of Minnesota Press. 411 p.
Rydberg PA. 1932. Flora of the prairies and plains of Central North America. New York: New York Botanical Garden. 969 p.
Shumilina ZK. 1949. Podgotovka posevu semyan drevesnykh i kustarnikovykh porod. Vses. Nauchnoissled. Inst. Agrolesomelior., Goslesbumizdat, Moskva-Leningrad [Preparation of tree and shrub seed for sowing. Transl. TT 67-51300, 36 p., 1967. CFSTI, USDC Springfield, VA].
Soljanik I. 1961. Proizvodnja sadnica od nedozrelog sumskog semena [in Croation]. 11 p. Savez. Inz. Teh. Sum. Drvne Ind. Sad. Beograd [Producing seedlings from unripe forest seed. English transl. for USDA 1968.]
Stevenson H. 1969. Personal communication. Elsberry, MO: Forrest Keeling Nursery.
Steyermark JA. 1963. Flora of Missouri.. Ames: Iowa State University Press. 1728 p.
Sus NI. 1925. Pitomnik in Russian: The forest nursery]. 227 p.
Swingle CF, comp. 1939. Seed propagation of trees, shrubs, and forbs for conservation planting. SCS-TP27. Washington, DC: USDA Soil Conservation Service. 198 p.
Titus GR. 1940. So-called 2-year seeds germinated first year. American Nurseryman 72(11): 22.
Tylkowski T. 1992. Thermal conditions for the after-ripening and germination of Cornelian cherry (*Cornus mas* L.) seeds. Arboretum Kornickie 36: 165B172.
Van Dersal WR. 1938. Native woody plants of the United States: their erosion-control and wildlife values. Misc. Publ. 303. Washington, DC: U.S. Department of Agriculture. 362 p.
Vimmerstedt JP. 1965. Flowering dogwood (*Conus florida* L.). In: Silvics of forest trees of the United States. Agric. Handbk. 271. Washington, DC: USDA Forest Service: 162B166.
Weaver RE. 1976. The cornelian cherries. Arnoldia 36(2): 50B56.
Wyman D. 1947. Seed collecting dates of woody plants. Arnoldia 7(9): 53B56.

Figure 1C*Cornus:* cleaned seeds, × 6. **A** = *C. alternifolia,* alternate-leaf dogwood; **B** = *C. amomum,* silky dogwood; **C** = *C. sericea* ssp. *orientalis,* California dogwood; D = *C. drummondii,* roughleaf dogwood; **E** = *C. florida,* flowering dogwood; **F** = *C. nuttallii,* Pacific dogwood; **G** = *C. racemosa,* gray dogwood.

Figure 2C*Cornus sericea,* red-osier dogwood: longitudinal section through an embryo of a stone (left); transverse section of a stone containing 2 embryos (right top) and transverse section of a stone containing 1 embryo (right bottom), × 6.

Figure 3C*Cornus florida,* flowering dogwood: seedling development at 2, 4, 8, and 31 days after germination.

Table 1 *C. Cornus,* dogwood: nomenclature and occurrence

Scientific name & synonym(s)	Common names	Occurrence
***C. alba* L.** *C. tatarica Mill.*	**Tatarian dogwood**	Siberia to Manchuria & North Korea
***C. alternifolia* L. f.** *Swida alternifolia* (L.f.) Small	**alternate-leave dogwood,** blue dogwood, pagoda dogwood	Newfoundland to SE Manitoba, S to Missouri & E Arkansas, E to Georgia
C. amomum P. Mill.	**silky dogwood,** kinnikinnik, red-willow	Maine to Indiana, S to Georgia & Florida
***C. canadensis* L.** *Chamaepericlymenum canadense* (L.) Aschers & Graebn. *Cornella canadensis* (L.) Rydb.	**bunchberry,** bunchberry dogwood, dwarf cornel	S Greenland to Alaska, S to Maryland, W to South Dakota, New Mexico, & California
***C. controversa* Hems.**	**giant dogwood**	Japan, China, & Nepal
***C. drummondii* C. A. Mey.** *C. priceae Small*	**roughleaf dogwood**	S Ontario, Ohio, & Kentucky, W to Nebraska, S to Texas & Mississippi
***C. florida* L.** *Cynoxylon floridum* (L.) Raf. ex B.D. Jackson	**flowering dogwood,** dogwood	E United States
***C. kousa* Hance**	**Japanese dogwood,** kousa dogwood	Japan & Korea
***C. macrophylla* Wall.**	**bigleaf dogwood**	Japan, China, & Nepal
***C. mas* L.**	**Cornelian-cherry,** corneliancherry dogwood	Central & S Europe & W Asia
***C. nuttallii* Audubon ex Torr. & Gray**	**Pacific dogwood,** western flowering dogwood, mountain dogwood	SW British Columbia, W Washington & Oregon, S in mtns to S California; also in central W Idaho
***C. officinalis* Siebold & Zucc.**	**Japanese cornelian cherry,** Japanese cornel dogwood	Japan, Korea, & China
***C. racemosa* Lam.** *C. circinata* L'Herit. *C. foemina* ssp. *racemosa* (Lam.) J.S. Wilson *C. paniculata* L'Herit.	**gray dogwood,** western dogwood	Maine to Manitoba, S to Florida, W to Missouri & Oklahoma
***C. rugosa* Lam.** *C. circinata* L'Herit.	**roundleaf dogwood,** roundleaved dogwood,	Quebec to Manitoba, S to Virginia, W to NE Iowa

	roundleaf cornel	
***C. sanguinea* L.** *C. sanguinea* var. *viridissima* Dieck *Swida sanguinea* (L.) Opiz	**bloodtwig dogwood,** common dogwood, dogberry, pegwood	Europe
***C. sericea* L.** *C. stolonifera* Michx. *C. baileyi* Coult. & Evans *Suida stolonifera* (Michx.) Rydb.	**red-osier dogwood,** American dogwood, kinnikinnik, squawbush	Newfoundland to Alaska, S to California, New Mexico, & Nebraska, in NE US from Wisconsin to New York
***C. sericea* ssp. *occidentalis* (Torr.& Gray) Fosberg**	**western dogwood,** California dogwood, creek dogwood	S British Columbia to N Idaho, S to S California

Source: Brinkman (1974).

Table 2C *Cornus,* dogwood: phenology of flowering and fruiting

Species	Flowering dates	Fruit ripening dates	Seed dispersal dates
alba	MayBJune	AugBSept	C
C. alternifolia	MayBJuly	JulyBSept	JulyBSept
C. amomum	MayBJuly	AugBSept	Sept
C. canadensis	MayBJuly	Aug	AugBOct
C. *controversa*	MayBJune	AugBSept	Oct
C. drummondii	MayBJune	AugBOct	AugBwinter
C. florida	Mar & Apr (S US)BMay (N US)	Sept (N US)BOct (S US)	SeptBNov
C. kousa	MayBJune	AugBOct	
C. macrophylla	JulyBAug	C	C
C. mas	FebBMarch	AugBSept	
C. nuttallii	AprilBMay	SeptBOct	SeptBOct
C. officinalis	FebBMar	Sept	C
C. racemosa	late MayBJuly	JulyBOct	SeptBOct
C. rugosa	MayBJuly	AugBSept	C
C. sanguinea	MayBJune	AugBSept	C
C. *sericea*	MayBJuly, JuneBAug (N US)	JulyBOct	OctBwinter
C. sericea ssp. *occidentalis*	AprBAug	JulyBNov	C

Sources: Asakawa, (1969), Billington (1943), Brinkman (1974), Dirr (1990), Fernald (1950), Forbes (1956), Holweg (1964), Gordon and Rowe (1982), Lakela (1965), McMinn (1951), Ohwi (1965), Rehder (1940), Rosendahl (195), Rydberg (1932), Steyermark (1963), Van Dersal (1938), Vimmerstedt (1965), Weaver (1976), Wyman (1947).

Table 3C *Cornus,* dogwood: height, seed-bearing age, seed crop frequency, and fruit ripeness criteria

Species	Ht at maturity (m)	Year first cultivated	Min seed-bearing age (yrs)	Yrs between large seed crops (yrs)	Ripe fruit color
C. alba	3	1741	C	C	Bluish white
C. alternifolia	5B8	1760	C	C	Dark blue
C. amomum	3	1658	4B5	1	Pale blue or bluish white
C. canadensis	0.3	C	C	C	Bright red or scarlet
C. controversa	9B18	1880	C	C	Red or purple to blue-black
C. drummondii	8B14	1836			White
C. florida	6B12	1731	6	1B2	Dark red
C. kousa	8	1875	C	2	Rose red pinkish
C. macrophylla	8B11	1827	C	C	Reddish purple to purple black
C. mas	8	Ancient	C	C	Scarlet
C. nuttallii	6B24	1835	10	2	Bright red to orange
C. officinalis	6B9	1877	C	C	Red
C. racemosa	4	1758	C	C	White
C. rugosa	3	1784	C	C	Light blue to white
C. sanguinea	2B5	C	C	C	Black
C. sericea	3B6	1656	C	C	White or lead colored
C. sericea ssp. *occidentalis*	5	C	C	C	White

Sources: Dirr (1990), Fernald (1950), Gordon and Rowe (1982), McMinn (1951), Rehder (1940), Weaver (1976).

Table 4C *Cornus,* dogwood: seed yield data

	Stones/fruit wt		Cleaned stones/wt Range		Average		
Species	kg/100 kg	lbs/100 lb	/kg	/lb	/kg	/lb	Samples
C. alba	C	C	27,900B40,900	12,700B18,600	33,000	15,000	33
C. alternifolia	C	C	13,000B20,500	5,900B9,300	17,600	8,000	6
C. amomum	15B18	17B20	22,400B30,800	10,200B14,000	26,800	12,200	6
C. canadensis	C	C	129,800B169,400	59,000B77,000	147,400	67,000	2
C. drummondii	16B24	18B27	18,900B46,200	8,600B21,000	34,500	15,700	5
C. florida	17B41	19B46	7,300B13,600	3,300B6,200	9,900	4,500	11
C. kousa	C	C	14,300B18,300	6,500B8,300	21,300	9,700	3
C. mas	13	15	3,500B7,500	1,600B3,400	5,000	2,300	22
*C. nuttallii**	11	12	8,800B13,400	4,000B6,100	10,300	4,700	4
C. racemosa	16B22	18B25	22,400B33,700	10,200B15,300	28,600	13,000	11
C. rugosa	C	C	C	C	41,800	19,000	1
C. sanguinea	C	C	16,100B26,000	7,300B11,800	20,200	9,200	70
C. sericea	13B18	15B20	30,400B58,700	13,800B26,700	40,700	18,500	9
C. sericea ssp. *occidentalis*	C	C	C	C	73,500	33,400	1

Sources: Asakawa (1969), Brinkman (1974), Edminster (1947), Forbes (1956), Gordon and Rowe (1982), Gorshenin (1941), Heit (1969), Mirov and Kraebel (1939), Mugford (1969), NBV (1946), Stevenson (1969), Swingle (1930).

* 0.036 cubic meters (1 bu) of fruit clusters weighed 15 kg (33 lb) and yielded 2 kg (4 lb) of stones (Brinkman 1974).

Table 5C*Cornus,* dogwood: stratification treatments

	Warm period			Cold period	
Species	Medium	Temp (C°)	Duration (days)	Temp (C°)	Duration (days)
C. alba	C	C	C	5	90B120
C. alternifolia	Sand, peat, or mix	30B20	60	5	60
*C. amomum**	"Moist"	C	C	3B5	21B28
	Sand, peat, or moss	C	C	5	90B120
*C. canadensis*H	C	C	C	C	60B90
	Sand, peat, or mix	25	30B60	1	120B150
C. controversa	C	C	60B90	C	60B90
*C. drummondii*I	Sand	21B27	1	5	30
		C	30B60	C	30B60
C. florida	Sand	C	C	5	120
C. kousa	Sand, peat, or	C	C	1B5	40B120
	vermiculite	C	C		
C. macrophylla	C	C	90B150	C	90
C. mas	Soil or vermiculite	20B30	120	1B13	30B120
C. nuttallii&	Peat	C	C	3	90
C. officinalis	C	15B22	120B150	C	90
C. racemosa	Sand	20B30	60	5	60, 120
C. rugosa	Soil	C	C	Outdoors	Overwinter
C. sanguinea	C	C	60	C	60B90
*C. sericea*I	Sand	C	C	2B5	60B90
	Sand	C	C	5	60-90
				160	

Sources: Billington (1943), Brinkman (1974), Dirr and Heuser (1987), Emery (1988), Guan and others (1989), Goodwin (1948), Gordon and Rowe (1982), Heit (1967, 1968b), Jack (1969), Nichols (1934), Ohwi (1965), Pammel and King (1921), Peterson (1953), Soljanik (1961), Swingle (1939),

* Seeds were soaked for 3 hours in water at room temperature before stratification (Heit 1968b).

H Seeds were soaked for 1 hour in sulfuric acid before stratification (Dirr and Heuser 1987).

I Seeds were mechanically scarified before stratification (Brinkman 1974).

& Seeds were soaked for 4 hours in sulfuric acid before stratification (Emery 1988).

I Seeds were soaked for 1 hour in sulfuric acid before stratification (Brinkman 1974).

Table 6C *Cornus,* dogwood: germination test conditions and results

Species	Germination test conditions* Daily light (hrs)	Duration (days)	rate Amount (%)	Period (days)	Germination Germination % Average (%)	Samples	Purity (%)
C. alba	C	C	C	C	C	C	C
C. alternifolia	8	60	8	50	10	2	63
C. amomum	8B24	14B28	86H	11	70	6	91
C. canadensis	C	60B90	6	26	16	5	90
C. drummondii	8	50	14	34	25	3	89
C. florida	8	60	14B45	15B20	35	7	97
C. kousa	C	30	C	C	85	2	C
C. macrophylla	C	C	C	C	C	C	C
C. mas	C	C	C	C	57	6	95
C. nuttallii	8B24	47	57	16	81	2	100
C. racemosa	8	60	22B30	14	20	8	83
C. rugosa	8	60+	8	15	46	4	95
C. sericea	C	60B90	35	13B18	57	18	99

Sources: Adams (1927), Asakawa (1969), Brinkman (1974), Heit (1968a, b, 1969), McKeever (1938), Nichols (1934), Peterson (1953), Soljanik (1961), Swingle (1939), Titus (1940).

* Temperatures were 30° C for 8 hours and 20° C for 16 hours each day. Sand was the medium used on all listed species. Additional tests were made on wet paper in germinators with seeds of *C. amomum, C. kousa,* and *C. nuttallii* (Brinkman 1974; Heit 1969).

HOne test.