Elaeagnus L.

elaeagnus

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Growth habit, occurrence, and use. The genus *Elaeagnus* includes about 40 species of shrubs and trees, but there are only 3 species that are valuable for planting and for which reliable information is available (table 1). Although these deciduous trees and shrubs are grown often as ornamentals, they also produce edible fruits and serve as a source of wildlife food and as honey plants. Russian-olive is grown widely and has escaped from cultivation in many river lowland areas, particularly in the Great Plains, where it was extensively planted for shelterbelts (Olson 1974). In many areas, it has become invasive.

Flowering and fruiting. The fragrant, small, perfect flowers are borne in late spring (table 2) and are pollinated by insects (Mowry 1971). The fruit is a dry and indehiscent achene that is enveloped by a persistent fleshy perianth and hence is drupaceous (Jack 1969) (figures 1, 2, and 3). The color of ripe fruit varies with the species (table 3). Seeds are often distributed by birds following consumption of the ripe fruits (Turček 1961).

Collection of fruits; extraction and storage of seeds. Ripe fruits are collected by picking them from the plants by hand or by beating or stripping them from the branches onto canvas or plastic sheets, usually from September to December (Olson 1974). Fruits may be spread out to dry or run through a macerator with water and the pulp floated off or screened out (Heit 1968; Olson 1974). Accordingly, commercial seedlots may consist of either dried fruits or cleaned stones. Dried fruits or cleaned stones at a moisture content from 6 to 14% can be stored successfully in sealed containers at 1 to 10 °C (Heit 1967; Mickelson 1968; Olson 1974; Peaslee 1969). Under ordinary storage conditions, seeds of silverberry remain viable for 1 to 2 years and those of Russian-olive up to 3 years (Olson 1974). The number of cleaned seeds (stones) per weight and other important yield data are presented in table 4. From 4.5 kg (10 lb) of fruit, about 0.45 kg (l lb) of cleaned seeds can be extracted. Fresh fruits of Russian-olive lost about 16 to 20% of their initial weight when air dried. The number of dried fruits per weight ranged from 3,970 to 9,900/kg (1,800 to 4,500/lb), with an average of 6,400/kg (2,900/lb). Purity of commercial seed for all 3 species has been high, ranging from 95 to 100% (Mickelson 1968; Olson 1974; Zarger 1968).

Pregermination treatments. Several pregermination treatments have been tested to overcome embryo dormancy in elaeagnus seeds. The most effective treatment is cold stratification at 1 to 10 °C for 10 to 90 days (Carroll 1971; Heit 1967, 1968; Lingquist and Cram 1967; Molberg

1969; Olson 1974). Stratification for less than 60 days is less effective than for longer periods (Carroll 1971). Intact autumn-olive seeds stratified at 5 °C from 2 to 6 weeks germinated less than 50% after 12 weeks at 25 °C, whereas seeds stratified for 10 to 14 weeks germinated completely in 12 weeks (Hamilton and Carpenter 1976). Allan and Steiner (1965) found that a 24-hour water soak followed by 45 days at 2 to 3 °C was sufficient to break dormancy in seeds of autumn-olive.

Russian-olive stones sometimes exhibit hard seededness, and then should be soaked for 2 to 1 hour in sulfuric acid before germinating (Heit 1967). The optimum length of after-ripening for Russian-olive was reached at 12 weeks (Hogue and LaCroix 1970). The removal of the 1970). Belcher and Karrfalt (1979) found that snipping off 2 mm at the radicle end, after a 7-day water soak, resulted in 96% germination. Snipping 2 mm at the cotyledon end only resulted in 50% germination. When 2 mm was snipped off both ends of the seed, the germination was 100%.

Seeds of Russian-olive that were not given a cold treatment but were soaked in Ethrel (2-chloroethyl phosphonic acid) germinated significantly better than seeds soaked in distilled water (Hamilton 1972). Concentrations of 300 and 600 ppm of Ethrel gave the maximum germination of 100 and 90%, respectively (Hamilton 1972). Germination was not further stimulated by giving the seeds 45 days of cold treatment before soaking in Ethrel (Hamilton 1972).

Gibberillic acid (GA_3) applied to autumn-olive seeds at concentrations of 500 and 900 ppm decreased the time of cold stratification and increased the total germination percentage(Hamilton and Carpenter 1976). A coumarin-like inhibiting substance was found in all parts of the dormant and fully chilled seeds of Russian-olive (Hamilton and Carpenter 1976). Gibberillic acid at concentrations of 100 and 500 ppm and kinetin at 100 ppm appear to reverse the action of the inhibitor (Hamilton and Carpenter 1976).

Silverberry seeds, with endocarps removed, reached 85 to 100% germination within 10 days (Corns and Schraa 1962). After intact seeds were stratified at 5 °C for periods of 40 to 110 days, the germination ranged from 23 to 75%, respectively (Corns and Schraa 1962). Supplemental treatments such as hot water soaks, gibberillic acid, and potassium nitrate (KNO_3) soaks did not affect the germination of silverberry (Corns and Schraa 1962).

Germination tests. Some germination test results on stratified seed are listed in table 5. Germination is epigeal. Silverberry had the best total germination (95 to 96%) and speed of germination after 60 to 90 days of stratification at 4 °C (Morgenson 1990). Seeds of silverberry used for strip mine reclamation yielded the highest germination (80%) after a 2-day warm (50 °C) water soak (Fung 1984). Results for autumn-olive seeds indicated that the optimum germination was achieved with cold stratification at 5 °C for 16 weeks and a night/day temperature of 10/20 °C (Fowler and Fowler 1987). Tests on excised embryos of Russian-olive have been completed in a very short time (Heit 1955). Belcher and Karrfalt (1979) found that it took 1 hour to completely excise the embryo from the seed and it resulted in 100% germination after 3 days incubation at 20 to 30 °C. Viability testing with 2,3,5-triphenyl tetrazolium chloride stain yielded 86% viable seeds for Russian-olive and 68 % viable seeds for autumn-olive (Olson 1974). Rules of the International Seed Testing Association (ISTA 1993) call for the use of tetrazolium staining for elaeagnus. Seeds should be soaked in water for 18 hours, then cut transversely at both ends to open the embryo cavity. After a 48-hour soak in 1% tetrazolium chloride, the seeds should be cut longitudinally to expose the embryos. The radicle tips and as much as one-third of the distal cotyledons can be unstained, and the seeds still considered viable. A secondary procedure calls for longitudinal cuts at the beginning.

Nursery practice. Seeds may be sown 13 to 25 mm (2 to 1 in) deep in the late summer or fall without stratification, or in the spring after 10 to 90 days of cold stratification (Baker 1969; Growl 1968; Hinds 1967; Jack 1969; McDermand 1969; Mickelson 1968; Molberg 1969; Olson 1974; Zarger 1968). July seeding after 90 days of stratification gave excellent germination of Russian-olive in southeast Saskatchewan (Cram and Elliott 1966). In Michigan, autumn-olive is seeded by broadcasting 1.7 kg of fresh fruit kg/10 m^2 of bed area (1 lb/25 ft^2) (Carroll 1971). At the Los Lunas Plant Material Center, Russian-olive is sown at a rate of 200 seeds or 40 g (1.4 oz) of clean seeds/m, which yields 150 usable plants. In areas with a large population of mice, the pulp should be removed and cleaned seeds used for sowing (Carroll 1971). Russian-olive seedlings are susceptible to damage from rabbits and must be protected if these rodents are a problem.

Soil splash, which coats the pubescent leaves of newly emerged seedlings, is an important cause of mortality, and consequently, nursery beds should be mulched to cover the soil and prevent rain spattering (Carroll 1971; Growl 1968; Hinds 1967; Mickelson 1968; Molberg 1969; Olson 1974; Zarger 1968). A seedling density of 130 to 320/m^2 (12 to 30/ft5) is desirable (Baker 1969; Molberg 1969; Zarger 1968). Stock usually is field planted as 1+0 or 2+0 seedlings, and grows well in most soils, including limestone or alkaline soils (Stoeckeler 1946).

References

Allan PF, Steiner WF. 1965. Autumn olive for wildlife and other conservation uses. Leaflet 458. Washington, DC: U.S. Department of Agriculture.

Baker LA. 1969. Correspondence. Elkton, OR: Dwight L. Phipps Forest Nursery.

Belcher EW, Karrfalt RP. 1979. Improved methods for testing the viability of Russian olive seed. Journal of Seed Technology 4(1): 57B64.

Borell AE. 1962. Russian-olive for wildlife and other conservation uses. Leafl. 517. Washsington, DC: U.S. Department of Agriculture. 8 p.

Carroll DA. 1971. Personal communication. East Lansing, MI: USDA Soil Conservation Service, Rose Lake Plant Materials Center.

Corns WG, Schraa RJ. 1962. Dormancy and germination of seeds of silverberry (*Eleagnus commutata* Bernh). Canadian Journal of Botany 40: 1051B1055.

Cram WH, Thompson AC, Elliott T. 1966. Nursery cultural investigations: 1966 summary report for the tree nursery. Indian Head, SK: Canada Department of Agriculture, Prairie Farms Rehabilitation Administration. 35 p.

Growl JM. 1968. Personal communication. Earlington, KY: Kentucky Reclamation Association.

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

Fowler LJ, Fowler DK. 1987. Stratification and temperature requirements for germination of autumn olive(*Elaeagnus umbellata*) seed. Tree Planters= Notes 38(1): 14B17.

Fung MYP. 1984. Silverberry seed pretreatment and germination techniques. Tree Planters= Notes 35(3): 32B33.

Hamilton DF, Carpenter PL. 1976. Regulation of seed dormancy in *Eleagnus angustifolia* by endogenous growth substances. Canadian Journal of Botany 54: 1068B1073.

Hamilton DF, Carpenter PL. 1976. Factors influencing low-temperature after-ripening in seed of *Eleagnus umbellata* Thunb. Journal of the American Society of Horticultural Science 10(2):

171B175.
Harrington HD. 1954. Manual of the plants of Colorado. Denver: Saga Books. 666 p.
Heit CE. 1955. The excised embryo method of testing germination quality of dormant seed. Proceedings of the Association of Official Seed Analysts 45: 108B117.
Heit CE.1967. Propagation from seed: 8. Fall planting of fruit and hardwood seeds. American Nurseryman 126(4): 12B13, 85B90.
Heit CE.1967. Propagation from seed: 11. Storage of deciduous tree and shrub seeds. American Nurseryman 126(10): 12B13, 86B94.
Heit CE. 1968. Personal communication. Geneva, NY: New York State Agricultural Experiment Station.
Heit CE.1967. Propagation from seed: 6. Hard-seedednessCa critical factor. American Nurseryman 125(10): 10B12, 88B96.
Heit CE.1968. Propagation from seed: 15. Fall planting of shrub seeds for successful seedling production. American Nurseryman 128 (4): 8B10, 70B80.
Heit CE. 1970. Personal communication. Geneva, NY: Cornell University, New York State Agricultural Experiment Station.
Hinds LW. 1967. Personal communication. Bismarck, ND: Lincoln-Oakes Nurseries.
Hogue EJ, LaCroix LJ. 1970. Seed dormancy of Russian olive (*Eleagnus angustifolia* L.). Journal of the American Society of Horticultural Science 95(4): 449B452.
Hora Bayard.1981. The Oxford encyclopedia of trees of the world. Oxford: Oxford University Press. 288 p.
ISTA [International Seed Testing Association]. 1993. Rules for testing seeds: rules 1993. Seed Science and Technology 21 (Suppl.): 1B259.
Jack RA. 1969. Persoanl communication. Silverton, OR: Silver Falls Nursery.
Lawrence GHM.1951. Taxonomy of vascular plants. New York: Macmillan. 823 p.
Lindquist CH,Cram WH.1967. Propagation and disease investigations: summary report for the tree nursery. Indian Head, SK: Canadian Department of Agriculture, Prairie Farm Rehabilitation Administration. 42 p.
McDermand J. 1969. Personal communication. Bismarck, ND: USDA Soil Conservation Service, Bismarck Plant Materials Center.
Mickelson AS. 1968. Personal communication. Jonesboro, IL: Union State Tree Nursery.
Molberg JM. 1969. Personal communication. Bottineau, ND: North Dakota School of Forestry.
Morgenson G. 1990. Pregermination treatment and stratification of silverberry seed. Tree Planters= Notes 41(1): 24B25.
Mowry CE. 1971. Personal communication. Elsberry, MO: USDA Soil Conservation Service.
Müller H. 1883. The fertilization of flowers. Thompson DW, transl. & ed. London: Macmillan.
Olson DF Jr. 1974. *Elaeagnus* L., elaeagnus. In: Schopmeyer CS, tech. coord. Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: USDA Forest Service: 376B379.
Peaslee AR. 1969. Personal communication. Lakin, WV: Clements State Tree Nursery.
Radford AE, Ahles HE,Bell CR. 1964. Guide to the vascular flora of the Carolinas. Chapel Hill: University of North Carolina Book Exchange. 383 p.
Rehder A.1940. Manual of cultivated trees and shrubs. 2nd ed. New York: Macmillan. 996 p.

Schumacher FW. 1968. Personal communication. Sandwich, MA: F. W. Schumacher.
Small JK. 1933. Manual of the southeastern flora. New York: J.K. Small. 1554 p.
Stoeckeler JH. 1946. Alkali tolerance of drought-hardy trees and shrubs in the seed and seedling stage. Minnesota Academy of Science Proceedings 14: 79B83.
Turček FJ. 1961. Ökologische Beziehungen der Vögel und Gehölze. Bratislava: Verlag der Slowakische Akademie der Wissenschaften.
Zarger TG. 1968. Personal communication. Norris, TN: Tennessee Valley Authority.

Table 1C*Elaeagnus,* elaeagnus: nomenclature, and occurrence

Scientific name & synonyms	Common name	Occurrence
***E. angustifolia* L.** *E. hortensis* Bieb.	**Russian-olive,** oleaster, narrow-leafed oleaster	S Europe, W & Central Asia; Pacific Northwest to Minnesota, S through Great Plains to Mexico
***E. commutata* Bernh. ex Rydb.** *E. argentea* Pursch, non Moench	**silverberry,** wolfberry	Quebec to Yukon, S to New Mexico, E to Nebraska
***E. umbellata* Thunb.** *E. crispa* Thunb.	**autumn-olive,** autumn elaeagnus	China, Korea, & Japan; Maine to New Jersey & Pennsylvania, W to SW Minnesota, occasionally S to South Carolina

Sources: Fernald (1950), Harrington (1954), Olson (1974), Rehder (1940), Small (1933).

Table 2C*Elaeagnus,* elaeagnus: phenology of flowering and fruiting

Species	Location	Flowering dates	Fruit ripening dates	Seed dispersal dates	Seed size (mm)
E. angustifolia	C	June	AugBOct	All winter	12B13
E. commutata	Black Hills, South Dakota	JuneBJuly	AugBSept	SeptBNov	8B9
E. umbellata	C	MayBJune	AugBOct	SeptBNov	6B8

Sources: Borell 1962, Dietz 1969, Hora 1981, McDermand 1969, Radford et. al. 1964, Rehder 1940.

Table 3C*Elaeagnus,* elaeagnus: height; seed-bearing age, seed crop frequency, and fruit ripeness criteria

Species	Height at maturity (ft)	Year first cultivated	Min. seed-bearing age (yrs)	Interval (yrs) between large seed crops	Fruit ripeness criteria Preripe color	Ripe color
E. angustifolia	15B30	Long cultivated	≤3	3	Whitish to silvery	Silver-gray outer; lemon-yellow inside
E. commutata	6B15	1813	C	1B2	Silvery green	Silver
E. umbellata	3B12	1830	6	C	Silvery, with	Red-pink brown scales

Sources: Borell (1962), Dietz (1969), Fernald (1950), Rehder (1940).

Table 4C*Elaeagnus,* elaeagnus: seed yield data

		Cleaned seeds/wt				
	Seed wt/fruit	Range		Average		
Species	wt ratio	/kg	/lb	/kg	/lb	Samples
E. angustifolia	15B60	7,650B15,400	3,470B6,990	11,380	5,160	15
E. commutata	C	5,950B10,140	2,700B4,600	8,380	3,800	5
E. umbellata	5B10	46,525B84,670	21,100B38,400	62,180	28,200	30

Sources: Belcher and Washburn (1965), Carroll (1971), Harrington (1954), Heit (1970), Hinds (1967), McDermand (1969), Mickelson (1968), Molberg (1969), Mowry (1971), Olson (1974), Schumacher (1968), Zarger (1968).

Table 5C*Elaeagnus,* elaeagnus: germination test conditions and results for stratified seed*

		Germination test conditions			Germinative energy		Germinative capacity	
		Temp. (°C)		Duration	Amount	Period		
Species	Medium	Day	Night	(days)	(%)	(Days)	Average	Samples
E. angustifolia	Sand	30	20	60	7B76	10B32	7B79	32
	Sand	C	C	21B40	C	C	54B90	11
	Moss	C	C	28	27	10	30	1
	Kimpak	30	20	28			68	19
E. commutata	Sand	30	20	50	52	13	60	1
E. umbellata	Kimpak	30	20	28			41	57
E. umbellata	C	30	10	C	C	C	93	C

Sources: Belcher and Washburn (1965), Heit (1968), Molberg (1969), Olson (1974).

* Seeds were stratified for 10 to 90 days at xx to xx °C (34 to 50° F).