

# Herbicide Options for Hardwood Management



Mississippi landowners intent on growing hardwoods are fortunate to have one of the most accommodating sets of environmental conditions in the nation. Long growing seasons, great climatic conditions, and the wide variety of appropriate species make establishment and maintenance of hardwood stands attainable as long as appropriate silvicultural methods are used.

Even a casual observer of nature can see how easily various woody and herbaceous species colonize most sites in the South. Consequently, land managers face a multitude of problems associated with unwanted vegetative competition. These problems typically involve reduced growth in established stands and reduced survival in planted stands.

Any given tract of land may have a wide variety of native plant species. Many of these species are not problematic and do not warrant special consideration. Typically, they are controlled with herbicides during the establishment period or are deemed to have insignificant negative effects on hardwood survival and growth. However, some species can be problematic in hardwood management.

Using herbicides has proven beneficial by lowering establishment costs, increasing growth, reducing mortality, and lessening vine-induced stem deformation. This publication discusses options available in the treatment of undesirable vegetation in hardwood management efforts. It is extremely important to follow labeled application rates and timing because many of the most effective herbicides can have negative impacts if applied improperly. This is not intended to be an all-encompassing list, but it includes product names, rates, and application timings of herbicides that have proven to be effective in controlling some of the more common problem species.

*Please note: The information given here is for educational purposes only. References to commercial products, trade names, or suppliers are made with the understanding that no endorsement is implied and that no discrimination against other products or suppliers is intended.*

## Artificial Regeneration

### Chemical Site Preparation

Pine and hardwood silviculture differ in many aspects, but both systems benefit from proper competition control. While post-planting herbicide options differ greatly between pines and hardwoods, chemical site preparation treatments are very similar. Applications using imazapyr (e.g., Arsenal AC, Chopper Gen2) and glyphosate (e.g., Accord Concentrate, Accord XRT II) are the “gold standard” for cutover sites. Phytotoxic symptoms on planted hardwoods due to residual soil activity of imazapyr have not been documented when herbicide applications are performed at least 12 weeks before planting. Glyphosate, a foliar-active-only herbicide (works only when applied to leaves), has no soil activity and no residual effects.

Because it is very expensive and has limited herbaceous control, very little chemical site preparation is performed in hardwood management. Treatment applications of this nature are intended to help control species that cannot be eliminated with herbicide applications after trees are planted (e.g., controlling woody species that cannot be removed using herbicidal means without severe damage to planted seedlings). If chemical site preparation should prove necessary, currently the standard recommendation is as follows:

28–32 ounces/acre Chopper GEN2 + 4–5 quarts/acre of a forestry-labeled glyphosate product.

Application should occur in August to late October before planting.

## ***Chemical Site Preparation for Retired Agricultural Fields***

Retired agricultural areas have a unique set of environmental variables that most cutover sites do not have. While chemical site preparation on cutover sites primarily targets woody competition, former agricultural fields often do not have a woody component. Woody species in former fields are often beneficial to planted seedlings, with improvement to desirable stem quality outweighing possible associated negative effects. A forester or other natural resource professional can help determine when nonplanted woody plant density reaches a level that is detrimental to planted stems.

Site preparation will not provide control of herbaceous competition after planting unless a product with residual soil activity like Oust XP is added to the mixture. Again, chemical site preparation should only be considered if it is necessary to control existing on-site vegetation that cannot be eliminated using growing-season herbaceous weed control. The expense of chemical site preparation is not justified unless one or more of these problem species is present.

Current application recommendations that vary by situation follow:

5–6 quarts/acre of a forestry-labeled glyphosate product + an appropriate surfactant

14–16 ounces/acre Arsenal AC + 4–5 quarts/acre of a forestry-labeled glyphosate product + an appropriate surfactant

16 ounces/acre Arsenal AC + an appropriate surfactant

28–32 ounces/acre Copper GEN2 + an appropriate surfactant

Applications should be performed from August to October.

### ***Herbaceous Weed Control***

Herbaceous weed control (HWC) is a treatment designed solely to control herbaceous competition during the first growing season after planting. While broadcast applications can be used for HWC, herbicides are typically applied in bands 4 to 6 feet wide. Banding herbicides in this manner reduces overall treatment cost and maintains cover and food sources for wildlife. Research over the last 25 years regarding herbicide rates and application timing has resulted in the following HWC recommendation in hardwood plantings (excepting cottonwood):

2 ounces/acre Oust XP (Applications should be performed before bud break.) (February–March) (Consideration should be given to soil pH. See below.)



Figure 1. Vegetation on a retired agricultural site 1 year post-chemical site preparation.  
Photo by Brady Self



Applied as a pre-emergent, Oust XP (sulfometuron methyl) provides excellent control of most grass and broad-leaf species. Special consideration is warranted if treating areas with higher pH soils (applications of 1 ounce/acre Oust XP should be used if pH is 6.5 or higher) or areas that flood from March to July.

If HWC is necessary in areas that typically flood, Oust XP should be avoided. Oust XP will move with water and may result in wasted application expense as well as off-target impact if flood waters reach application areas. Goal 2XL (oxyfluorfen) is a good alternative in these situations. Long used in cottonwood HWC, Goal-treated hardwood seedlings have exhibited no phytotoxicity. Like Oust XP, Goal 2XL provides best results when used as a pre-emergent, but it exhibits less residual soil activity and controls fewer species. Of particular note, Goal can be applied post-emergent, but it does not control most grasses. Standard use rate recommendations are:

Pre-emergent = 64 ounces/acre Goal 2XL+ an appropriate surfactant

Post-emergent = 32 ounces/acre Goal 2XL + an appropriate surfactant

Application timings for Goal 2XL vary by targeted species. Consult the herbicide label to determine appropriate timing for treatment.

Occasionally situations arise that dictate the use of a grass-only herbicide for HWC. Two products labeled for grass control in hardwoods are Select 2EC (clethodim) and Fusilade DX (fluazifop-P-butyl). Both herbicides are foliar-active and effective only on grass species. These two herbicides offer the best option to control “problem” grasses such as bermudagrass or johnsongrass, with Select generally being more effective in single-application treatments. Use a nonionic surfactant with either product. Spray rates and appropriate application timings depend on growth stage and target species.

Different herbicides exhibit different lengths of vegetative control when applied on targeted vegetation. None of the herbicides used in HWC will provide complete control of vegetation for an entire growing season. The intent of these applications is not to achieve complete growing-season herbaceous control, but rather to provide adequate time for planted seedlings to become established in a “free-to-grow” status.

## Natural Regeneration

Light is one of the most important factors in natural regeneration of hardwoods. Many regeneration attempts fail when established shade-tolerant midstory stems outcompete newly germinated shade-intolerant seedlings. Even



Figure 2. Banding of Oust XP in HWC application.  
Photo by Brady Self

the best planned and timed overstory treatments combined with a proper harvesting schedule will fail to produce adequate natural regeneration if available light levels are insufficient for germinant survival. Midstory injection is an effective way to control undesirable stems competing for light in the midstory. This increases light at ground level so young shade-intolerant stems can grow.

Several compounds have been tested and are labeled for injection. Historically, injections were performed by girdling trees using frill cuts and “painting” a solution of Tordon (picloram) into the cut. Tordon products worked well in this capacity, but nontarget species tended to be impacted. More recently, Arsenal AC has become the standard for midstory injection work because it controls a wide variety of woody species while reducing labor requirements. Eliminate ground contact with imazapyr because soil activity could result in nontarget impact of hardwoods. Current midstory injection recommendations are:

Arsenal AC mixed at 20% vol/vol with water. Apply 1 milliliter of solution per cut and use 1 cut per 3 inches of stem diameter

Efficacy of midstory injection with imazapyr varies depending on timing. Early fall applications (September to

October) are most effective; applications from November to February and July to August give slightly less control. Avoid injection during March to June.

While injection typically works very well, other methods/compounds may be justified at times because of species resistance and numbers. There may not be enough target small-diameter stems to warrant the expense of injections. Conversely, the number of target stems may be so great as to make injection cost-prohibitive. For more detailed information regarding stem injection, please read MSU Extension Publication 2942 *Tree Injection for Timber Stand Improvement*. Additionally, some species are naturally resistant to imazapyr (e.g., elms, locusts, eastern redbuds, waxmyrtles). In these situations, you should use a different compound. If this is the case, and most target stems are not taller than 30 feet, skidder applications of glyphosate or Garlon 3A (triclopyr amine) may be possible. Under these conditions, standard application recommendations are:

4% vol/vol of a forestry-labeled glyphosate product + an appropriate surfactant

4% vol/vol of a forestry-labeled glyphosate product + 3% vol/vol Garlon 3A + an appropriate surfactant (if species are present that glyphosate will not control)



Figure 3. Results of midstory injection using a 20 percent solution of Arsenal AC (note control of undesirable stems and increased light on the ground). Photo by Derek Alkire.

## ***Invasive/Noxious Species***

Many species have extremely aggressive growth rates and may become a severe threat to young hardwoods, especially if no chemical site preparation is used. If possible, try to control these species before hardwood establishment. Herbicidal control of several of these “problem” species is detailed below.

### **Morning-glory**

Morning-glory is a small, herbaceous vine that often climbs planted hardwoods, pulling seedling tops over. In agricultural fields, this vine can quickly overtake a large area, causing severe stem deformity and mortality of planted seedlings. In addition, seedling leaves are often shaded, resulting in insufficient light and increased seedling mortality. Seven species of morning-glory are native to Mississippi, and Goal 2XL will control the five most common. Pre-emergent treatment of morning-glory with Goal is not typically effective, but post-emergent applications have proven to have great control. Currently the treatment recommendation for morning-glory is:

32 ounces/acre Goal 2XL + an appropriate surfactant (post-emergent)

Timing of application varies depending on species involved and growing conditions, but it should occur when vine leaders are between 1 and 2 feet long.

### **Kudzu**

This introduced native of Asia has resulted in timber management problems across the state for decades. Several compounds are labeled for kudzu control, but Escort XP (metsulfuron methyl) typically yields the best results. If treating areas with seedlings/saplings, Escort XP may cause damage in hardwoods. Transline (clopyralid) is a more appropriate compound for controlling kudzu in areas with smaller hardwoods. Transline is not as effective as Escort XP, but it will not damage hardwoods. A relative newcomer in kudzu control is Streamline (aminocyclopyrachlor + metsulfuron methyl), which provides excellent control. Treatment recommendations include:

4 ounces/acre Escort XP + an appropriate surfactant

21 ounces/acre Transline + an appropriate surfactant

10 ounces/acre Streamline + an appropriate surfactant

Application for all three products should be done from July to October, with overall spray volumes in the 50 to 100 gallons per acre (GPA) range for adequate coverage.

### **Wisteria**

Wisteria is a vine species that impacts hardwood seedlings/saplings in a manner similar to morning-glory. The tops of smaller trees are pulled over and shaded by wisteria foliage. Additionally, this species may compete with larger trees in the same manner. Many products have been tested for wisteria control in hardwood areas with little success for most compounds. Transline has demonstrated good control, and the treatment recommendation is:

21 ounces/acre Transline + an appropriate surfactant

For greatest efficacy, herbicide applications should occur from May to July.

### **Trumpet Creeper**

Trumpet creeper, also known as “cow itch vine,” is another vine species that often has severe impacts on seedling growth and survival in regeneration efforts. Glyphosate has proven very effective in trumpet creeper control. Avoid herbicide contact with hardwood foliage because glyphosate will damage or kill the trees. The standard treatment recommendation for trumpet creeper is:

4 quarts/acre of a forestry-labeled glyphosate product + an appropriate surfactant

Herbicide applications should occur during late summer (August to September).

### **Redvine**

Redvine is a perennial woody vine common to bottomland sites with clay soils. The species can be difficult to control and competes with hardwood seedlings/saplings much in the same manner as morning-glory and wisteria. Heavy coverage of redvine often occurs, resulting in intense competition for light and subsequent planting failures. Dicamba HD (diglycolamine) can be used to provide good control in nonseedling areas. Chemical site preparation is the only viable option for redvine control on properties scheduled to be regener-



ated, or on those recently regenerated, because nontarget seedling damage is likely. In older hardwood stands, recommended treatment is:

2 quarts/acre Dicamba HD + an appropriate surfactant

Application timing should be during late summer (August to September).

### **Peppervine**

Peppervine is another vine species that is very problematic and very difficult to control. Little can be done to control peppervine after seedlings are planted or naturally regenerated. Multiple compounds have been tested with little success. The best option available for regenerating hardwoods in areas where peppervine occurs is to attempt control of the species during site preparation. Imazapyr at site preparation rates has shown promise in this regard.

### **Japanese climbing fern**

Another introduced vine native to southeastern Asia, Japanese climbing fern was introduced into Florida and spread throughout the state, into the southern portions of Gulf Coast states, and now into central Mississippi. Japanese climbing fern engulfs young trees underneath a dense canopy of vegetation. Damage and mortality is similar to that of other problem species discussed above. Current application recommendations are:

1 ounce/acre Escort XP + an appropriate surfactant (may damage seedlings)

5% vol/vol Clearcast + an appropriate surfactant (will damage seedlings)

Applications should be performed from July to October.

### **Cogongrass**

Cogongrass is native to southeastern Asia and was first reported in the United States in the early 1900s. The species outcompetes most native species, resulting in their suppression or elimination from the system. Cogongrass is spread between sites on unsanitized roadside/farming equipment. Combinations of imazapyr and glyphosate have been used in control attempts, but multiple-application treatments are needed for total control. Additionally, Streamline has proven very effective in cogongrass control. Control recommendations are:

10 ounces/acre Streamline + an appropriate surfactant (may damage seedlings)

Applications should take place during April.

### **Trifoliolate Orange**

Trifoliolate orange, sometimes called “mock orange,” “lemon tree,” or “Chinese bitter orange,” is native to Asia and closely related to citrus species. This species can form dense thickets capable of reducing available light to a level where most native hardwood species cannot be regenerated. Control can be difficult, but options are available in the form of basal and foliar treatments. Options for control include Garlon 4 (triclopyr ester), Garlon 3A, and Perspective (aminocyclopyrachlor + chlorsulfuron):

Basal sprays (large stems):

20–25% vol/vol Garlon 4 in basal oil

10% vol/vol Perspective in basal oil

Foliar spray (small stems):

4% vol/vol Garlon 3A + an appropriate surfactant (August)

### **Eastern Baccharis**

Eastern baccharis, also known as baccharis, saltbush, and groundsel tree, is a native invasive shrub species historically found in wetland and coastal areas. The species has become problematic throughout much of the state because its seeds are transported very easily by wind. Eastern baccharis readily establishes on sites with exposed mineral soil and will completely occupy cutover areas or old fields. Dense canopies are often formed in severe infestations of the species, with other species being eliminated or suppressed for some period of time. Timing of herbicide treatment varies depending on the compound used. Control recommendations include:

10 ounces/acre Streamline + an appropriate surfactant (July to September)

6 quarts/acre Garlon 4 + an appropriate surfactant (November to February) (nondormant hardwoods may be damaged or killed)

### **Chinese Privet**

Similar to many exotic species, Chinese privet was introduced as a landscaping plant. Originally, this shrub species was used as an ornamental and to form privacy hedges. It quickly spread through seed dispersal from

birds and root sprouts, and it can now be found across the state. Native plant species are quickly suppressed in the dense thickets that often form when Chinese privet grows unchecked. Varying degrees of control have been achieved using glyphosate, imazapyr, triclopyr, metsulfuron, and hexazinone. Of these, glyphosate products have produced the best results with lowest costs. The standard recommended treatment for Chinese privet in hardwood stands is:

5% vol/vol of a forestry-labeled glyphosate product + an appropriate surfactant (by hand)

4 quarts/acre of a forestry-labeled glyphosate product + an appropriate surfactant (aerial)

Hand applications can be performed year-round because Chinese privet is an evergreen. Aerial applications should be performed after hardwood leaf drop on nontarget vegetation (**late winter**). However, best efficacy for both treatments is achieved during the month of February in Mississippi. Optimal timing during February may be early in the month for south Mississippi and later in the month for northern portions of the state.

### **Chinese Tallowtree**

Another nonnative woody species native to Asia, Chinese tallowtree was introduced as an ornamental. Other names commonly associated with Chinese tallowtree include Florida aspen, chicken tree, popcorn tree, and tal-lowtree. Species characteristics include very quick growth, large amounts of seeds at as early as 3 years of age, extremely high seed germination rates, and decaying leaves that are toxic to other species of plants. These attributes make Chinese tallowtree extremely damaging to hardwood systems. Recommended treatments for control are:

64 ounces/acre Clearcast + methylated seed oil (MSO) (aerial)

2% vol/vol Clearcast + MSO (by hand)

30% vol/vol Krenite S + an appropriate surfactant

3% vol/vol Garlon 4 + an appropriate surfactant

All treatments should be applied July to October and will damage hardwood seedlings.

### **Yaupon Holly**

Yaupon holly is an evergreen shrub or small tree that is native to Mississippi and is used extensively in landscaping. While it is native, when released, it can cause some of the same regeneration and crowding issues as described for Chinese privet and eastern baccharis. Control efforts typically require multiple treatments, with site preparation treatments yielding the best results. However, repeated treatments in existing stands can be somewhat effective, with single-application treatments controlling up to 75 percent of yaupon stems. Subsequent spot spraying will be required. Treatment efficacy is greatest when application occurs during May or June. Recommended treatment for yaupon is as follows:

6 quarts of a forestry-labeled glyphosate + 2 quarts of Garlon 4 + an appropriate surfactant (spray to wet)

### **Bamboo**

Several species of bamboo have been introduced into southern ecosystems. All form extremely dense thickets that shade out and suppress native species. Most species grow too tall for over-the-top applications of herbicides by hand. Additionally, escaped bamboo multiplies so rapidly that aerial herbicide applications cannot adequately control it. The best option is to cut/bulldoze the stand. After stems resprout and are 1 to 3 feet tall, treat with Velpar (hexazinone) products. Standard treatment prescriptions for bamboo control are:

8–10 quarts/acre Velpar L + an appropriate surfactant

85–107 ounces/acre Velpar DF + an appropriate surfactant

### **Switchcane**

Switchcane, also known as giant cane and river cane, includes three species of native bamboos. Historically, these species formed dense canebrakes where other plant species could not survive. While switchcane is not as prevalent as in pre-European times, it can still cause problems in hardwood management. For troublesome quantities, the recommended treatment is:

4–5% vol/vol of a forestry-labeled glyphosate product + an appropriate surfactant

On occasion, larger canebrakes may need bulldozer/cutting treatment.

## Saw Palmetto

Saw palmetto is a small, slow-growing palm that grows on a variety of sites across the southeast United States. The species competes with other native species for moisture and nutrients and can reach densities that prohibit growth and survival of desired hardwoods. Best treatment options include:

2 quarts/acre Garlon 4 + 2 ounces/acre Escort XP + 1–2% vol/vol MSO

Due to the dense and extensive nature of saw palmetto vegetation, spray volumes should be 20 to 40 GPA. Typical control will be approximately 90 percent, and repeat spot treatment should be applied after 8 to 12 months.

## Conclusions

The practice of using herbicides in hardwood systems is increasing. Planning herbicide use in hardwood management can be difficult compared to that required in similar pine systems. However, most targeted species can be controlled through careful consideration of effective herbicides and appropriate application timing. Land managers should be cautious when using herbicides in any forest management effort, but current herbicide options for use in hardwoods make suppressing unwanted vegetation both efficient and cost effective.

## Additional Reading

Andrew B. Self, Andrew J. Londo, Andrew W. Ezell. 2015. Tree Injection with Reduced Labor Requirements. IS1573. Mississippi State University Extension Service.

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This work is supported by the USDA National Institute of Food and Agriculture, Renewable Resources Extension Act Project No. MISZ069400, Accession No. 1002390.

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Publication 2873 (POD-03-16)

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Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. GARY B. JACKSON, Director