Amur Corktree

Phellodendron amurense Rupr.
Citrus family (Rutaceae)

NATIVE RANGE

Eastern Asia including Northern China (Manchuria, Ussuri, Amur), Korea, and Japan

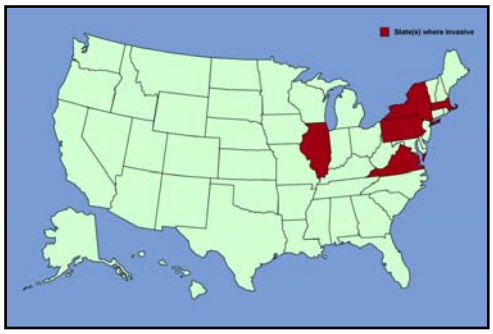
DESCRIPTION

Amur corktree is a deciduous tree named for its thick corky bark (from Greek: phellos for cork and dendron for tree). Mature trees have shelf-like branching and grow from 35-50 ft in height with a spread nearly as wide. Corktree bark is a light golden brown on younger trees and gray-brown, ridged, and furrowed on mature trees. Both young and old trees have bark that is slightly spongy or corky to the touch and a distinctive bright neon yellow layer of inner bark that can be revealed with a quick scrape of a pocket-knife. The leaves are opposite, pinnately compound and composed of 5-13 entire leaflets that are dark green, turning bright yellow in the fall. When crushed, the leaves have a distinctive citrusy smell sometimes likened to a disinfectant or skunk odor. Male and female plants are separate (dioecious) and each bears hanging panicles of yellowish-green flowers from May through June. From mid-June to mid-July, female trees produce abundant clusters of fruits (technically drupes) which are ¼ to ½ in. diameter. The fruits bright are green, turning black in late summer to fall, and may remain on the tree until early winter. Male trees do not produce fruit. The wood of the tree is strong and rot resistant and is prized by some woodworkers.

ECOLOGICAL THREAT

Amur corktree outcompetes native tree and shrub species including oaks and hickories in forested natural areas. It may inhibit and suppress regeneration of overstory canopy trees. Corktree's effect on eastern American forest communities does not depend on the health and growth of individual large trees but on the great number of small ones. Oaks and hickories provide a nutritious fat-containing nut for wildlife that remains available through the winter, whereas corktree provides sugary berries that are lower in nutritional value. Many birds and mammals are dependant on oaks and hickories for food, including grackles, turkey, grouse, quail, blue jays, woodpeckers, waterfowl, deer, bear, squirrels, mice, rabbits, foxes, and raccoons. Because wildlife populations vary with the availability of acorns, populations of acorn-dependent species decrease in forests where Amur corktree has become established.

Amur corktree is invasive in parks and natural areas in New York City, New York and Philadelphia, Pennsylvania, where it has escaped from plantings. Within fifty years of its planting as an ornamental, it has become a dominant tree in New York City parks. The establishment and spread of corktree at three Audubon wildlife sanctuaries in eastern Massachusetts has been documented. It does especially well in forests and wooded areas that have been exposed to human disturbance, where it forms dense stands and crowds out native species. Corktree changes the light regime of forest understory with shelf-like branching that shades out seedlings of competing species. The high volume of seed produced and relative lack of seed predators gives it an additional competitive advantage over native species.



DISTRIBUTION IN THE UNITED STATES

Amur corktree has reported to be invasive in Illinois, New York, Pennsylvania and Virginia, and Massachusetts. Based on its USDA hardiness rating, corktree could occur in Zones 4 to 7, possibly even 3 to 9. Although some have recommended corktree for use in landscaping and as a street tree in parts of the U.S., its ability to withstand urban pollution, root constriction, and frost is highly variable.

HABITAT IN THE UNITED STATES

Corktree grows well in full sun or as an understory tree beneath the shade of a closed canopy oak forest. It can germinate and establish a dense and durable understory under the shade of mature oak-dominated forests. In youth, at least, it is highly shade tolerant in eastern oak forests. It responds to release from overstory shade but is not fatally supressed by it. Corktree may inhibit and suppress regeneration of overstory canopy trees.

Corktree grows best on moist, well-drained soils, but can tolerate periods of dry soils and a wide range of soil pH from 5.0 to 8.2. It has a competitive advantage over native species in the more alkaline soils of urban areas and it has no known pests in this country which is one of the reasons it is recommended for street and landscape planting. The Urban Horticulture Institute at Cornell University recommends Amur corktree for landscape plantings but notes that the tree can naturalize if planted near a forest. Some advocates recommend planting a male cultivar to avoid berries that are messy and stain sidewalks. Corktree appears to do less well in edge habitats in urban areas, where black locust and tree of heaven offer strong competition. Seedlings can establish under parent trees and very dense stands (greater than 36/acre) have been observed.

BACKGROUND

Amur corktree was introduced to the U.S. around 1856. The Harvard University Arnold Arboretum first acquired the sachalinense variety of the tree in 1901 and the true amurense variety in 1906. By 1933, the New York Botanical Garden reported it to be naturalized in their forests, where it remains today. The bark of Amur corktree has been prized for its use in traditional medicine in China, India and Japan. The inner yellow bark was used to make a special dye in ancient China and to make yellow paper for governmental and religious documents. In this country the tree has been used as an ornamental and street tree and is widely planted on college campuses. Demand for corktree and its varieties as a street tree are increasing as shown by a recent study of urban foresters in Ohio. The strong, rot resistant wood is useful for creating railings and bollards for erosion control.

BIOLOGY & SPREAD

In forests, Amur corktree reaches reproductive maturity at about 3 to 5 years of age and has been classified as having a moderate to fast growth rate of 10 to 12 ft. over a 5 to 8 year period. The trees produce abundant seed which is dispersed by birds and probably by water via streams and other drainages. Native birds such as the Northern robin eat the drupes late in the fall and winter and seem to prefer it over other available food sources. In New York, the seed is seldom found more than a few hundred yards from its source and may remain viable in the soil for a number of years.

MANAGEMENT OPTIONS

The best way to control Amur corktree is not to plant it in the first place. An ounce of prevention is worth hundreds of hours of labor and thousands of dollars spent that are needed to remove it once established. Control of corktree requires a long-term strategy with monitoring and follow-up because its seeds remain dormant in the soil for a few to several years and it tends to resprout vigorously after being cut back or incompletely girdled. Sprouts can also produce large amounts of seed. Managed sites should be monitored and retreated as needed for several years to ensure complete control. Female trees should be prioritized for control, to remove the primary seed source. They can be marked in the fall when the fruits are present and highly visible in the forest after the leaves have fallen. Cleared sites should be replanted with appropriate native species to prevent reestablishment of corktree.

Chemical
The most effective management of Amur corktree is through a combination of cutting or girdling followed by application of a systemic herbicide. Systemic herbicides that have been used successfully for corktree control include triclopyr (e.g., Garlon® 3A, Garlon® 4, and Pathfinder II®). Garlon® 3A is an amine formulation that can be used as a cut stump treatment. Garlon® 4 is an ester formulation that can be used either as a foliar spray on stands of seedlings, or a basal bark treatment mixed with horticultural or other recommended oil. Pathfinder II®, a premixed combination of triclopyr and oil, works well applied as a basal bark treatment straight out of the bottle.

Systemic herbicides like triclopyr (e.g., Garlon® 3A and Garlon® 4) and glyphosate (e.g., Accord®, Glypro®, Rodeo®) are absorbed into plant tissues and carried to the roots, killing the entire plant within about a week. Herbicide applications can be made any time of year as long as temperatures are above 55-60ºF for 24 to 48 hrs and rain is not expected for at least 24 hours. Fall and winter applications will avoid or minimize impacts to native plants and animals. Generally, applications should not be made when temperatures are above 85ºF because the mixture may be subject to volatization. Repeated treatments are likely to be needed. Follow-up monitoring should be conducted to ensure effective control. As much as possible, avoid contact of the herbicide with desirable plants. In areas where spring wildflowers or other native plants are interspersed, application of herbicides should be done prior to their emergence or delayed until they have died back. If native grasses are intermingled with the corktree, triclopyr is a better optin because it is selective for broad-leaved plants and will not harm grasses.

Glyphosate products referred to in this fact sheet are sold under a variety of brand names (Accord, Rodeo®, Roundup Pro® Concentrate) and in three concentrations (41.0, 50.2 and 53.8% active ingredient). Other glyphosate products sold at home improvement stores may be too dilute to obtain effective control. Triclopyr comes in two forms – triclopyr amine (e.g., Garlon® 3A, Brush-B-Gone®, Brush Killer®) and triclopyr ester (e.g., Garlon® 4, Pathfinder®, and Vinex®). Because Garlon® 3A is a water-soluble salt that can cause severe eye damage, it is imperative that you wear protective goggles to protect yourself from splashes. Garlon® 4 is soluble in oil or water, is highly volatile and can be extremely toxic to fish and aquatic invertebrates. It should not be used in or near water sources or wetlands and should only be applied under cool, calm conditions.

Manual
Young seedlings may be pulled by hand, preferably when the soil is moist.

Mechanical
Older trees will need to be cut, girdled, or sprayed. Cutting alone is not recommended because corktree resprouts vigorously. Repeated cutting over time should kill trees and repeated cutting of female trees will help reduce the number of seeds produced. Girdling may be effective, but an incomplete girdle will allow the tree to continue growing and resprouting may occur below the girdle.

USE PESTICIDES WISELY: Always read the entire pesticide label carefully, follow all mixing and application instructions and wear all recommended personal protective gear and clothing. Contact your state department of agriculture for any additional pesticide use requirements, restrictions or recommendations.

NOTICE: mention of pesticide products on this page does not constitute endorsement of any material.

CONTACTS
For more information on the management of Amur corktree, please contact:

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SUGGESTED ALTERNATIVE PLANTS
There are many alternative trees that can be planted in place of the Amur Corktree. In the mid-Atlantic region tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), black walnut (*Juglans nigra*), willow oak (*Quercus phellos*), service berry (*Amelanchier laevisa*), and red bud (*Cercis canadensis*) may all be used. The Natural Resources Group of the New York City Department of Parks and Recreation is planting sweetgum and tulip tree on corktree removal sites because they are relatively fast growing and hardy trees. Because U.S. native plants can become invasive outside their

natural, historical ranges, be sure to use plant species native to the ecological region you live in. Check with your local native plant society for recommendations of species and sources of native plants.

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REFERENCES

American Forests. Spring 1999. So you want to plant a tree? American Forests 105(1): 30-36.

Arnold Arboretum. 2003. Arnold Arboretum's living collections database, BG-BASE. Available online at http://rbg-web2.rbge.org.uk/forms/multisite2.html (downloaded December 5, 2003).

D'Amato, N.E., Sydnor, T.D., and D. K. Struve. November 2002. Urban foresters identify Ohio's tree needs. Journal of Arboriculture 28(6): 291-301.

Department of Horticulture, Michigan State University. 2003. Recommended trees for Michigan's lower peninsula. Available online at http://www.hrt.msu.edu/ash.alt/amur_corktree.htm (downloaded December 5, 2003).

Dirr, Michael A. 1983. Manual of Wood Landscape Plants: Their Identification, Ornamental Characteristics, Cultural, Propagation and Uses. Champaign: Stipes Publishing Company. pp. 487-488.

Friends of the Wissahickon. Fall 2002. Fall 2002 Newsletter - Page 5. Available online at http://www.fow.org/newsfall2002-5.htm (December 13, 2003).

Gibbs, P.J. and K.R. Seddon. 1998. Berberine and Huangbo: Ancient Colorants and Dyes. The British Library Studies in Conservation Science 2. London: The British Library.

Gilman, E.F. and D.G. Watson. 2003. *Phellodendron amurense* 'Macho': 'Macho Amur Corktree.' Adapted from Fact Sheet ENH-597 (published November 1993). Florida Cooperative Extension Service: Environmental Horticulture Department. Available online at http://edis.ifas.ufl.edud/BODY_ST438 (downloaded December 5, 2003).

Hudak, Joseph. 1980. Trees for Every Purpose. New York: McGraw-Hill Book Company. p.183.

Johnson, P. S. March 1994. How to manage oak forests for acorn production. USFS NCFES Technical Brief. TB-NC-1. Available online at http://www.snr.missouri.edu/techbrf/techbrf1.html (December 11, 2003).

Lamont, E.E., and S.M. Young. 2002. Noteworthy plants reported from the Torrey Range – 2001. The Journal of the Torrey Botanical Society 129(4): 363–371.

Philips, L. October 2001. Be an urban tree troubleshooter. Landscape Management. 44-47.

Schuler, S. 1977. Simon and Schuster's Field Guide to Trees. P. 139.

Swearingen, J. 2006 Weed-US: Database of Plants Invading Natural Areas in the U.S. http://www.nps.gov/plants/alien/list/WeedUS.xls

The Nature Conservancy, California Regional Office. April 2000. *Phellodendron amurense* Element Stewardship Abstract Report (prepared by Tunyalee Martin). Arlington, Virginia. Available online at http://tncweeds.ucdavis.edu/alert/alrtphel.html. (Downloaded August 15, 2003).

University of Illinois Extension. 2003. Illinois plant, landscape and nursery technology: Amur Corktreee. Available online at http://www.extension.uiuc.edu/IPLANT/plant_select/arboretum_trees/Amur_Corktree.htm (downloaded December 10, 2003).

Urban Horticulture Institute. 2003. Recommended Urban Trees: Site Assessment and Tree Selection for Stress Tolerance. Ithaca: Cornell University. Available online at http://www.hort.cornell.edu/department/faculty/bassuk/uhi/outreach/recurbtree/index.html (Downloaded December 5, 2003).

USDA Forest Service, Southern Region and Southern Research Station, and the Southern Group of State Foresters. 2003. "Urban Soils," from: Urban Forestry: A Manual for the State Forestry Agencies in the Southern Region. Available online at http://www.urbanforestrysouth.org/pubs/ufmanual/soils/index.htm (Downloaded December 10, 2003).

USDA, NRCS. 2002. *Phellodendrum amurense* Rupr. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Yiesla, S.A., and F.A. Giles. 1992. Shade Trees for the Central and Northern United States and Canada. Champaign: Stipes Publishing Company. pp.157-158.

Yoshida, T. and T. Kamitani. 1999. Growth of a shade-intolerant species, *Phellodendron amurense*, as a component of a mixed-species coppice forest of central Japan. Forest Ecology and Management 113(1): 57-65.

Wenskus, Tim. 2002. 2002 Annual Report City of New York Parks and Recreation Natural Resources Group Forest Restoration Team.