Tree-of-Heaven and Paulownia – Identification, Potential Spread, and Control

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Most of the invasive woody plants (trees, shrubs, and vines) promoted by disturbance to the site

Invasive Species	Response to Disturbance			
	High Light	Soil Disturbance	Fire	Re-sprout/ re-grow
Tree of Heaven	Promoted	Promoted	Negligible	Yes
Paulownia	Promoted	Promoted	Promoted	Yes
Tallow tree	Promoted	Promoted	Discouraged	Yes
Autumn Olive	Promoted	Promoted	Promoted	Yes
Privet	Promoted	Promoted	Negligible	Yes
Oriental Bittersweet	Negligible	Promoted	Negligible	Yes
Japanese Honeysuckle	Promoted	Promoted	Negligible	Yes
Japanese Climbing Fern	Negligible	Promoted	Promoted	Yes

Source: Invasive Plant Responses to Silvicultural Practices in the South. Evans et. al. 2006

Princess Tree - *Paulownia tomentosa*

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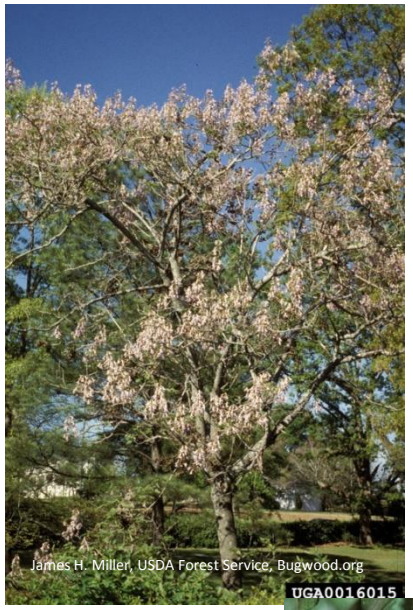
- Princess tree is native to western and central China where historical records describe its medicinal, ornamental, and timber uses as early as the third century B.C.
- It was cultivated centuries ago in Japan where it is valued in many traditions.
- Currently it is also grown in plantations and harvested for export to Asia where its wood is highly valued.

Princess Tree - *Paulownia tomentosa*

- Small to medium sized tree 30-60 feet.
- Bark is rough, gray-brown, and interlaced with shiny, smooth areas.
- Stems olive-brown to dark brown, hairy and markedly flattened at the nodes.
- Leaves are large, broadly oval to heart-shaped, sometimes shallowly three-lobed, and noticeably hairy on the lower leaf surfaces. They are arranged in pairs along the stem.
- Conspicuous upright clusters of showy, pale violet, fragrant flowers open in the spring.
- The fruit is a dry brown capsule with four compartments that may contain several thousand tiny winged seeds. Capsules mature in autumn when they open to release the seeds and then remain attached all winter, providing a handy identification aid.



Shiny gray bark with reddish mottled fissures.

Princess Tree - *Paulownia tomentosa* *Invasive Species Compendium*

(www.cabi.org)

- *P. tomentosa* is a showy, aggressive ornamental introduced from East Asia.
- It is also grown in plantations for timber production, and has tended to escape and invade, growing rapidly in disturbed areas.
- It seeds profusely and re-sprouts from roots and stumps forming monocultures, and is proving to be a problem weed in eastern USA.
- It continues to be promoted, in North America and elsewhere, and it is possible that it could prove invasive in Europe where it continues to be introduced and planted.
- *P. tomentosa* is on invasive species lists for the states of Connecticut and Tennessee, USA (USDA-NRCS, 2008) and is showing invasive characteristics elsewhere. It has also failed risk assessments for Australia and the Pacific (PIER, 2008). It may become invasive where already introduced in Europe and South America, but noting its value as a fast-growing plantation timber and ornamental species, it is highly likely that it will be further introduced elsewhere.

Princess Tree - *Paulownia tomentosa* *Invasive Species Compendium*

(www.cabi.org)

Invasiveness

- Fast growing
- Has a broad native range
- Has high genetic variability
- Has high reproductive potential
- Highly adaptable to different environments
- Highly mobile
- Long lived
- Pioneering in disturbed areas
- Tolerates, or benefits from, cultivation, browsing pressure, fire etc

Tree of Heaven – *Ailanthus altissima*

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- Ailanthus altissima, also called stinking sumac or Chinese sumac is naturalized throughout much of the United States. It was first introduced into the eastern United States in the late 1700s from China.
- Ease of establishment, rapid growth and absence of insect or disease problems resulted in tree of heaven being extensively planted in U.S. towns and cities during the 1800s. Today this invasive tree threatens to overwhelm natural areas, agricultural fields and roadsides in many states.
- A. altissima is adapted to a wide variety of ecological sites ranging from urban areas, saline soils, surface-mined lands and natural areas. High seed production (325,000 seeds per female tree) and viability, and vegetative sprouting from the roots increase this plant's invasiveness.

Tree of Heaven – *Ailanthus altissima*

- Mature trees can reach 80 feet in height.
- Ailanthus has smooth stems with pale gray bark and twigs which are light chestnut brown.
- Large compound leaves are 1-4 feet in length, alternate, and composed of 10-41 smaller leaflets. Each leaflet has one or more glandular teeth along the lower margin.
- Ailanthus is a dioecious (male and female flowers occur on separate plants).
- Flowers occur in large terminal clusters and are small and pale yellow to greenish.
- Flat, twisted, winged fruits each containing a single central seed are produced on female trees in late summer to early fall and may remain on the trees for long periods of time.
- All parts of the tree, especially the leaves and flowers, have a nutty or burned nut odor.

Tree of Heaven – *Ailanthus altissima* *Invasive Species Compendium*

(www.cabi.org)

- A. altissima has become extensively naturalized in North America (Luken and Thieret, 1997), from Massachusetts to southern Ontario (Canada), Iowa and Kansas, and south to Texas and Florida, as well as from the southern Rocky Mountains to the Pacific Coast (Feret, 1985; Shah, 1997).
- It was reported to be already widespread and naturalized in Tennessee in the late 1800s (SE-EPPC, 2002) and in some parts of the USA it is so well established that it appears to be a part of the native flora (Schopmeyer, 1974).
- From China and Japan to India, it is cultivated in the plains and hills of the north (Singh et al., 1992). It grows abundantly along roadsides and is able to grow on barren and stony substrates. A. altissima has become naturalized in many of the temperate regions it has been introduced to, including Australia, India, Japan, Malaysia and Indonesia.

Tree of Heaven – *Ailanthus altissima*

- Clonal stems can grow 100 feet from parent tree.
- Dense thickets exclude other species.
- Roots are shallow and extensive, surviving extended periods of drought.
- Clones attached to parent trees can persist in low light conditions for at least 20 years.

Princess Tree - *Paulonia tomentosa* *Invasive Species Compendium*

(www.cabi.org)

Invasiveness

- Has high reproductive potential
- Highly adaptable to different environments
- Highly mobile
- Proved invasive outside its native range
- Tolerates, or benefits from, cultivation, browsing pressure, fire etc

Planning an Invasive Woody Plant Control Strategy

Understand your target

- Species
- Size (particularly height)
- Density

Control and Management

Tree of Heaven – *Ailanthus altissima and* Princess Tree - *Paulonia tomentosa*

- Tree size and site conditions dictate the management method selected .
- Because of its rapid growth rate, there is an advantage of using stem injection, basal bark, and cut stump application methods, rather than foliar treatment.
- Cut stump technique is most appropriate with very large trees or stem-clusters having well-developed bark.
- Early fall herbicide applications followed by periodic evaluations the following spring with follow-up retreatment of sprouts was reported to provide the best long-term control of an infestation.
- Manual removal can be attempted on small, newly established populations but all root fragments must be removed to be effective.
- Mechanical cutting or burning without herbicide application will not control these species and will increase density.

Resources for Recomendations

“Modified” High-Volume Foliar

- Total volumes between 25 and 75 gallons per acre
- Target woody plant density higher than 1500 stems per acre
- Heights can be 8-10 feet
- Suited for reclamation of large areas

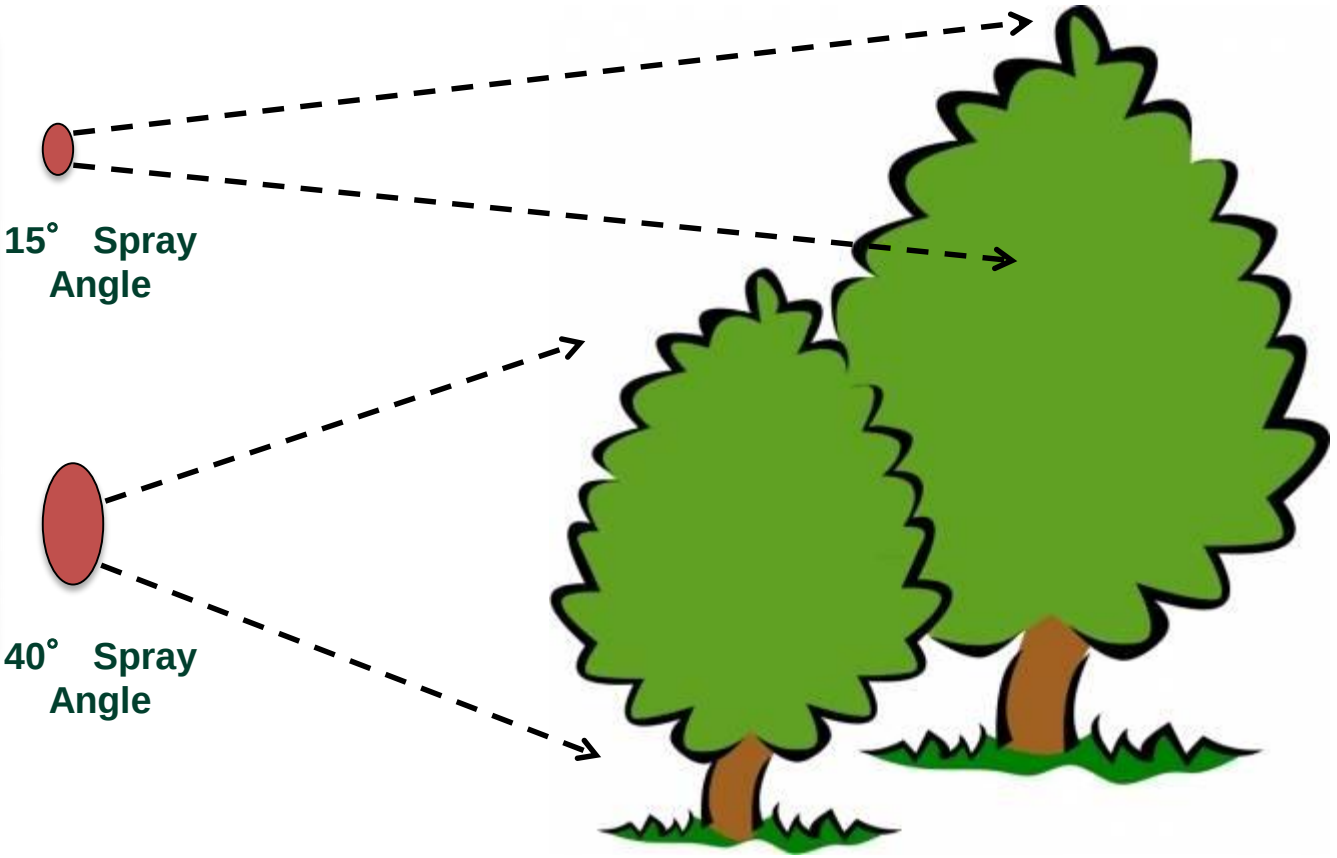
Target Species	“MODIFIED” HIGH VOLUME FOLIAR (MHVF) 25-75 GPA
Ailanthus	Garlon® 3A + Milestone® Capstone®
Paulownia	Garlon® 3A + Milestone® Capstone®

Low Volume Foliar

- Total volumes between 5-25 GPA
- Cover 80% of leaf surface with special attention to the growing points
- Heights less than 6 to 8 feet
- Spray to wet

Target Species	LOW VOLUME FOLIAR (LVF) 5-25 GPA
Ailanthus	Garlon 3A + Milestone, Capstone Arsenal Accord XRT II
Paulownia	Garlon 3A or Garlon 4 Ultra Arsenal Accord XRTII

Roll over nozzle



Basal Bark Application – Herbicide/Oil Mixture

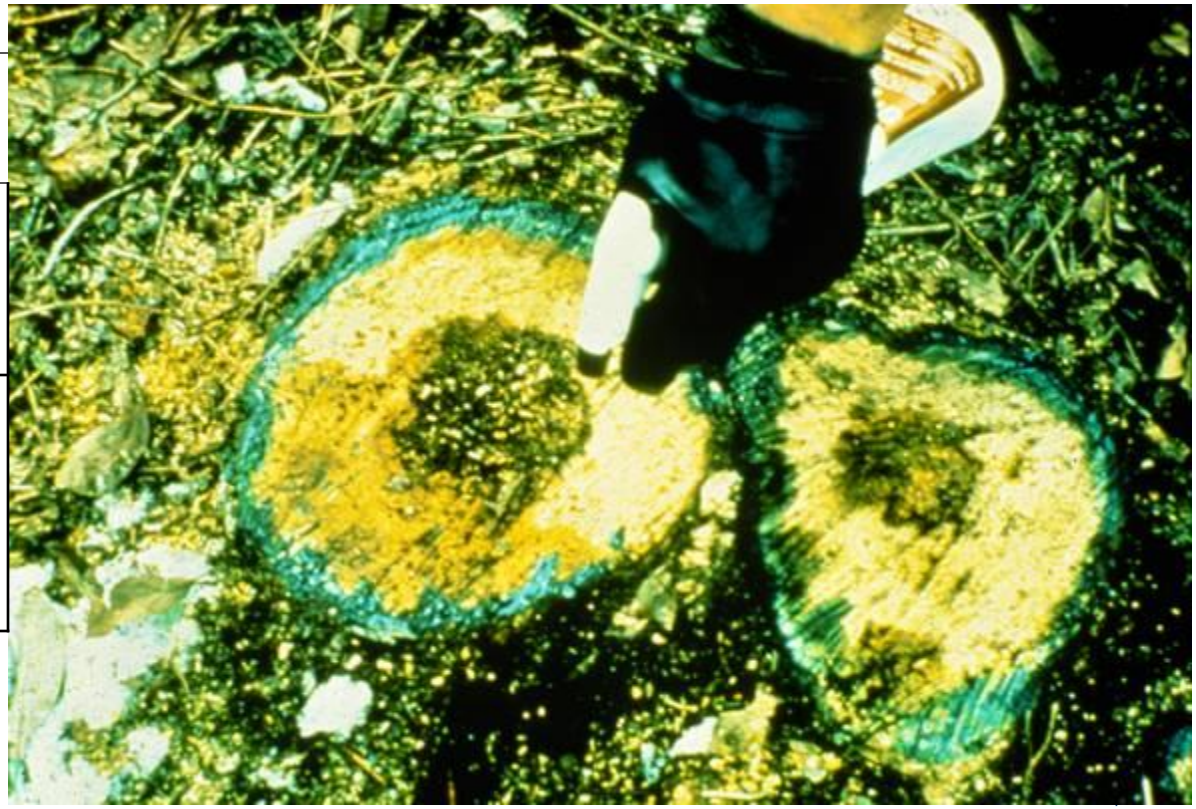
- Coverage of the entire stem circumference is key to success (lower 12-15 inches)
- On root suckering species, make sure collar area is covered, treat root flares, or exposed roots
- Year round treatment for low density woody vegetation and sensitive sites
- Do not treat when bark is wet

Target Species	BASAL & CUT STUMP (ALL YEAR)
Ailanthus	Garlon 4 ULTRA + basal oil Pathfinder II
Paulownia	Garlon 4 ULTRA + basal oil Pathfinder II

Cut Stump
Water Soluble Herbicides

- Should be applied immediately after cutting
- Apply the herbicide to the cambium layer of the cut surface

Target Species	HACK & SQUIRT (ALL YEAR)
Ailanthus	Pathway® Capstone Arsenal
Paulownia	Pathway Capstone Arsenal Garlon 3A



Cut Surface
Injection (water soluble herbicides)

- Hypo-hatchet has a plunger that injects the herbicide as the cut is being made.
- Hack and Squirt involves cutting with a hatchet and separately applying the herbicide solution into the cut.

Hypo-hatchet

Hack and squirt

Basal Cut Stump – Herbicide and oil mixes

- Can be applied any time after cutting (prior to re-sprouting)
- Apply the herbicide to the cambium layer of the cut surface and exposed bark to the ground line (apply like the low volume basal technique)

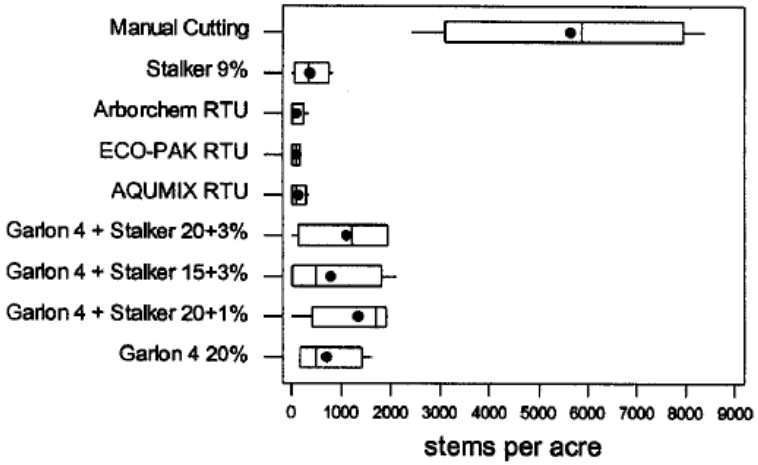
Target Species	BASAL & CUT STUMP (ALL YEAR)
Ailanthus	Garlon 4 ULTRA + basal oil Pathfinder II
Paulownia	Garlon 4 ULTRA + basal oil Pathfinder II

Individual Plant Treatment for Woody Plant Control

Target Species	"MODIFIED" HIGH VOLUME FOLIAR (MHVF) 25-75 GPA	LOW VOLUME FOLIAR (LVF) 5-25 GPA	HACK & SQUIRT (ALL YEAR*)	BASAL & CUT STUMP (ALL YEAR)
Ailanthus	Garlon® 3A + Milestone® Capstone®	Garlon 3A + Milestone, Capstone Arsenal Accord XRT II	Pathway® Capstone Arsenal	Garlon 4 ULTRA + basal oil Pathfinder II
Paulownia	Garlon® 3A + Milestone® Capstone®	Garlon 3A or Garlon 4 Ultra Arsenal Accord XRTII	Pathway Capstone Arsenal Garlon 3A	Garlon 4 ULTRA + basal oil Pathfinder II

Actual rates may vary with size and growth stage of vegetation.

* Except during spring sap flow



Black dot represents the mean value, the vertical line near mean represents the median value, the rectangular box represents roughly 50% of the middle data, and the horizontal lines (tails) represent the extent of the data.

Treatment	Mean Stems Per Acre 2 YAT
Manual cutting 7-15 cm above ground	5645
Stalker 9% in HY-Grade EC	363
Garlon 4 20% + 5% Tordon K in Arborchem RTU	81
Garlon 4 20% + 5% Tordon K in ECO-PAK RTU	81
Garlon 4 20% + 5% Tordon K in AQUMIX RTU	121
Garlon 4 20% + 3% Stalker in HY-Grade EC	1089
Garlon 4 15% + 3% Stalker in HY-Grade EC	766
Garlon 4 20% + 1% Stalker in HY-Grade EC	1331
Garlon 4 20% in HY-Grade EC	685

Figure 1. Box plot of stem count (number of stems per acre) as affected by treatments. Untreated is hand-cut only.

Individual Plant Treatment for Woody Plant Control

Month of Application

Application Method	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Foliar					after full leaf-out in the spring through summer until 10% leaf coloration							
Backpack Dormant Stem	Up to 25% leaf-out									After leaf senescence		
Cut Surface				avoid application during spring sap flow and when it is cold enough for spray mixture to freeze								
Low Volume Basal	year 'round except on wet stems											

Questions?