



Galax

Galax urceolata

An Annotated Bibliography

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Galax (*Galax urceolata*)

is an important product in the international floral industry.



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Abstract

Galax (*Galax urceolata*) is an evergreen groundcover harvested for use in the floral industry. The plant's durable, shiny green leaves turn red in the fall and are popular background foliage in floral arrangements. People living in the mountains of North Carolina and other rural Appalachian locations have harvested (pulled) galax to supplement their incomes since before the 20th century; however, over the last decade, Hispanic laborers have largely displaced local harvesters. Today, more than 90 percent of the harvesters are of Hispanic origin. An experienced harvester can pull approximately 5,000 leaves a day; the value of this amount can range from \$20 to \$120. Prices vary depending on the season, the size and color of the leaves, and market demand. Industry concern for the availability or sustainability of galax has prompted the USDA Forest Service to restrict the harvest season. Since 2001, no harvesting is allowed from May 1st through June 15th when new leaves are emerging. The USDA Forest Service and the National Park Service are both conducting research to determine sustainable harvest levels.

Keywords: Conservation, floral industry, galax, nontimber forest products, poaching.

Nomenclature

Galax (*Galax urceolata*), a member of the Diapensiaceae family, is a fairly common evergreen perennial that occurs throughout the Central and Southern Appalachian Mountains. In the floral industry, the plant is known as galax, though wildflower enthusiasts and landscapers also use the common names wandflower or beetleweed (Encyclopaedia Britannica 2003, Fern 1997–2000). The recognized scientific name is *Galax urceolata* (Poir.) Brummitt, though in older literature the plant is occasionally referred to as *G. aphylla* auct. non. L. or *G. rotundifolia* (Evans 2000, Reed 1999–2002).

Botany and Ecology

Galax is an herbaceous groundcover with glossy green, leathery, heart-shaped leaves (fig. 1). Leaves have a serrate margin and a 3- to 5-inch diameter when mature. Each leaf has a thin, 3- to 6-inch-tall stem (Anon. 1983, Reed 1999–2002). In late spring and early summer, the plants produce small white flowers on a raceme that can reach 20 inches tall (Appalachian State Museum 2003, Reed 1999–2002, Slaby 2002). Roots consist of horizontal rhizomes (Anon. 1983).



Figure 1—Galax plant (Britton and Brown 1913).

The ideal galax habitat is a cool, moist site with partial shade and acidic soil with high organic content (Anon. 1983, Evans 2000, Fern 1997–2000), though plants can be found thriving in various habitats, including dry chestnut oak (*Quercus prinus*) forests or high-elevation red oak (*Q. rubra*) forests.¹

The NatureServe Explorer (2002) database indicates that the range of galax extends north into Maryland and West Virginia, west to Kentucky and south through the Appalachian Mountains to Georgia and Alabama (fig. 2). The species is considered exotic in Massachusetts, New York, Ohio, and the District of Columbia and is not known to occur north of Maryland and West Virginia (NatureServe Explorer 2002, Sorrie and Somers 1999). In North Carolina, where it seems to be most prevalently collected, galax can be found throughout the State but prefers the mountains in the western region. Plants are hardy in zones 5A to 8A (Horticopia, Inc. 2001). The global heritage status rank is G5, and the national heritage status rank is N5, meaning that galax is currently secure within its range (NatureServe Explorer 2002).

Galax can be propagated by root division or by seed. Divided rhizomes should be planted in early fall or spring by positioning them horizontally, approximately 1 inch below the soil surface (Anon. 1983, Slaby 2002).

¹ Personal communication. 2003. Gary Kauffman, Botanist Forest Products Specialist, USDA Forest Service, National Forests in North Carolina, Asheville, NC 28804.

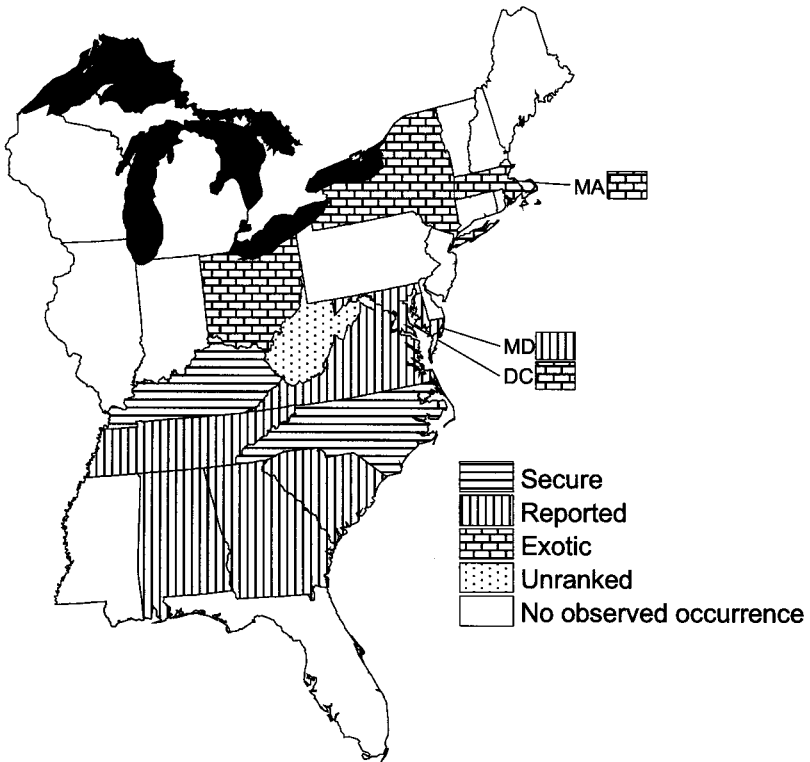


Figure 2—Galax distribution and conservation status [adapted from NatureServe Explorer (2002) and U.S. Department of Agriculture, Natural Resource Conservation Service (2001)].

According to Fern (1997–2000), seed should be sown in cold frames in early spring or fall and then planted out in the second year after the plants have hardened off. In North Carolina, Bir and Deyton (n.d.) have conducted research into propagation methods for large-scale cultivation. Their results show that rhizome cuttings were more successful sprouting leaves and roots when soaked in room-temperature water overnight before planting. Treatments with various concentrations of rooting hormones did not affect the number of leaves and roots that were produced but did lead to an increase in the size of roots 6 months after planting. Propagation by seed was recommended as more practical than rhizome cuttings for large-scale cultivation. Transplants require organic matter such as old sawdust or crushed leaves and shade cloth in order to thrive.

Several studies have examined the genetic makeup of the species, particularly the natural occurrence of three cytotypes (number of

chromosome sets): diploids with two sets of chromosomes, triploids with three sets of chromosomes, and tetraploids with four sets of chromosomes (Burton 1999, Burton and Husband 1999, Nesom 1983). Diploids are the most common cytotype, and triploids are the least common. Nesom (1983) suggests that throughout the Blue Ridge escarpment (southwestern Virginia, western North Carolina, eastern Tennessee, and northern Georgia), diploids are more common in xeric areas, and tetraploids are more common in mesic areas. Research by Burton and Husband (1999) found that populations along the Blue Ridge that consisted of all one cytotype tended to be diploid or tetraploid, but never triploid. Populations that were a mix of two or three cytotypes varied in composition, but triploids were always in the minority. Although all three cytotypes were found throughout the Blue Ridge Mountain Range, diploids were more commonly found in the northeast and less in the southwest. These findings indicate that there is chromosome selectivity in reproduction, and that both genetic and ecological factors contribute to cytotype abundance and occurrence (Burton and Husband 1999).

One of the distinguishing characteristics of galax is its odor (Amoroso 2002, Appalachian State Museum 2003). Many people comment that the plants smell like skunk or mold. According to Amoroso (2002), the source of the odor is still unknown. Speculation has linked it to chemical compounds—long sulfur chains such as mercaptan or butyl-thiols (which are similar to the chemicals found in a skunk’s scent) emitted from the stomata or from the decomposing leaves.

Another distinguishing factor, one that makes galax particularly popular with the floral industry, is the burnt red color that the leaves turn in late fall (Noland 1997). This color, which can be described as red, bronze, purple, or brown, is caused by the presence of the pigment anthocyanin. Only the leaves or portions of leaves that are exposed to sun will produce enough anthocyanin to change color when temperatures drop in the fall and winter. Neufeld (2002) explains this phenomenon, stating that unlike tree leaves, which change color in the fall due to a loss of chlorophyll, the chlorophyll levels in galax leaves remain the same whereas anthocyanin levels increase. He suggests that the increase in anthocyanin may help protect leaves from cold temperatures and offers several hypotheses about the chemical processes and mechanisms for this adaptation.

Uses

Galax is in high demand in the floral industry because its attractive shiny leaves are sturdy and can be stored for weeks, even months (Noland 1997).

Leaves with deep red colors harvested in the fall and winter command a higher price than green leaves; however, red leaves stored in a dark cooler will lose their red color and change back to green.² Single rounded or heart-shaped leaves are preferred in floral arrangements as background foliage (Noland 1997). Leaves may also be hot-glued onto a plastic tray or wrapped to make a “floral rose.” Leaves are sometimes sown together to form tablecloths for weddings or blankets for funeral caskets.²

Galax plants can also be used in landscaping, particularly in areas that are damp and shady or prone to erosion (Anon. 1983). Galax has been cultivated in plant nurseries since the late 1800s (Smithsonian Institute Libraries 2001), though it is infrequently used and not cultivated on any large scale.²

Native Americans used galax to heal cuts and treat kidney ailments and nervous conditions, though these medicinal uses are not common today (Fern 1997–2000, Hamel and Chiltoskey 1975).

Social History

The name galax comes from the Greek word “gala,” meaning “milk,” in recognition of the plant’s raceme of white blooms (Galax-Carroll-Grayson Chamber of Commerce, n.d.). In the early 1900s, small towns located in the center of the galax industry in southwestern Virginia and northwestern North Carolina relied on the sale of galax leaves for their support. According to one legend, an official from the Norfolk and Western Railway Company who observed this suggested that one of the towns be named Galax. In 1906, the Virginia General Assembly officially chartered the town of Galax, VA (Anon. 2000).

People living in the mountains of North Carolina and other rural Appalachian regions have harvested galax to supplement their incomes since before the turn of the 20th century (Guerrant 1910). Today, many galax pickers are Hispanic. Galax dealers suggest that the first Hispanics arrived in western North Carolina in the late 1980s. According to Greenfield and Davis,² area nurseries hiring Hispanic laborers encouraged them to harvest galax in the off-season. Greenfield and Davis² suggest that during the last 10 years, the Hispanic community has grown approximately 500 percent in

² Greenfield, J.; Davis, J. 2003. Western North Carolina nontimber forest products. 81 p. plus appendices. Draft final report. On file with: USDA Forest Service, Southern Research Station, 1650 Ramble Road, Blacksburg, VA 24060.

Yancey County, NC, alone. Although no one knows the exact number, estimates suggest that this ethnic group now makes up 90 percent of the galax harvesters. Tensions and conflicts between recent immigrant harvesters and long-time residents have been reported (see footnote 2).

Market Trends

In the early 1900s, pickers received from \$0.15 to \$0.25 per 1,000 galax leaves (Guerrant 1910). In comparison, harvesters received approximately \$10.00 per 1,000 leaves in July 2002 (see footnote 2). Galax wholesalers typically bundle 25 leaves together and pack the bundles in boxes designed to hold either 2,500 or 5,000 leaves (Ronald Jones Ferneries, n.d.; Sluder Floral Company, n.d.; United Galax, n.d.). In July 2002, harvesters received around \$0.01 to \$0.02 per leaf, or \$50 per box of 5,000 leaves (see footnote 2). In 2001, the highest price paid to harvesters was around \$80 per box of 5,000 leaves, whereas the lowest price was around \$20 per box (see footnote 2). According to the U.S. Department of Agriculture (2002), the price at the terminal market in Philadelphia ranged from \$0.85 to \$1.25 for a bunch of 25 leaves. A Florida-based wholesale mail-order company recently priced galax at \$2.25 per bundle of 25 leaves (see footnote 2). According to data from an Internet search of wholesalers we conducted in 2002, the prices for landscape plants sold in pots varied from \$3.90 for a 5-inch pot to \$4.50 for a half-gallon pot (Eastern Plant Specialties, n.d.; Fraser's Thimble Farms, n.d.; Gardens of the Blue Ridge, n.d.; Rock Island Wildflowers, n.d.; Shooting Star Nursery, n.d.).

In July 2002, 11 galax dealers were identified in North Carolina. This number had declined to nine as of January 2003 (see footnote 2). The decrease in the number of dealers is indicative of the industry's fluctuation; firms move into and out of the market fairly regularly. Most of the dealers are located in Yancey and Avery Counties, NC. Interviews with dealers in North Carolina revealed that most of the harvest occurs in nine counties: Ashe, Avery, Buncombe, Madison, McDowell, Mitchell, Transylvania, Watauga, and Yancey with some harvest also observed in Jackson and Macon Counties. The dealers indicated that most of the harvesting takes place on public lands (see footnote 2).

Conservation

Concern for the conservation of galax has been raised in a number of forums. The popular press has covered galax on several occasions (Ellison

2002, Nickens 2001, Ostendorff 2001, Stroupe 2002), focusing primarily on harvesting pressures, poaching problems, and the restricted harvest season.

Annual timber theft activity reports from the USDA Forest Service indicate a severe problem with galax poaching in the national forests of North Carolina. For example, although the 2001 report does not give a specific count of galax theft incidents, it does suggest that almost all of the 203 forest product theft occurrences involved galax or American ginseng (*Panax quinquefolius*) (Gregory 2001).

In 2001, the National Park Service reported several incidents on the Blue Ridge Parkway that resulted in arrests of poachers. According to Garrison (2001a), in February 2001 approximately 17,800 galax stems with an estimated value of around \$800 wholesale or \$4,000 retail were seized in one incident. The poacher received a sentence of 45 days in prison and 2 years probation. Several additional incidents of galax poaching and arrests occurred throughout the year with as many as 14 individuals arrested and over 60,000 stems confiscated. Individuals were required to appear in court and pay fines or serve jail sentences based on the severity of the crime and the individual's history (Garrison 2001a–2001d). The same year, four galax poachers were apprehended on private land at Grandfather Mountain in North Carolina (Anon. 2001).

Although galax collection is illegal on the Blue Ridge Parkway and other national park lands, it is legal to harvest on portions of national forest land with a permit. The U.S. Department of Agriculture Forest Service (1991) lists galax as an “other forest product” in its list of salable products. According to a report by Robbins (1999), 459 galax permits were sold in 1995, 630 in 1996, and 544 in 1997 for the Cherokee (TN), Pisgah (NC), and Nantahala (NC) National Forests. The majority of these permits were sold in the Pisgah National Forest. Discussions with Forest Service botanists indicate an increasing trend in permit issuances over the last 5 years.

In 2001, as a result of the increased harvest pressure and concerns from industry members about the sustainability of galax resources, the USDA Forest Service implemented a seasonal harvest restriction. No galax harvest is permitted between May 1 and June 15 when new leaves are emerging and are particularly susceptible to damage from trampling. Prohibiting galax harvest during this period does not reduce the number of leaves available for harvest; it simply protects the immature young leaves and therefore increases the ability of plant populations to recover from the disturbance caused by harvesters (Bradley and Seyden 2001). In recent interviews, several dealers indicated that a longer restricted season would be warranted.

Two public agencies that manage forest lands in North Carolina—the National Forests of North Carolina (NFNC) and the National Park Service (NPS)—have initiated projects to examine the impact of harvesting. The NFNC has proposed a study to determine the growth and yield of several nontimber forest products including galax (Kauffman and others 2001). The foundation for the study was the recognition that there had been a major increase in the issuance of galax permits over the previous 5 years, particularly to new individuals who may not use traditional low-impact harvest methods. There are concerns that patches of galax are being stripped of large leaves faster than the rate of regeneration (Kauffman and Danley, n.d.). No results are yet available from this study, but informal monitoring has been done. The authors recommend that annual checks be made in the spring to determine if the harvest season needs to be modified.

The NPS has also started studying the impact of harvesting on galax populations. In the first year of the study, Ulrey (2001) established thirty-two 1-meter-square permanent sample plots along the Blue Ridge Parkway. Locations for these plots were selected based on three criteria: no evidence of collection, remote or inconspicuous locales, and well-developed patches. As many large leaves (> 3 inches in diameter) as possible were harvested from selected plots. Removal rates were calculated by comparing the number of harvested leaves to the number of leaves retained in each plot. Although insufficient time has passed to provide definitive results, discussions with the principal investigator of this project indicate that harvesting is not having a significant impact on these populations.

To deter poaching on national park land, the NPS has implemented a tagging/marking program for several nontimber products including galax. Under the program, galax plants are sprayed with an adhesive and then dusted with microtaggant, a six-layer polymer that bears a “signature” coding. Using this method, plants in areas where harvesting is illegal are marked and can be tracked back to their source if they are collected and sold. This program is also being implemented on USDA Forest Service lands that do not allow harvest, such as designated wilderness and special interest areas (see footnote 2) (Nickens 2001).

The rising use of unsustainable harvest methods has also increased conservation concerns. Traditional galax harvesters pulled or cut leaves from the plants individually, leaving the rhizomes in the ground undisturbed. This method of harvest is time consuming but decreases the damage done to plants and allows for regeneration for future harvests. Most harvesters today opt to pull up whole plants by the roots and rhizomes for a

quick large-scale harvest, severely damaging plant populations in the process (see footnote 2).

A few efforts have been made by the North Carolina State Extension Service to educate pickers. Deyton (2001), an agricultural extension agent in Yancey County, NC, has prepared an instructional bulletin that provides details about obtaining a permit for collection on Forest Service lands, desired leaf qualities, and picking techniques. Under the current policy, USDA Forest Service permits cost \$25 and are good for 30 days or 100 pounds of galax leaves. Harvested leaves should be at least 3 inches in diameter with 3 inches of stem and no roots attached. Deyton provides additional recommendations for harvesting and packaging, including desired leaf qualities and bundling procedures.

Discussion

The information available on galax is primarily focused on botany and ecology, particularly the distribution and ecological preferences of the plant. Although less is known about the social, economic, and market dynamics that affect the species, there is a growing body of knowledge and experience. Traditionally harvested by local mountain residents, galax is now mostly collected by Hispanic laborers. In some cases, this has increased tensions between community members and may have resulted in more illegal harvesting. Although some harvesters depend on the sale of galax as their primary source of income, most use the revenues to supplement income from other sources. Most galax is harvested from nine counties in western North Carolina; about nine wholesale enterprises located in the area buy leaves, most of which are exported to Europe for the floral industry.

There is a general lack of information about the impact of harvest on galax or associated species. Both the USDA Forest Service and the NPS are examining these issues and trying to determine sustainable harvest levels, though these studies have just gotten underway and have not generated sufficient data to draw conclusions. In general, forest managers and botanists are concerned about the impact of harvesting; however, many agree that there is not enough information to definitively state that harvesting is having a negative impact on plant populations. Many forest managers believe that although harvesting may be impacting local populations, little, if any, impact has occurred throughout the range of the species.

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Research Literature

Amoroso, J. 2002. Wild ideas: the odor of galax. *Chinquapin*. 10(2): 12.

Reviews speculations by several professionals about the source of the strange smell associated with galax leaves. Common ideas for the origin of the musky odor include bacteria or fungi associated with the roots or leaf decay. Neither the exact source of the odor nor the chemicals that cause the odor are known. Individual leaves, when collected or crushed, do not have the odor. Dr. Howard Neufeld, a plant physiologist at Appalachian State University, set up a carbon trap to determine if the volatile compounds causing the odor were amine or selenium. No definitive results were obtained, so Dr. Neufeld developed a new hypothesis that the odor comes from sulfur compounds such as mercaptan. Alice Zawadzki, Professor Emeritus of chemistry at St. Mary's College, finds the odor similar to that of a skunk and proposes a similar chemistry involving butyl thiol or some other thiol (skunk odor is n-butyl mercaptan or a butyl-thiol compound). These compounds have a low vapor pressure and stay low to the ground, yet increase diffusion as temperatures rise in August. Long-chain sulfur compounds produce no smell in living leaves, but, as dead leaves decompose, these compounds would be broken down and released causing the skunky odor.

Keywords: Chemical constituents, odor, research.

Bir, D. 2001. How many galax leaves in a pound? 1 p. Unpublished data. On file with: Mountain Horticultural Crops Research and Extension Center, 455 Research Drive, Fletcher, NC 28732.

Summarizes packaging information from United Galax, a galax distributor. Leaves are bundled into bunches of 25 and packed in boxes in three separate grades: Brown, Purple, and Special. Galax leaves per pound: Brown- 329; Purple- 212; Special- 174.

Keywords: Floral uses, packaging.

Bir, D.; Deyton, C. [N.d.]. Domesticating galax. http://www.cals.ncsu.edu/specialty_crops/pubs/bir.html. [Date accessed: January 2, 2004].

Summarizes research on galax cultivation techniques. Transplants require organic matter and shade in order to thrive. Seeds do not require scarification or stratification. Rhizome cuttings are more successful when soaked in room-temperature water overnight before planting. Various concentrations of rooting hormones showed no effect on the number of leaves and roots produced by rhizomes, though rhizomes that had been treated with hormones had larger root systems than untreated rhizomes 6 months after planting. No positive results were observed from tissue culture experiments. The authors conclude that propagation by seed is more practical than rhizome cuttings or tissue culture for large-scale cultivation.

Keywords: Cultivation, propagation, research, rhizomes, seeds, tissue culture.

Burton, T. 1999. Polyploidy establishment in *Galax urceolata*. University of Guelph, Ontario, Canada: Plant Population and Evolution Research Laboratory. 1 p. <http://www.uoguelph.ca/botany/research/evollab/galexpr.htm>. [Date accessed: January 2, 2004].

Describes doctoral research on the evolution, reproduction, and physiology of polyploidy in natural populations of galax.

Keywords: Cytotypes, polyploidy, research.

Burton, T.L.; Husband, B.C. 1999. Population cytotype structure in the polyploid *Galax urceolata* (Diapensiaceae). *Heredity*. 82: 381-390.

Summarizes the results of research on the distribution and abundance of diploids, triploids, and tetraploids in various natural galax populations. The ranges for the various cytotypes overlap in the Blue Ridge Mountains. Of the groups studied, about a third include two cytotypes, 40 percent contain only one, and 26 percent contain three. Diploids are more common in the northeastern part of the range and less common in the southwest. If triploids are present, they are always a minority in number and never found in single cytotype populations. Diploids or tetraploids are dominant in most populations, though the distribution is not evenly mixed and suggests a disruptive chromosome selection in reproduction. These results suggest that both genetic and ecological variables determine cytotype abundance. Details on previous research and theories, sampling methods, results, and discussion are included, along with a distribution map and tables.

Keywords: Cytotypes, distribution, polyploidy, research.

Gregory, J.L. 2001. Annual timber protocol report – region 8. 22 p. Administrative report. On file with: U.S. Department of Agriculture, Forest Service, Southern Research Station, 1650 Ramble Road, Blacksburg, VA 24060.

Reports a total of 203 forest product theft incidents in 2001. The exact number of incidents involving galax is not specified, though the report indicates that the majority of the thefts involved galax or American ginseng (*Panax quinquefolius*). The estimated value of forest product thefts in 2001 was \$322,250.

Keyword: Poaching.

Kauffman, G.; Danley, D. [n.d.]. Restriction on galax gathering season. Unpublished report. 4 p. On file with: U.S. Department of Agriculture, Forest Service, Southern Research Station, 1650 Ramble Road, Blacksburg, VA 24060.

Suggests the need to restrict galax harvest during the spring, based on research into the galax life cycle. Galax has been harvested in the Southern Appalachians for the last century; the leaves are gathered year-round and used in floral decorations and wreaths. Details are given on the botanical characteristics, polyploidy types and habits, and growth range. Galax is considered to be secure, with a global heritage status rank of G5. When young leaves are emerging in spring, they are more susceptible to damage from trampling because they have not had a chance to harden off. Damage during the spring period can have long-term effects, reducing regeneration

after disturbance. Galax patches should be monitored over the next several years to assess the effectiveness of the harvest restriction.

Keywords: Conservation, harvest restriction, monitoring.

Kauffman, G.L.; Danley, D.; Simon, S.A.; McNab, W.H. 2001.

Experimental harvest of Fraser-fir, log moss, and galax: determining growth and yield. In: Kauffman, G., comp., ed. Forest botanical products program of work: maintaining sustainability and responding to socio-economic needs in the Southern Appalachians. [Place of publication unknown]: National Forests of North Carolina. 31 p.

Emphasizes the need to research galax in North Carolina forests, where, since the late 1980s, the national forests have sold more permits for gathering galax than for any other botanical product. Due to an increase in the number of permits sold and the growing number of new “pullers” who are not using conservative methods to collect leaves, it is necessary to restrict the harvest season during the spring when new growth is emerging. Gatherers and researchers are concerned that patches of galax are being stripped of large leaves faster than they can be replaced and that current harvest levels are not sustainable. More research is needed to determine the ability of galax populations to withstand the increasing harvest pressures. Details are given on the plan to establish long-term monitoring plots and expose them to various harvest levels and techniques to determine the limitations for sustainable practices.

Keywords: Harvest, permits, research, sustainability.

Nesom, G.L. 1983. Galax (Diapensiaceae): geographic variation in chromosome number. *Systematic Botany*. 8(1): 1-14.

Investigates geographical distribution of diploid and tetraploid cytotypes in galax. Tetraploids are more abundant along the Blue Ridge escarpment region, though diploids are most abundant throughout the rest of the range. There is no definite difference in habitat preference for the cytotypes, though it appears that diploids are more common in xeric areas, and tetraploids are more common in mesic areas of the Blue Ridge escarpment. A detailed background, materials and methods, results, and discussion are provided along with several tables and distribution maps.

Keywords: Cytotypes, distribution, polyploidy, research.

Neufeld, H.S. 2002. The role of anthocyanin in winter: inquiry responses. *Chinquapin*. 10(1): 1-2, 5.

Discusses anthocyanin production, the process that causes green galax leaves to turn reddish hues in winter. Anthocyanin is a red pigment found in many flowers, fruits, and leaves as they change color in fall. Unlike other red pigments such as carotenes and betalains, anthocyanins change color with variations in pH. Exposure to sun is also necessary for anthocyanin production; leaves or portions of leaves that are shaded will remain green. In the leaves of most trees that turn red in the fall, the color change is a result of chlorophyll loss; in galax, however, chlorophyll levels remain the same while anthocyanin levels increase. The benefits of this process are unknown, but there are several hypotheses. The rise in levels of anthocyanin may protect leaves against low-temperature photoinhibition (a problem caused by low temperatures and high light levels) by lowering photosynthesis rates, reducing light compensation points, and protecting sensitive tissues against damaging ultraviolet radiation. Anthocyanin may also act as an antioxidant, reducing reactive oxygen radicals produced in cold winter temperatures. Lastly, it may enhance cold tolerance, possibly by lowering the freezing point of cell sap. These various chemical processes are discussed in detail, along with the adaptive purposes and suggested evolutionary roles.

Keywords: Anthocyanin, leaf color, research, sun requirements.

Robbins, C. 1999. Medicine from U.S. wildlands: an assessment of native plant species harvested in the United States for medicinal use and trade and evaluation of the conservation and management implications. Prepared by TRAFFIC North America for the Nature Conservancy. <http://www.nps.gov/plants/medicinal/pubs/traffic.htm>. [Date accessed: January 2, 2004].

Discusses conservation issues for several valuable plants. Permits sold for galax in the Cherokee (Tennessee), Pisgah, and Nantahala (North Carolina) National Forests totaled 449 in 1995, 630 in 1996, and 548 in 1997.

Keywords: Conservation, harvest, permits.

Sobieraj, J.H.; McCarron, J.K.; Neufeld, H.S. [n.d.]. Hydraulic properties of *Galax urceolata*, an evergreen, understory herb of the Southern Appalachians. <http://abstracts.allenpress.com/esa/web2000/abstracts/HOW-3-32-21.html>. [Date accessed: January 2, 2004].

Investigates the mechanisms for drought tolerance in galax leaves. Galax has shallow roots and can experience drought conditions when soils dry out between rains. Each leaf persists for 2 years, and plants consist of mixed leaf-age classes. Details are given for experimental measurements of water conductivity in both young and old leaves. No differences were found between the first- and second-year leaves. Galax plants were able to maintain water flow to leaves even under severe drought conditions.

Keywords: Drought tolerance, research, water requirements.

Soltis, D.E.; Bohm, B.A.; Nesom, G.L. 1983. Flavonoid chemistry of cytotypes in galax (Diapensiaceae). *Systematic Botany*. 8(1): 15-23.

Investigates the chemical structure of galax in relation to cytotype. No significant differences in flavonoid levels are found among the diploid and tetraploid cytotypes, suggesting autopolyploid origins for the tetraploid cytotypes. Detailed materials and methods, results, and discussion are included along with several tables.

Keywords: Chemical constituents, cytotypes, flavonoids, research.

Ulrey, C. 2001. Summary of first-year (2001) results from galax removal study. Blue Ridge Parkway, National Park Service. 4 p. Unpublished report. On file with: U.S. Department of Agriculture, Forest Service, Southern Research Station, SRS-4702, 1650 Ramble Road, Blacksburg, VA 24060.

Summarizes the first year of a study on the impact of galax harvest. Using remote locations along the Blue Ridge Parkway, researchers established sample plots in well-developed galax patches that showed no signs of previous harvest. Plots were harvested (pulling leaves by the petiole) and the remaining plants counted to determine removal rates. Several unharvested control plots were established for comparison. Results from the first year showed that although harvest targeted larger leaves, many roots, rhizomes, and smaller leaves were inadvertently pulled also. This may affect the ability of the plants to re-establish. The plots will be monitored annually until complete regeneration is achieved.

Keywords: Blue Ridge Parkway, conservation, harvest, monitoring, research, sustainability.

Popular Press

The following articles and websites have not been peer reviewed, but are included to indicate popular views and perceptions.

Anon. 1983. Wandflower shines in the shade. *Southern Living*. 18: 67.

Provides guidelines for using galax in the landscape. Called by the common name wandflower, the glossy leaves of this groundcover add color and texture, particularly in damp, shady areas. Each leaf is rounded, finely toothed, on a stem that reaches up to 8 inches in height. In spring and summer, leaves are a deep green color but change to bronze, red, and purple tones in winter. Plants spread by runners and can form dense colonies. The common name wandflower comes from the blooms, which are 12- to 18-inch-tall spikes with tiny white flowers. Suggested areas for wandflower include shady rock gardens, woodland gardens, around azaleas and rhododendrons (*Rhododendron* spp.), and on shady hillsides prone to erosion. In the northern parts of its range, the plant can tolerate partial sun. Galax can be propagated from seeds sown in a cold frame in fall or from rhizomes planted and mulched in fall or spring. Specific details are provided on soil requirements, propagation, and cultivation.

Keywords: Cultivation, flowers, habitat, landscape uses, leaf color, propagation.

Anon. 2000. Galax, VA: a small Appalachian town steeped in music. Galax-Carroll-Grayson Chamber of Commerce. Parkway Milepost. Spring: 9.

Summarizes the history and other special interests for the town of Galax, Virginia. This article reveals that the large trade in galax leaves supported several small towns in the area and was the origin of the town name. In 1905, an official from the Norfolk Railway Company suggested naming the town Galax after seeing railway cars at the depot full of the glossy green leaves ready to be shipped all over the country.

Keywords: Galax, Virginia; history.

Anon. 2001. Galax: a pretty problem. *The Grandfather Journal*. February 23, 2001. [Not paged].

Comments on the problem of galax poaching on Grandfather Mountain in North Carolina. In 2001, four poachers were caught taking galax from Grandfather Mountain. It is believed that many others have taken galax

without being caught. Grandfather Mountain is private property, and individuals who remove galax are subject to prosecution.

Keywords: Grandfather Mountain, poaching.

Appalachian State Museum. 2003. Galax. Kimberly J. Hampton Steward memorial garden: the garden chronicles. <http://www.museum.appstate.edu/kimmem/galax/pages/galax.html>. [Date accessed: January 2, 2004].

Provides a brief description and picture of galax. Galax is a common groundcover throughout the Southern Appalachian Mountains. It is a member of the same family (Diapensiaceae) as Oconee bells (*Shortia galacifolia*) and Pixie moss (*Pyxidantha barbulate*). The heart-shaped, glossy green, leathery leaves are used by florists in Christmas decorations. Plants have a distinct musky odor.

Keywords: Diapensiaceae family, floral uses, odor.

Bradley, P.; Seyden, T. 2001. Spring harvesting of galax to be restricted. National Forests in North Carolina News Release. February 28, 2001. http://www.cs.unca.edu/nfsnc/press/galax_release.htm. [Date accessed: January 2, 2004].

Announces the restriction of the galax harvest season during the spring months of May 1 through June 15 due to concerns that harvesting during this time can damage newly emerging leaves, thus reducing regeneration. The U.S. Forest Service implemented this restriction in response to concerns raised by galax buyers and wholesalers about the sustainability of galax harvesting and the future of the industry. The dates chosen for the restriction are believed to protect plants at both low and high elevations where leaves mature at different times. This restriction does not reduce the number of leaves available for harvest, but protects young leaves from being trampled and allows them to harden off so that they are better able to recover from the disturbance of harvesting.

Keywords: Conservation, floral industry, harvest restriction, sustainability.

Deyton, C. 2001. Procedures for harvesting and selling galax. 1 p. Unpublished document. On file with: North Carolina Cooperative Extension Service, Yancey County, 10 Orchard Dr., Burnsville, NC 28714.

Outlines procedures and regulations for individuals harvesting galax from public lands. Details are given for obtaining a permit from the U.S. Forest

Service to harvest in Yancey, Avery, and Mitchell Counties in North Carolina. The permit costs \$25.00 and is good for 30 days or 100 pounds of galax. Leaves should be 3 inches or larger and should be pulled with 3 inches or more of stem attached, but no roots. Leaves should be neatly stacked face-up and tied in bunches of 25. Two hundred bunches are then grouped into one box (5,000 leaves). Boxes should be kept cool until sold. The Cooperative Extension Service offers more information including a list of buyers.

Keywords: Harvest, packaging, permits, regulations.

Ellison, Q. 2002. Galax harvest halted for spring. Asheville Citizen-Times. Monday, June 17. <http://www.citizen-times.com/news/03121098.shtml>. [Date accessed: January 2, 2004].

Announces the restriction of the galax harvest season during the spring months of May 1 through June 15.

Keywords: Harvest restriction, media coverage.

Galax-Carroll-Grayson Chamber of Commerce. [n.d.]. The galax leaf. <http://www.gcgchamber.com/leaf.htm>. [Date accessed: January 2, 2004].

Highlights the popularity and importance of galax in southwest Virginia. The name galax is derived from the word “gala,” Greek for “stream of milk,” which the plant’s white blooms resemble. Galax is used in the floral industry and has been an important part of the economy around the town that bears its name—Galax, VA.

Keywords: Floral industry, Galax, Virginia; history, nomenclature.

Garrison, J. 2001a. Blue Ridge Parkway (NC/VA) - poaching arrests. National Park Service Morning Report. Friday, February 9: 01-044. <http://data2.itc.nps.gov/morningreport/archives.cfm>. [Date accessed: January 2, 2004].

Reports arrests of galax poachers on the Blue Ridge Parkway. One poacher was arrested with 17,800 galax stems from the Pisgah District. He pleaded guilty and was sentenced to 45 days in prison and 2 years probation. The value of the galax was \$800 wholesale or \$4,000 retail. Several days later, a citizen tip led to the arrest of five galax poachers in the Highlands District; 2,700 stems were seized at the time of the arrest.

Keywords: Blue Ridge Parkway, poaching.

Garrison, J. 2001b. Blue Ridge Parkway (NC/TN) - poaching arrests. National Park Service Morning Report. Wednesday, February 14: 01-050. <http://data2.itc.nps.gov/morningreport/archives.cfm>. [Date accessed: January 2, 2004].

Reports galax poaching on the Blue Ridge Parkway. On one occasion, two rangers found a group of poachers in the Pisgah District. The group escaped, and rangers confiscated the 20,000 stems left behind. Several days later, five poachers were apprehended with 20,000 stems on the parkway. At the time of the report, they were scheduled to appear in Federal magistrate's court in Asheville, NC.

Keywords: Blue Ridge Parkway, poaching.

Garrison, J. 2001c. Blue Ridge Parkway (NC/VA) - galax theft convictions. National Park Service Morning Report. Monday, August 13: 01-440. <http://data2.itc.nps.gov/morningreport/archives.cfm>. [Date accessed January 2, 2004].

Reports the conviction of galax poachers on the Blue Ridge Parkway. Two poachers were arrested on the parkway with 7,500 galax stems. They were found guilty in court and fined \$1,200; one man received a 30-day prison sentence. The two men had previous records for various crimes. On another occasion, a man was arrested on the parkway with several thousand galax stems. After conviction, he was sentenced to a 2-month jail sentence. He had two prior convictions for galax poaching.

Keywords: Blue Ridge Parkway, poaching.

Garrison, J. 2001d. Blue Ridge Parkway (NC/VA) - poaching arrests. National Park Service Morning Report. Friday, November 9: 01-596. <http://data2.itc.nps.gov/morningreport/archives.cfm>. [Date accessed: January 2, 2004].

Reports the arrest of galax poachers on the Blue Ridge Parkway. Two poachers were arrested with 7,500 galax stems on the parkway near Mount Mitchell in North Carolina.

Keywords: Blue Ridge Parkway, poaching.

Guerrant, E. 1910. The galax gatherers: the gospel among the highlanders. Richmond, VA: Onward Press. 220 p.

Gives a historical account of rural southerners. This 1910 text was written about small communities in the Appalachians and highlights galax gathering as a way for poorer individuals to earn money during winter months. The galax gatherers endured harsh weather conditions and strenuous labor to collect the small leaves that were used to decorate the houses of rich families in other cities. For their labor, gatherers received \$0.15 to \$0.25 per 1,000 leaves. Galax is only briefly mentioned in the text, which mainly focuses on the subjects of community and religion.

Keywords: Harvesters, history, market prices.

Hamel, P.; Chiltoskey, M. 1975. Cherokee plants: their uses – a 400-year history. Sylva, NC: Herald Publishing. 72 p.

Provides thumbnail sketches of traditional uses of herbs by the Cherokee people. Includes conversations with elders in Cherokee, NC, and an explanation of the spiritual relationship of the Cherokee with the environment.

Keywords: Ethnobotany, history, medicinal uses, traditional uses.

Nickens, T.E. 2001. Catching bandits in the Smokies. National Wildlife Federation. February/March. <http://www.nwf.org/nationalwildlife/article.cfm?articleId=310&issueId=65>. [Date accessed: January 2, 2004].

Reports on the poaching problem for several valuable plants found in the Great Smoky Mountains National Park. The article also discusses the actions taken by botanists and law enforcement to catch poachers and protect the plants with details on marking methods and tracking. Galax is marked with microtaggant, a powder originally used in the explosives industry. The approximate value of galax is 1 penny per stem. In the first 6 months of 2000, 100,000 galax stems were seized along the Blue Ridge Parkway.

Keywords: Blue Ridge Parkway, Great Smoky Mountains National Park, market prices, marking, microtaggant, poaching.

Ostendorff, J. 2001. Rangers crack down on galax poaching. Asheville Citizen Times. Feb 16: [Page number unknown].

Summarizes recent arrests and convictions of galax poachers and discusses the efforts of the U.S. Forest Service to deter poaching. Although it is legal to harvest galax with a permit on national forest lands, no harvest is allowed

on national park lands. Galax on national park lands is being tagged so that it can be traced back to the source. It is estimated that an individual can pick 2 boxes per day at 5,000 stems per box with a retail value of \$110 per box. Most florists only buy from established dealers to avoid illegally harvested leaves.

Keywords: Harvest, marking, media coverage, poaching.

Stallard, G.J. 1997. *Galax aphylla* – Diapensiaceae family. The Appalachian Quarterly. 2(3): 71.

Gives a general description of galax with ecology, habitat, and floral usage.

Keywords: Ecology, floral uses, habitat.

Stroupe, N. 2002. Restrictions placed on spring harvesting of galax. The Mountain Times. March 21. [Page number unknown].

Announces the restriction of the galax harvest season during the spring months of May 1 through June 15. The galax industry is important in the Southern Appalachian Mountains. Most of the modern harvesters are Hispanics who come to the area to work for Christmas tree growers and pull galax for money in the off-season. Leaves keep their deep color and pliable texture for many months, making them desirable in the floral industry. One company in western North Carolina ships galax as far as California and Europe. In the spring when young leaves are emerging, they are susceptible to damage from trampling. The harvest restriction will allow these new leaves to harden off, increasing the ability of the plants to regenerate after harvest. A forest ranger in the Appalachian District (including the Pisgah National Forest in parts of Yancey and Avery Counties) reported the sale of 500 permits per year for galax. Another ranger in the Grandfather District (also including the Pisgah National Forest in Avery and Watauga Counties) reported the sale of 300 permits per year. Local wholesalers process more galax than is allotted by the permit sales, indicating that there is illegal harvest occurring.

Keywords: Floral industry, harvest restriction, Hispanic harvesters, media coverage, permits, poaching, sustainability.

Other Information Sources

The following are general materials that provide background and reference information. Included are encyclopedias, fact sheets, historical documents, planting guides, herbal manuals, and other miscellaneous information.

Britton, N.L.; Brown, A. 1913. An illustrated flora of the Northern United States, Canada, and the British Possessions. Vol. 2. New York: Charles Scribner's Sons. In: U.S. Department of Agriculture, Natural Resources Conservation Service. 2001. The PLANTS database. Version 3.1. National Plant Data Center, Baton Rouge, LA 70874-4490 U.S.A. Available at <http://plants.usda.gov>. [Date accessed: April 26, 2004].

[No abstract].

Keyword: Botanical description.

Encyclopedia Britannica. 2003. Diapensiales. <http://www.britannica.com/eb/article?eu=30773>. [Date accessed: January 2, 2004].

Describes traits of the Diapensiales order. Characteristics of the evergreen shrubs and woody herbs found in this order include bisexual flowers with five sepals, stamens, and fused petals. The list of species includes galax, which has durable heart-shaped leaves commonly used in the floral industry.

Keywords: Diapensiaceae family, flowers.

Evans, E. 2000. *Galax aphylla*. Consumer Horticulture Plant Fact Sheets: wildflowers. Raleigh, NC: North Carolina State University. 1 p. http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/wildflowers/galax_aphylla.html. [Date accessed: January 2, 2004].

Provides brief growing requirements and a picture. Galax is a perennial best suited to cool, shady sites with moist soil. White blooms appear in late spring or early summer.

Keywords: Flowers, habitat.

Fern, K. 1997-2000. Plants for a future: the species database. http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Galax+urceolata&CAN=LATIND [Date accessed: May 24, 2004].

Details the habitat, usage and cultivation of galax. Also known as beetleweed, this perennial grows in acidic, moist soils of various types. The plant is mainly found in shaded areas, particularly woodlands and mountains, and is hardy to zone 5. Galax can be used medicinally to heal cuts and treat kidney troubles, though it is more commonly used as a ground cover with attractive leaves that turn a bronze-red color in winter. Propagation can be done by root division or by seed. Seeds are planted in a cold frame in spring or fall, then transplanted into their permanent spots in

the spring after their first year of growth. Plants should be kept moist, shaded, and mulched with pine needles or other organic matter.

Keywords: Cultivation, habitat, hardiness range, landscape uses, leaf color, medicinal uses, propagation, soil.

Horticopia, Inc. 2001. *Galax urceolata*. Horticopia Plant Information. <http://www.horticopia.com/hortpix/html/pc2571.htm>. [Date accessed: May 24, 2004].

Describes the environment needed to grow galax in the landscape. Plants do best in hardiness ranges 5A to 8A with full to partial shade and moist soil.

Keywords: Habitat, hardiness range, landscape uses, sun requirements.

NatureServe Explorer. 2002. An online encyclopedia of life [Web application]. Version 1.6. Arlington, VA: NatureServe. <http://www.natureserve.org/explorer>. [Date accessed: January 2, 2004].

Presents scientific analysis of conservation status. Galax has a global heritage status rank of G5 and a national heritage status rank of N5, meaning that it is secure within its range. Distribution maps are included.

Keywords: Conservation, distribution, global heritage status rank, national heritage status rank, range.

Noland, D. 1997. Galax leaves. Introduction to floral design: cut flower identification and use. <http://classes.aces.uiuc.edu/NRES107/galax.htm>. [Date accessed: January 2, 2004].

Provides general information on the use and handling of galax leaves for florists. Leaves have a long vase life and are available year round. Leaf color is green in spring and summer, and green with burgundy edges in winter. In floral designs, galax leaves are used as a colorful background, as an accent, or to frame the center of interest.

Keywords: Floral uses, handling, leaf color.

Reed, D. 1999-2002. Wildflowers of the Southeastern United States. <http://2bnthewild.com>. [Date accessed: January 2, 2004].

Describes the attractive characteristics of galax. This herbaceous perennial has 6-inch-wide heart-shaped basal leaves with rounded teeth on the margins. Tough and leathery, the leaves turn a reddish-brown color in

winter. The small white flowers have five parts and are on a single spike, appearing in late spring and early summer. Some plants have double chromosomes.

Keywords: Botanical description, flowers.

Slaby, P. 2002. *Galax urceolata*. Rock garden plant database. <http://web.kadel.cz/flora/c/kvCard.asp?Id=1051>. [Date accessed: May 24, 2004].

Gives brief details on galax cultivation. Leaves have a bronze tinge in winter. In spring and summer, plants produce a raceme of small white flowers. Propagation is done by seeds or by division of rhizomes in spring or fall. Plants grow best in a shaded, cool area with moist soil.

Keywords: Cultivation, flowers, habitat, propagation.

Smithsonian Institute Libraries. 2001. Kelsey, Harlan P. In: The American seed and nursery industry: biographies. Washington, DC: Smithsonian Institute Libraries. <http://www.sil.si.edu/SILPublications/seeds/kelseyharlan-p.html>. [Date accessed: January 2, 2004].

Provides a brief biography of Harlan Kelsey from North Carolina, supposedly the first person to cultivate galax in the 1870s.

Keywords: Cultivation, history.

Sorrie, B.; Somers, P. 1999. The vascular plants of Massachusetts: a county checklist. Westborough, MA: Massachusetts Division of Fisheries and Wildlife, Natural Heritage Program & Endangered Species Program. 187 p.

[No abstract].

Keyword: Distribution.

U.S. Department of Agriculture. 2002. Decorative greens and cut foliage. In: Philadelphia Wholesale Ornamental Crops Report. Fresno, CA: U.S. Department of Agriculture, Agricultural Marketing Service, Fruit and Vegetable Programs, Market News Branch. 25(24): 4.

Reports wholesale prices of cut flowers and florist greens in the Philadelphia area. The price for a bunch of 25 galax stems is listed as \$0.85 to \$1.25.

Keywords: Floral industry, market prices.

U.S. Department of Agriculture, Forest Service. 1991. Timber sale and preparation. Forest Service Handbook. FSH 2409.18. Chapter 80. http://www.fs.fed.us/cgi-bin/Directives/get_dirs/fsh?2409.18. [Date accessed: January 2, 2004].

Outlines regulations from the U.S. Forest Service manual for galax sales. If the sale complies with State and Federal plant protection laws, it is legal for forest officers to sell galax leaves. Other plants and sale regulations also are included in this manual.

Keywords: Harvest, regulations.

U.S. Department of Agriculture, Natural Resource Conservation Service. 2001. The PLANTS database. Version 3.1. Baton Rouge, LA: Plant Data Center. <http://plants.usda.gov>. [Date accessed: January 2, 2004].

Provides photographs and information on galax ecology, distribution and range, and conservation. Galax is a perennial dicot in the Diapensiaceae family. The native range includes Alabama, Georgia, Kentucky, Massachusetts, New York, North Carolina, Ohio, South Carolina, Tennessee, Virginia, and West Virginia. Links to additional maps include county-by-county distribution for these States.

Keywords: Conservation, Diapensiaceae family, distribution, ecology, range.

Welby, E.M.; McGregor, B. 1997a. Agricultural export transportation handbook: compatibility groups. In: Agricultural export transportation handbook. Agric. Handb. 700. [Place of publication unknown]: Agricultural Marketing Service, Transportation and Marketing. <http://www.ams.usda.gov/tmd/export/index.htm>. [Date accessed: January 2, 2004].

Lists groups of plants than can be shipped in similar conditions. Galax should be shipped at 0 ° to 2 °C (32 ° to 36 °F) with 90 to 95 percent relative humidity. Other florist greens that require these conditions include cedar (various species), ferns (various species), ground pine (*Lycopodium* spp.), holly (*Ilex* spp.), juniper (*Juniperus* spp.), mistletoe (various species), rhododendron (*Rhododendron* spp.), and mountain laurel (*Kalmia latifolia*).

Keywords: Floral uses, shipping.

Welby, E.M.; McGregor, B. 1997b. Agricultural export transportation handbook: recommended temperature, relative humidity, and approximate transit and storage period for cut flowers and florist greens. In: Agricultural export transportation handbook. Agric. Handb. 700. [Place of publication unknown]: Agricultural Marketing Service, Transportation and Marketing. <http://www.ams.usda.gov/tmd/export/index.htm>. [Date accessed: January 2, 2004].

Provides recommendations for shipment of various agricultural products. Galax should be kept at 0 °C (32 °F) in moisture-retentive cases. The storage life is unspecified.

Keywords: Floral uses, shipping.

Commercial Vendors

Note: The following list of vendors is included to provide access to current information about availability and prices. The authors do not intend to recommend these vendors over any others not listed.

Eastern Plant Specialties. [n.d.]. Galax. Georgetown, ME. <http://www.easternplant.com/epsdetail.asp?ID=96>. [Date accessed: January 2, 2004].

Vendor of galax plants for use in the landscape industry. Includes current prices for half-gallon and gallon pots.

Keywords: Landscape products, vendors.

Flowerbuyer. [n.d.]. Galax. <http://www.flowerbuyer.com/docs/ProductDesc.asp?item=148>. [Date accessed: January 2, 2004].

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Keywords: Floral products, handling, shipping, vendors.

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Keywords: Landscape products, vendors.

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Keywords: Floral products, vendors.

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Vendor of galax leaves for use in the floral industry.

Keywords: Floral products, vendors.

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Disclaimers

This annotated bibliography represents a comprehensive, but not exhaustive, review of the literature on galax. The references included were identified through a detailed search of academic library-based databases, regional literature, government documents, Internet databases, as well as commercial Internet sites. Bibliographic references are organized into sections—Research Literature, Popular Press, Other Information Sources—to indicate their origins. Research Literature includes references to peer reviewed articles published in scientific journals, while the references in Popular Press are not scientifically reviewed, but are included to indicate popular knowledge and perceptions. Other Information Sources include technical bulletins, horticultural lists, historical documents, and Web sites.

This document is available from the nontimber forest products Web site of the U.S. Department of Agriculture, Forest Service, Southern Research Station at <http://www.sfp.forprod.vt.edu/>.

Web sites listed in the bibliography were active at the time this document was prepared, but Web addresses may change or disappear over time. The date accessed indicates the last time the Web sites were checked.

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Predny, Mary L.; Chamberlain, James L. 2005. Galax (*Galax urceolata*): an annotated bibliography. Gen. Tech. Rep. SRS-87. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 33 p.

Galax (*Galax urceolata*) is an evergreen groundcover harvested for use in the floral industry. The plant's durable, shiny green leaves turn red in the fall and are popular background foliage in floral arrangements. People living in the mountains of North Carolina and other rural Appalachian locations have harvested (pulled) galax to supplement their incomes since before the 20th century; however, over the last decade, Hispanic laborers have largely displaced local harvesters. Today, more than 90 percent of the harvesters are of Hispanic origin. An experienced harvester can pull approximately 5,000 leaves a day; the value of this amount can range from \$20 to \$120. Prices vary depending on the season, the size and color of the leaves, and market demand. Industry concern for the availability or sustainability of galax has prompted the USDA Forest Service to restrict the harvest season. Since 2001, no harvesting is allowed from May 1 through June 15 when new leaves are emerging. The USDA Forest Service and the National Park Service are both conducting research to determine sustainable harvest levels.

Keywords: Conservation, floral industry, galax, nontimber forest products, poaching.



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