Control and Utilization of Tree-of-Heaven

A Guide for Virginia Landowners

Virginia Department of Forestry
www.dof.virginia.gov

Introduction

Ailanthus altissima (also known as tree-of-heaven, paradise tree, Chinese sumac, stink tree or just Ailanthus) is a native of China and was first introduced to the United States from England to Philadelphia, PA, in 1784. It was often nursery grown in the eastern U.S. and widely planted in cities and towns during the early 1800s. In the 1850s, Ailanthus was brought to California by Chinese immigrants. Its widespread use as an urban and shelterbelt tree is due to its ease of establishment, rapid growth, and lack of significant insect and disease problems. Tree-of-heaven also has a high tolerance of poor soils, low soil moisture and air pollution, making it an ideal tree for heavily urbanized areas. Unfortunately, it produces an unpleasant odor and regenerates prolifically from root sprouting and heavy seed production. Despite these negative qualities, widespread planting continued well into the 20th century. Over this time period, it has become naturalized in 42 states.

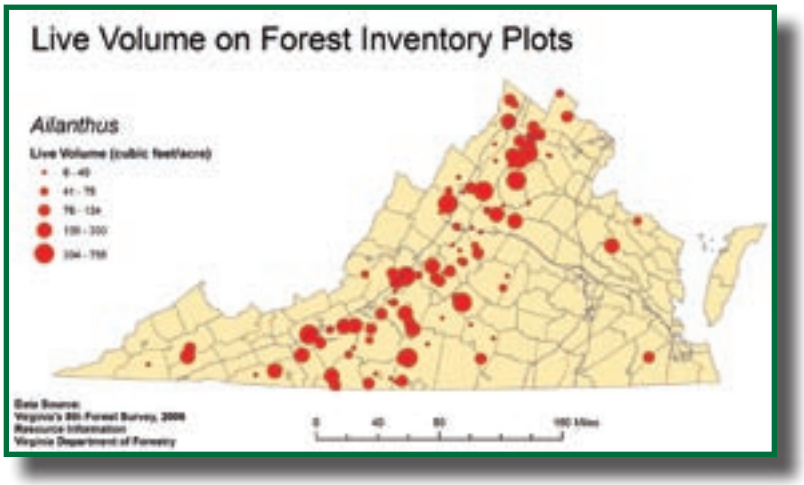

Figure 1. FIA plot data for Ailanthus volume distribution in Virginia.

Based on current FIA inventory data, 49 counties in Virginia have measurable quantities of Ailanthus and state-wide volumes are more than 67 million cubic feet, concentrated primarily along the Blue Ridge Mountains and I-81 corridor (Figure 1). As a point of reference, this represents approximately 0.20 percent of the 33 billion cubic feet of live volume in Virginia. This volume amount exceeds that of many native tree species and Ailanthus is 42nd in abundance out of a list of 128 tree species for the Commonwealth. It is found mostly in disturbed habitat, particularly along highway and roadway corridors and medians. In many locations, it has also established itself within more heavily forested areas where it can threaten to displace many native plant species.

As in many states, Virginia is increasingly dealing with the impact of non-native invasive plants. In many areas, they have become so naturalized that eradication is no longer an option. However, through a multi-faceted approach, the impact of some invasive plants can be minimized. One approach that has been little explored to date is developing uses and markets for woody invasive species. A number of species, such as *Ailanthus altissima*, *Paulownia tomentosa* (Paulownia or Princess tree) and *Albizia julibrissin* (Mimosa or silk tree), have now attained the volume and size in places to have potential use. By developing uses for these species and making use of pre-existing markets, it becomes more economical to control their spread. Since most of the forest land in Virginia is owned by non-industrial private landowners, anything that can provide additional income or reduce the cost of land management will increase the incentive to control invasive species.

At this point, a disclaimer is necessary: by suggesting we make use of Ailanthus using pre-existing markets, such as furniture, pulp and paper, charcoal and possibly biomass, we are in no way implying that this invasive weed should be cultured for profit. Ailanthus plantations would not be a profitable enterprise for landowners and would only contribute to further spread and proliferation of this species.

Landowners frequently ask forestry personnel about the feasibility of controlling tree-of-heaven and what research is being done to combat this problem. Market development as a means of mitigating impacts of invasive tree species is a novel approach that may hold promise for addressing multiple problems. Likewise, efforts to control Ailanthus must not only involve cutting and harvesting, but also proper and timely application of herbicides to prevent vigorous re-sprouting. This publication will address both of these tactics.

Biology and Life Cycle

Ailanthus seeds germinate beginning in May and throughout the summer. Seeds and seedlings are very tolerant of poor soils, but they germinate and grow best in full sunlight and are fairly intolerant to shade and wet soils. Seedlings quickly put down a large taproot and can grow up to three feet or more during their first year. While trees can reach a size of 60 to 70 feet in height and two feet to three feet in diameter, they are typically short-lived, with an average life span of 30 to 50 years. Unfortunately, they can dominate an area due to vigorous re-sprouting, root-suckering, and secretion of a chemical from its root system to the surrounding soil that is toxic to other plants.

Tree-of-heaven sprouts from the roots, root crown and bole. Re-sprouting occurs when the main stem is cut, burned or otherwise damaged. Top dieback from frost or drought can produce the same effect. These sprouts typically grow much faster than a seedling growing from seed because an extensive root system is already established. Growth rates of re-sprouts can be as fast as 10 feet per year. Root suckering can occur at any time and can be some distance from the parent tree. Root suckers also grow quite fast, up to six feet per year and may appear as far as 50 feet to 90 feet from the parent tree. Often they grow in response to mechanical disturbance of the root system or an ineffective herbicide treatment. Root suckers can develop into whole new trees, but re-sprouts often do not live long due to weak attachment to the stump. Such aggressive vegetative growth, however, makes it very difficult to control (Figure 2).

Most Ailanthus trees produce either male or female flowers. Pollination occurs from a variety of nectar and pollen-feeding insects, such as honey-bees and beetles, that are attracted to the strong odor of the male flowers. Many small, light seeds are produced in large clusters. Normally the most prolific seed production occurs between ages 12 and 20. However, fruiting has been observed in saplings as young as 1-year-old or in 2-year-old root sprouts. Several hundred inflorescences may be produced in one year. Since an individual flower can produce hundreds of seeds, a tree can yield more than 300,000 seeds per year, with most being viable. One tree in Pennsylvania was documented to produce more than a million seeds in one year.

The winged fruits are easily dispersed by wind, water and machinery. Seeds retain dormancy for less than one year, so there is no long-term build up of seed banks. Seed can germinate in highly compacted or salty soil. They contain two-large cotyledons (embryonic leaves) with stored oils and, therefore, are well equipped for rapid growth. Oak leaf litter has been shown to delay germination and increase mortality of Ailanthus seed.

Once established, tree-of-heaven is perhaps among the fastest growing tree species in North America, often growing three feet to six feet in the first year. Saplings can average an additional three feet to four feet of height growth per year for at least four years. Pole-sized trees continue to grow rapidly, but overall growth

slows after age 20 to 25. Once established, Ailanthus density expands mainly by root sprouting. An acre of land can become dominated by root sprouts from the same individual tree. Sprout growth slows considerably if they become shaded. Cattle, deer and rodent browsing, as well as defoliation by ermine moth caterpillars, may strip seedlings and saplings of their foliage.

Figure 2: Ailanthus trees often grow in clumps that sprout from the same root system and are clones of each other, or each tree may have germinated independently from seed.

Control or Elimination

History has taught us that the permanent eradication of a weed species from a geographic region is not a realistic goal. But for specific situations and limited areas where the silvicultural objectives will require the removal of invading tree-of-heaven, there are options available. Long-term elimination of Ailanthus requires diligence; its seed production, germination rate and sprouting potential make repeated follow-up monitoring essential. New sprouts or seedlings should be treated as soon as possible after detection so they will not rebuild root and seed reserves. Establishing a thick cover of non-invasive native vegetation can help discourage re-establishment but will not prevent it.

The most effective, economical and environmentally sound long-term control strategy is to develop an integrated pest management (IPM) approach that involves the coordinated use of several compatible control strategies. Due to the many characteristics that make it so persistent and invasive, Ailanthus is a prime candidate for an IPM approach to maintain long-term control.

Tree-of-heaven has been the subject of a good deal of research, experience and publication. What follows is a compendium of generally-accepted information condensed from many sources. The reader is referred to the suggested reading listed at the end of this document for further details and additional perspectives on Ailanthus control.

In general, methods of weed management can be categorized as:

1. Physical (manual or mechanical removal);
2. Thermal (spot or broadcast burning);
3. Managerial (plant competition or grazing);
4. Biological (selective insects or pathogens), or
5. Chemical (herbicides).

Physical

- **Manual.** These methods may have promise for landowners with low budgets or on sites with other rare or sensitive plants that need to be carefully tended and preserved.
  - **Pulling.** Ailanthus can be effectively removed by pulling up young seedlings as soon as they are large enough to grasp securely. Be sure this is done before they start to produce seeds or develop a tap root (which would make this physically difficult or impossible). It may be easier to attempt this after a rain when the soil is loose.
  - **Cutting.** Manually operated tools, like brush cutters, saws, axes, machetes, loppers and clippers, can be used to cut Ailanthus. This is an initial control practice, and long-term success will likely require either an herbicidal control or repeated cutting of re-sprouts. It can be a useful tactic if the density of Ailanthus or the terrain would otherwise make access to the plants for ongoing treatments difficult or dangerous. If possible, the initial cutting should be in early summer to impact the tree when its root reserves are lowest. Cutting large seed producing trees can reduce seedling proliferation.
  - **Digging.** This is a slow and labor-intensive approach, but with care it can be effective. Since every piece of root that breaks off and remains in the soil may produce a new plant, it is important to be thorough and methodical. As a result of the time required, this technique may be suitable only for small infestations and around trees and shrubs where other methods are not practical.
  - **Girdling.** This involves manually cutting through bark and cambial tissues around the entire trunk of the undesirable tree in the spring when it is actively growing. It is relatively inexpensive. Re-sprouting will likely be an issue (unless herbicides are applied to the girdled area), and there may be concern about leaving standing dead trees on some sites, but this could be a useful technique for at least eliminating large seed-producing trees.
- **Mechanical.** These methods use mechanized power equipment to remove selected or all above-ground vegetation. They are non-selective in that all vegetation on a treated site may be affected, but can be effective on gentle topography with a minimum of obstacles, such as rocks, stumps or logs. Most mechanical equipment is not safe to operate on slopes over 30 percent, and the approach is not recommended where soils are compactable or erosive.
  - **Chopping/Cutting/Mowing.** Saplings can be trimmed back by equipment-mounted mowers or choppers. They can be removed faster and more economically in these ways than by manual means and with less soil disturbance than with scarification. However, these methods are nonselective. They reduce the potential for biological control through plant competition and open up new niches for invading vegetation. Wildlife forage is eliminated. Saplings usually require several cuttings before the underground parts exhaust their reserve food supply. After cutting or chopping with mechanical equipment, Ailanthus re-sprouts from root crowns in greater density if not treated with herbicides.
  - **Scarification.** In recent years, several machines designed to grind and mulch above-ground vegetation and scarify the surface layer of the soil have become available. They are expensive but excellent for cleaning a site and leaving it easily accessible and operable for future management activities, and leave the prior plant community as incorporated organic matter or surface mulch. To an even higher degree than mowing, scarification prepares the site for re-colonization and eliminates wildlife forage and shelter. On at-risk slopes or soils, it can also increase the chance of erosion.

Thermal

- **Spot Treatment.** Fire has limited use for tree-of-heaven control. It can be effective for initial spot treatment using a weed burner to heat-girdle individual stems. This method is cheaper than herbicide options and can be used during periods of rain or snow, but Ailanthus re-sprouts prolifically after heat-girdling so additional follow-up treatments would still be required.
- **Broadcast Burning.** This approach has not been widely attempted or studied for controlling Ailanthus. However, it seems reasonable to expect that by removing the canopy and releasing a flush of nutrients such a fire could result in heavy sprouting and rapid growth of tree-of-heaven – not a useful result.

Managerial

- **Plant Competition.** This method alone is not a reliable control method for tree-of-heaven. Establishing and maintaining a healthy overstory can minimize the chance of re-invasion or at least slow the spread of new Ailanthus. But its rapid growth rate, prolific seeding, sprouting potential and shade tolerance will often allow it to out-compete native species that occur or are planted on a site.
- **Grazing.** The continued removal of the tops of seedlings and re-sprouts by grazing animals prevents seed formation and also gradually weakens the root systems. Grazing must be continued until the seed bank is eliminated or Ailanthus could re-colonize quickly after livestock is removed and begin to dominate pastures once again.

Biological

Biological control methods for Ailanthus have not been studied extensively. Some evidence suggests that the fungal pathogens *Verticillium dahliae* and *Fusarium oxysporum*, isolated from dead and dying Ailanthus trees, could hold promise. Furthermore, research at Virginia Tech is exploring the potential of an introduced weevil from China that feeds on Ailanthus to be released if it proves effective and can be done safely with little or no impact to non-target plant species. It is also hoped that this weevil, through feeding on Ailanthus infected with the Verticillium fungus, may move the Verticillium around and effectively inoculate new trees with it – resulting in a lethal combination. However, all of this research is preliminary and practical results, if achieved, would not be available for some time.

Chemical

Herbicides are probably the most effective tool for controlling Ailanthus, and they are usually the quickest way to kill the root system and prevent re-sprouting of cut trees. There are several registered general-use herbicides available that can be applied either as foliar sprays, cut stump treatments, by injection into the plant, or as basal sprays. It is important to carefully read and follow all of the label instructions and warnings for any herbicide, and to use care when applying them near other plants that have ecological or economic value.

- **Foliar Spray.** Herbicide solutions can be applied to fully-expanded leaves of individual trees using backpack sprayers (directed applications) or to all foliage in an area using tractor- or truck-mounted sprayers or even helicopters (broadcast applications). Foliar sprays are recommended where Ailanthus-size and distribution allow effective spray coverage of all foliage without unacceptable contact to nearby desirable vegetation. Where Ailanthus is in association with other exotic weed species, as is often the case, foliar spray offers the

advantage of treating the entire area at one time. Timing is critical and can limit this application, while logistics can be complicated by the large volumes of diluted spray mix to be transported and applied or by the need to arrange loading areas or heliports.

- Herbicide active ingredients that are effective when applied to the foliage of Ailanthus include glyphosate (e.g., Roundup®, Rodeo®, Accord®, RazorPro®), triclopyr ester (Garlon 4), and triclopyr amine (Garlon 3A). In directed backpack sprays, concentrations of 2 percent glyphosate applied June 15 to September 15, 1.5 percent triclopyr ester, or 2 percent triclopyr amine product, such as Garlon® 3A, applied June 1 to September 1 worked well (the triclopyr products may be slightly more effective). For broadcast applications, the concentration for these products could be reduced by 0.5 percent to 1.0 percent. Other herbicides, which have proven to be effective for foliar application of Ailanthus, are dicamba (e.g., Banvel®, Vanquish®), imazapyr (e.g., Arsenal®, Chopper®), and metsulfuron methyl (e.g., Escort®), but those products tend to have residual soil activity that could control non-target plants or require a waiting period before restoration planting efforts.

- **Cut Stump Treatment.** The cut stump method is used when trees will be cut as part of the process. Felling trees can be slow, labor intensive, and hazardous, so make sure qualified skilled individuals are conducting that phase. If the tree must be cut, however, it is better to treat the stump than not. This method is likely to be most successful during the growing season, with diminishing success through the early fall. Application of herbicide to the cut stumps must be conducted immediately after cutting, within five minutes to 15 minutes of the cut with water soluble formulations, or longer with oil mixtures, to ensure uptake of the chemical before the plant seals off the cut area. The mixture may be painted on with a paint brush or sprayed on using a spray bottle or backpack sprayer. A mixture of 20 percent to 25 percent Garlon® 4 in an oil-based carrier is effective (Figure 3). In this case, the whole stump surface and sides to the ground line would be sprayed.

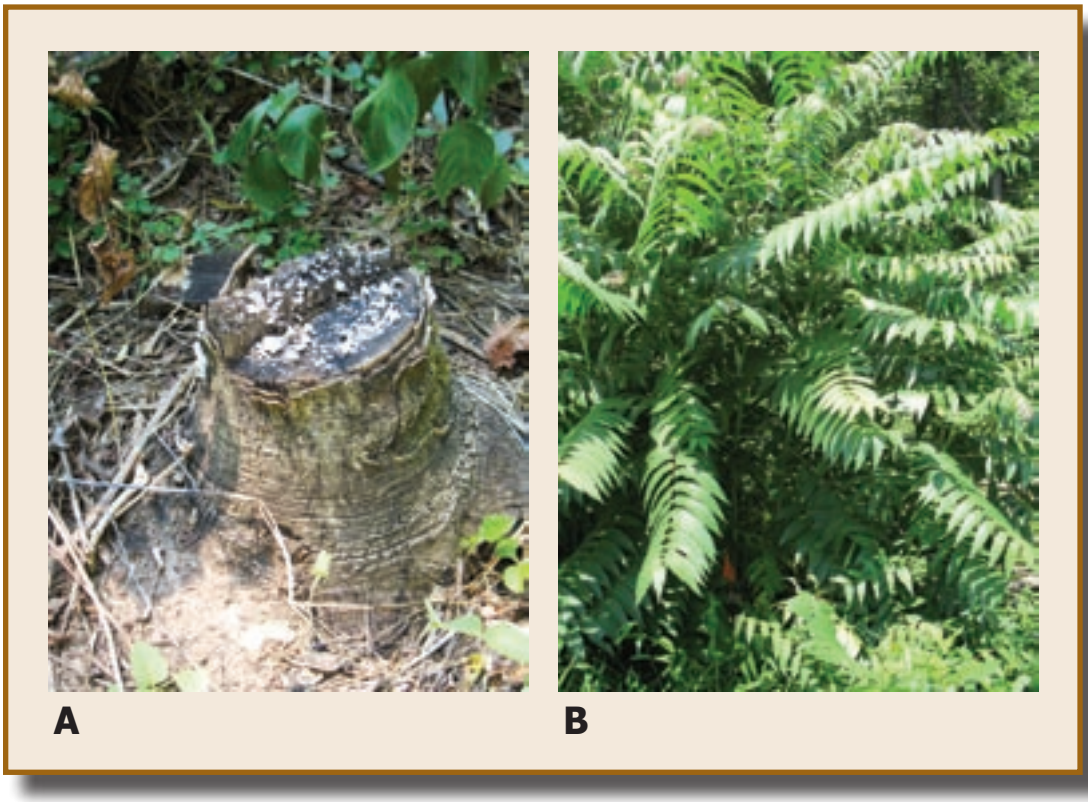

Figure 3: Typical treated and untreated tree-of-heaven stumps one year after cutting: A) Stump from stem treated with Garlon 4 basal spray one week prior to cutting; B) Prolific stump sprouting when stump is cut without an herbicide application.

Another option is to use Garlon® 3A at 100 percent, treating only the outer third of the stump surface. Re-check the following year and control any new stump sprouts or root suckers. Other herbicides, which have proven to be effective in stump treatment of Ailanthus, are dicamba (e.g., Banvel®, Vanquish®), imazapyr (e.g., Arsenal® A.C., Chopper®), and 2,4-D + picloram (e.g., Pathway®). Dicamba is particularly effective in October.

- **Stem Injection (hack-and-squirt).** This technique is very effective when applied during the summer. Root suckering will be an increasing problem in the fall, winter and spring. It requires first making downward-angled cuts into the sapwood around the tree trunk at a comfortable height, using a hand ax. With spray bottle or wand in the other hand, squirt the selected product into the cuts within a minute or two, so that the bottom of the cut is covered but liquid doesn't run out of it. Follow label directions for your chosen product for exact rates and spacing of cuts. This method can be used with trees of any size, though it is most effective with stems over two inches in diameter. This method is relatively easy for one person to do, with hatchet in one hand and spray bottle in the other, but should not be done alone in case of an accident. Monitor the treatment area and be prepared to follow-up the next year. Glyphosate products have sometimes been recommended for control of Ailanthus using this method, but several field trials have shown consistently poor long-term control. Other herbicides, which have been effective for hack-and-squirt control of Ailanthus during the growing season, are the same as those listed above for cut stump application.

- **Basal Spray.** A basal bark application is one of the easiest and most effective methods of controlling tree-of-heaven. It does not require any cutting, and works best during late winter, early spring and summer. The base of the tree stem must be free of snow, ice or water on the bark from recent rainfall, though precipitation following application is inconsequential. Late winter through early spring (February 15 to April 15 in Virginia) is generally the most productive time, since vegetation near the base of the trees is usually absent or leafless. Application through the summer works very well in Virginia as long as vegetation is not a hindrance and spray coverage is thorough. Fall to mid-winter applications (October to January) have reportedly given poor results. A solution of a 20 percent to 25 percent concentration of oil-soluble triclopyr product (e.g., Garlon® 4) in an oil-based carrier is highly effective. Another option is to use a pre-mixed, ready-to-use triclopyr product designed for basal bark (and cut stump) application (e.g., Pathfinder® II). Using a handheld or backpack-type sprayer, apply the mixture in a continuous 12-inch wide band around the tree base. The basal bark method is generally used for trees that are less than six inches in diameter, though larger stems (up to 16 inches) may also be treated effectively by thoroughly treating bark (Figure 4). Another herbicide, which has been shown to be effective for basal bark control of Ailanthus, is imazapyr (e.g., Chopper®, Stalker®). This is sometimes used in a combination with triclopyr at a concentration of 15 percent Garlon® 4 and 5 percent Stalker® in 80 percent oil diluent. Thorough wetting is necessary for good control.

- **Secondary Insects Following Herbicide Use.** While the effects of herbicide treatment (yellowing and wilting foliage) can be observed within weeks or even days during spring and summer, control at other times of the year can still kill trees, albeit more slowly (Figure 5). Herbicide-treated trees that are not killed outright are often weakened to such an extent that they become attacked by tiny wood-boring insects called ambrosia beetles. They are easily identified by the fine sawdust that emerges

from their burrowing holes as they bore deeper into the tree. This dust often forms a narrow tube that is the width of the hole, and is called a frass tube (Figure 6). If the infested wood is cut open in cross section it will expose beetle galleries stained with a black fungus. These beetles do not normally attack healthy trees, so their presence indicates a tree that is highly stressed or dying. In many cases, if the herbicide does not kill the tree completely, other secondary insects or diseases eventually will.

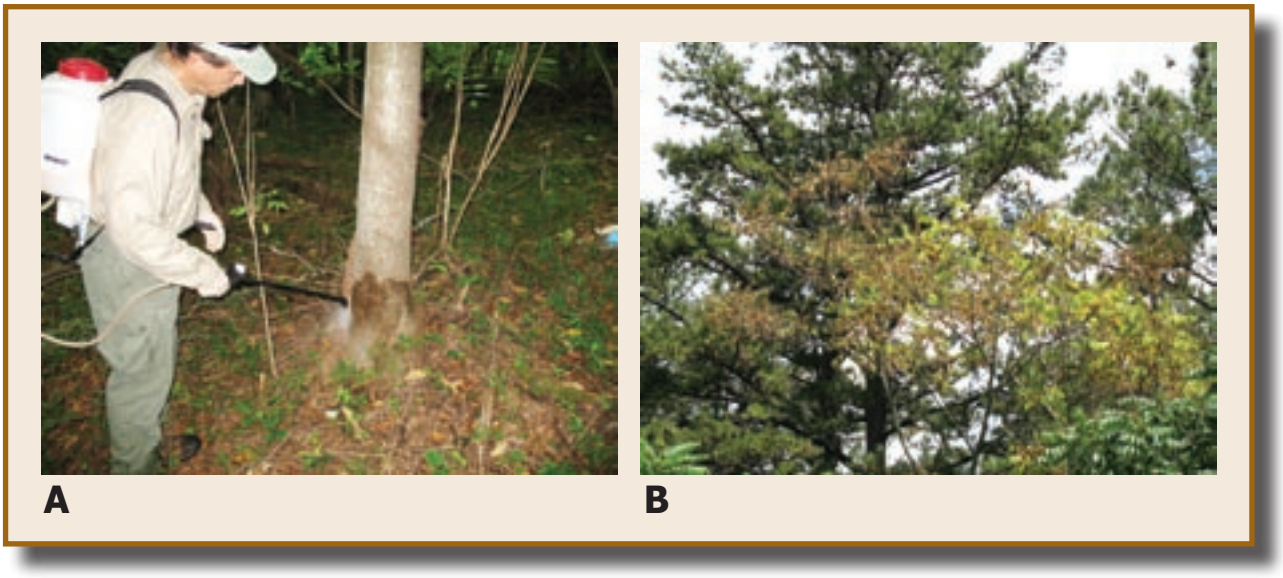

Figure 4. A) Basal spray application of Garlon 4 in June and B) crown fading of same tree one month later.

Figure 5. Example of stunted thin foliage of treated Ailanthus the spring following a September basal spray of triclopyr in oil (Garlon 4).

Figure 6. Emergent frass tubes result from boring of ambrosia beetles, which can attack Ailanthus following treatment with herbicides.

Utilization of Ailanthus

Incorporating Ailanthus control with other forest management activities is important to improve markets and reduce eradication costs. In most cases, Ailanthus must be marketed with other species to get it harvested. By coordinating spraying or other control methods with harvesting and other forest management operations, the wood can be utilized and invasive species impact to the forest can be reduced. Basal spraying the Ailanthus a few weeks before harvest will minimize risk of stump and root sprouts while still leaving the wood usable. Even if the trees are not harvested, it is important to control them to reduce the impact from sprouts and seeds regenerating in the forest. Invasive species control should be part of all forest management plans.

Working with Virginia Tech and several local woodworkers, research and evaluation on potential uses of Ailanthus was conducted. Ailanthus trees from several sites were harvested and processed into various products to determine mechanical and physical properties and what might be feasible for commercial use. Based on stated uses in its native habitat of China, products evaluated were pulpwood, firewood, charcoal, lumber, pallet stock and secondary wood products. Some of the results are compared with local native species to help with evaluation.

Ailanthus characteristics can be quite variable depending on its location and growth patterns. Research has shown differences in mechanical and physical properties in different parts of the country. It is a ring-porous tree and produces lumber that looks very similar to ash. Faster growing trees that are more open-grown tend to have more stresses in the wood, which lead to higher rates of warping, twisting, cupping and less stability and strength compared to slower, straighter-growing trees. Ailanthus has very soft, corky pith that can lead to utilization problems for most products. It is recommended that all sawed products not include any pith wood to minimize potential impacts to strength and stability. Ailanthus tends to have a high moisture content when green that impacts its strength and susceptibility to mold and stain. It is known to have a strong odor when leaves and branches are crushed or broken. Although there appeared to be a mild odor from green materials, especially if they contained bark, there is no apparent odor in finished products.

Pulpwood

Ailanthus has a history of being used for pulp and is accepted at pulp mills in Virginia that use hardwoods. Volumes are small compared to other species used.

Firewood

Based on research, Ailanthus should make acceptable firewood. When dry, it is comparable to other preferred hardwoods, such as ash, oak, maple, beech and hickory, for heat value. Because of the high moisture content of green Ailanthus, it is important that it is dried well before using. Users of Ailanthus firewood reported no odor concerns.

Table 1. Heat values by species.

Species	Higher Heating Value (BTU/lb.)
Ailanthus altissima	8,171 - 8,452
White Ash	8,246 - 8,920
Sugar Maple	8,190
Red Oak	8,037 - 8,690
Hickory	8,039 - 8,670
White Oak	8,169 - 8,810
Beech	8,151 - 8,760
Hemlock	8,885

Natural Lump Charcoal

As part of a project to develop value-added products from small diameter and waste wood, several batches of Ailanthus slabs and branches were used to make charcoal (Figure 7). The quality of the charcoal was good, especially that made with slabs. Several food items at different events were cooked using the charcoal with extremely positive results. To maximize charcoal quality and quantity, some air drying of the wood is necessary due to high moisture content of green material.

Figure 7: Department of Forestry charcoal kiln and Ailanthus charcoal.

Figure 8: Cutting Ailanthus boards (Charlie Becker, left, and Tim Tigner, retired, of the Virginia Department of Forestry).

Lumber

As with any species, the quality of the logs will have an impact on the quality and use of the lumber. Because of the fast and often crooked growth, high moisture content and corky pith, Ailanthus can cause difficulties as lumber, if not processed carefully. However, with proper care and selection, the wood can be used for a variety of products.

To minimize the problems associated with growing stress and pith, logs for sawing should be fairly straight with the pith centered in the log and at least 10 inches in diameter. To minimize end checks, the ends of logs should be coated with a sealer. When using band saws, blades need to be sharp to keep the saw tracking straight. The ring-porous nature of the wood can sometimes cause blades to follow the grain. During sawing, stresses are sometimes released that will cause the log and lumber to move. These problems can be reduced by rotating the log to balance the tensions and avoiding the pith (Figure 8). Because of the high moisture content, lumber should be stickered to begin drying as soon as possible. In the summer months, mold and stain can develop within a couple of days if the surface remains wet. If air drying, place stacks in an area with good air circulation. Ailanthus can be dried quickly with little concern for surface checks and splitting with one-inch-thick lumber. Placing weights on top of the stacks will improve flatness of lumber. During hot, humid weather, moving wood directly to a dry kiln is advisable.

Pallet Parts

Some preliminary work has been done to look at the feasibility of using Ailanthus for pallet parts. As with the lumber, some of the properties will make it a challenge to use. One of the first constraints is that most pallet lumber comes from the low-grade center of trees. The corky pith in Ailanthus can reduce the strength and stability of the core wood and its usefulness as pallet stock. While the specific gravity of the tested Ailanthus (0.57-0.62) is closer to typical medium-density hardwoods, the strength and stiffness is closer to low-density hardwoods. The moisture content of the wood also affects the strength and there is more potential for mold development. Additional work needs to be done to determine what factors determine the strength and stiffness of wood for pallet parts.

Kiln Drying

For most uses, wood needs to be kiln dried. Several loads of Ailanthus were dried at VA Tech to determine drying characteristics. Most lumber was 1-1¼-inch thick and variable width. Due to small volumes, all lumber regardless of grade was dried. Green Ailanthus is capable of being dried rapidly with average moisture losses experienced being as high as 10 percent per day when moisture contents are more than 30 percent. Moisture losses of 19 percent to 20 percent were experienced in the first two days of drying of 4/4 material without causing checking to the material. Although further testing is needed, a 10 percent moisture loss per day seems acceptable for this species without leading to degrade. Ailanthus is not prone to surface checking like many other ring porous species but it does have issues with warp (cup, twist, bow and crook) since it contains large amounts of tension wood. In a couple of cases, honeycomb defects were found, but they were always confined to a single growth ring. Conditioning (stress relief) of lumber is important. In most cases, Ailanthus can be dried from green to 7 percent moisture in less than two weeks. Thicker material (two-inch thick) had more warping problems than thinner wood and also some end splitting. For this material, a 6.6 percent loss per day is acceptable. Until additional research is done, it is recommended that all boards, especially thick lumber, should be end coated to minimize splits. Lumber should be cut and graded to minimize pith and other degrade in material to be kiln dried. Weights should be placed on all stacks during drying to minimize warping.

Wood Properties

Although Ailanthus has the reputation of being a weak, light wood, tests of dried wood in Virginia showed many of its properties to be similar to woods, such as ash, oak, maple and birch, including specific gravity and hardness (Table 2). These properties indicate that Ailanthus may make a good flooring material, although dimensional stability may be of concern.

The Virginia Department of Forestry conducted a number of Ailanthus harvests and provided several woodworkers with boards to get feedback on wood-working properties and potential market demand. Projects included a bench, blanket chest, small tables, chairs and shelves. In general, most enjoyed the challenge of using the wood and would use it again. However, there was quite a mix of results on wood stability. This was probably due to the wide variety of wood quality that was used. In most cases, there was a lot of waste due to cupping and warping. While the stress tests indicated that the material was stress free, when this material was used to build a piece of furniture, significant longitudinal stress was evident, particularly those boards that contain or were located near the center of the tree. This was not unexpected due to the large amounts of abnormal wood (juvenile and or tension wood) present in the samples.

Table 2. Wood properties by species.

Strength Property	Ailanthus (Virginia)	Sugar Maple	Black Oak	Southern Red Oak	White Ash	Beech	Yellow Birch
Hardness (max. load, lbs.)	1,282	1,450	1,210	1,060	1,320	1,300	1,260
Specific Gravity	0.62	0.63	0.61	0.59	0.60	0.64	0.62
Shear (psi)	2,147	2,330	1,910	1,390	1,910	2,010	1,880
Bending (psi)	14,125	15,800	13,900	10,900	15,000	14,900	16,600
Tension (psi)	880	-	-	510	940	1,010	920

Below are comments from various craftsmen:

"It had excellent machining properties in the joiner and planer. It tooled real well with the jigs used to make dovetail joints."

"It behaved very much like white ash. If I had not been told it was Ailanthus, I would have guessed it to be white ash."

"The grade of the lumber is very important. Many of these boards looked pretty good, but there was still a lot of waste."

"In storage, it warped and cupped extremely badly. It did not check or split nearly as bad. I stored it in the upstairs shop, which is pretty hot during the summer. I stored much of the other hardwood I use their too, so it was a good comparison."

"It sanded very well."

"It finished very well. Tung oil was used on the blanket chest to accent the grain pattern. It appeared to take stain well on a test piece."

"It would be important to saw it at least 5/4. This is needed to be able to get the cup and warp out. Even with this thickness, I had to rip the boards and then glue them back together. I do this with most wide boards of other species to reduce problems with cupping."

"I felt the wood had potential in furniture manufacture where a good hardwood was needed for framing that would then be covered with fabric."

"I really look forward to using more of this wood. I hope to see it on the market soon, especially if it can be bought at a good price."

Suggested Publications:

Creighton, J. L. 2008. Tree-of-Heaven (Ailanthus) Control Methods. Forest Research Review October 2008. Charlottesville, VA. Virginia Dept. of Forestry: 11-12.

Eck, William E.; McGill, David W. 2007. Testing the efficacy of triclopyr and imazapyr using two application methods for controlling tree-of-heaven along a West Virginia highway. Gen. Tech. Rep. SRS–101. U.S. Department of Agriculture, Forest Service, Southern Research Station: 163-168.

Evans, C. W.; D. J. Moorehead; C. T. Bargeron, and G. K. Douce. 2006. Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton, GA, BW-2006-03. 52 p.

Miller, J. H. 2003. Non-native invasive plants of southern forests: a field guide for identification and control. Revised. Gen Tech. Rep. SRS-62. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 93 p.

Suggested Web Resources:

Non-native Invasive Plants of Southern Forests - USDA Forest Service

http://www.invasive.org/eastern/srs/TofH.html - Jan. 6, 2008

Plant Invaders of Mid-Atlantic Natural Areas - National Park Service and U.S. Fish and Wildlife Service

http://www.invasive.org/eastern/midatlantic/aial.html - Jan. 6, 2008

Southeast Exotic Pest Plant Council Invasive Plant Manual - SE-EPPC

http://www.invasive.org/eastern/eppc/ailanthus.html - Jan. 6, 2008

Weeds Gone Wild: Alien Plant Invaders of Natural Areas - Plant Conservation Alliance

http://www.nps.gov/plants/alien/fact/aial1.htm - Jan. 6, 2008

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