HERBICIDE OPTIONS FOR HARDWOOD MANAGEMENT

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Abstract—The use of herbicides in hardwood management presents special problems in that many of the most effective herbicides are either designed to control hardwoods or the product is not labeled for such applications. Numerous studies involving herbicide application in hardwoods have been completed at Mississippi State University. This paper is a compilation of results from research projects which provides the latest information for such applications which we have to make available.

INTRODUCTION

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 more attainable than some other regions of the country provided the appropriate silvicultural methods are used. Even a casual observer of nature notes the ease with which various woody and herbaceous species colonize most sites in the South. Consequently, land managers are faced with a multitude of problems frequently associated with unwanted vegetative competition. These problems typically involve reduced growth in established stands and often include reduced survival in planted stands. Any given tract of land may possess a vast array of native plant species. Many of these species are not problematic and do not warrant special consideration in their role associated with hardwood management. 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 offer special problems in the management of hardwoods.

The use of herbicides has proven beneficial in management efforts by lowering establishment costs, increasing growth, reducing mortality, and lessening vine induced stem deformation. This publication informs the reader of options available in the treatment of undesirable vegetation in hardwood management efforts. Adherence to labeled application rates and timing is extremely important in hardwood management due to the negative impacts many of the most effective herbicides can have if applied improperly. Although not intended to be an all-encompassing listing, product names, rates, and application timings proven to have greatest efficacy in both operational forest herbicide work and research are reviewed.

ARTIFICIAL REGENERATION

Chemical Site Preparation For Cutover Sites

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, .etc.) and glyphosate (e.g. Accord® Concentrate, Accord® XRT II, .etc.) are the "gold standard" for use on cutover sites. There has been no noted documentation of phytotoxic symptoms on planted hardwoods due to residual soil activity of imazapyr when herbicide applications are performed at least 12 weeks prior to planting. Glyphosate, a foliar-active only herbicide, has no soil activity and has no residual effects. Due to prohibitive costs and a lack of growing season herbaceous control, very little chemical site preparation is performed in hardwood management.

Treatment applications of this nature are intended to aid in control of species that cannot be eliminated through use of a herbicide application after trees are planted.

If chemical site preparation should prove necessary, currently the standard recommendation is:

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

Application should occur in August – October late prior to planting.

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Chemical Site Preparation For Retired Agricultural Fields

Retired agricultural areas encompass a unique set of environmental variables not present in most cutover sites. While chemical site preparation on cutover sites primarily targets woody competition, former agricultural fields often do not have a woody component. Woody species present 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, is needed to aid in determining when non-planted woody plant density reaches a level that is detrimental to planted stems.

Site preparation will not provide control of herbaceous competition following 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 necessary for control of existing onsite vegetation that cannot be eliminated using growing season herbaceous weed control. Unless necessitated for control of one or more of these problem species, the expense of chemical site preparation is not justified.

If necessary, chemical site preparation on retired field sites is typically applied in bands 4 to 6 feet wide. Banding herbicides in this manner reduces overall treatment cost and maintains both cover and food sources for wildlife. Current application recommendations that vary by situation are:

- 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 August – October.

Herbaceous Weed Control

Herbaceous weed control (HWC) is a treatment designed solely for control of herbaceous competition during the first growing season after planting. Research over the last 25 years regarding herbicide rates and application timing has developed prescription recommendations. Currently, the typical HWC recommendation in hardwood plantings (excepting cottonwood) is:

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

Applied as a pre-emergent, Oust® XP (sulfometuron methyl) provides excellent control of most grass and broadleaf species when applied in bands or broadcast applications. Special consideration is warranted if treating areas with higher pH soils (applications of 1 ounce Oust® XP/acre should be used if pH ≥ 6.5) or areas that flood March - July. Other products are effective, but result in off-label use when used in hardwood management.

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 exhibits less residual soil activity and controls fewer species. Of particular note, Goal® can be applied post-emergent, but 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. The herbicide label should be consulted when determining 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 for control of “problem” grasses such as bermudagrass or johnsongrass with Select® generally exhibiting greater efficacy in single application treatments. Nonionic surfactants should be used if utilizing either product. Spray rates and appropriate application timings vary dependent upon 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 an adequate time period for establishment of planted seedlings in a “free-to-grow” status.

NATURAL REGENERATION

Light is the one of the most important factors in establishing and recruiting natural regeneration of hardwoods. Many regeneration attempts fail when established shade-tolerant midstory stems outcompete newly germinated shade-intolerant seedlings. Even 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 provides an effective means of control for undesirable stems competing for light in the midstory. Light is increased at ground level and young shade-intolerant stems are provided with adequate levels of light for growth.

Several compounds have been tested and are labeled for injection. Historically, much injection work was performed through girdling trees using frill cuts and "painting" a solution of Tordon® (picloram) into the cut. Tordon® products worked well in this capacity, but problems with non-target species being impacted were common. More recently, Arsenal® AC has become the standard for midstory injection work due to its effectiveness at controlling a wide variety of woody species while reducing labor requirements. Care should be taken to eliminate ground contact with imazapyr, as soil activity could result in non-target impact of hardwoods. Current midstory injection recommendations are:

> Arsenal® AC mixed at 20 percent vol/vol with water. Apply 1ml of solution per cut and use 1 cut per 3 inches of stem diameter

Efficacy of midstory injection with imazapyr varies depending on timing with early fall applications (September – October) proving most effective with slightly less control from November – February and July – August applications. Avoid injection during March – June.

While injection works typically works very well, other methods/compounds may be justified at times due to species resistance and numbers. Stand conditions may exist where the number of target small diameter stems precludes injection due to expense. Additionally, some species are naturally resistant to imazapyr (e.g. elms, locusts, eastern redbud, waxmyrtle). Control in these situations warrants use of a compound other than imazapyr. If either stand condition is encountered, and most target stems are not greater than 30 feet in height, skidder applications of glyphosate or Garlon® 3A (triclopyr - amine) may be possible. Under these conditions, standard application recommendations are:

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

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 on an area. If possible, managers should endeavor to control these species prior to 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 to a point were insufficient levels of light are available thus resulting in 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 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 will vary dependent upon species involved and growing conditions, but should occur when vine leaders are between one and three feet in length.

Kudzu—This introduced native of Asia has resulted in timber management problems across the state for decades. Several compounds are labeled for use in 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. Efficacy from Transline® is not as good as in Escort® XP, but damage to hardwoods is avoided. 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 timing for all three products should be in July – 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 seedling/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 control of wisteria 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 during the months of May – July.

Trumpet Creeper—Trumpet creeper, also known as "cow itch vine," is another vine species often having severe impacts on seedling growth and survival in regeneration efforts. Glyphosate has proven very effective in trumpet creeper control. Careshould be taken to avoid herbicide contact with hardwood foliage as 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 months (August – 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 planting failures due to intense competition for light. Dicamba HD (diglycolamine) can be used to provide good control in non-seedling areas. Chemical site preparation is the only option for redvine control on properties to be regenerated as non-target seedling damage will be prohibitive. If control of redvine is desired in older hardwood stands, recommended treatment is:

2 quarts/acre Dicamba HD® + an appropriate surfactant

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

Peppervine—Peppervine is another vine species that is very problematic and very difficult to control. Little can be done to control peppervine competition after seedlings are planted or naturally regenerated. Multiple compounds have been tested with little success. The best option available for managers wishing to regenerate hardwoods in areas where peppervine occurs is to attempt control of the species in site preparation efforts.

Japanese climbing fern—Another introduced vine native to southeastern Asia, Japanese climbing fern was introduced into Florida and has spread throughout Florida and into the southern portions of Gulf Coast states. Currently, the spread of the species has reached central Mississippi. Japanese climbing fern engulfs young trees underneath a dense canopy of vegetation. Damage and mortality to tree species 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 percent vol/vol Clearcast® + an appropriate surfactant (will damage seedlings)

Applications should be performed from July - 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 spread is promoted through the lack of cleaning roadside/farming/logging equipment when moving between sites. 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 in hardwoods are:

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

Applications should take place during April.

Trifoliate Orange—Trifoliate orange, sometimes called "mock orange," "lemon tree," or "Chinese bitter orange," is native to Asia and is closely related to citrus species. This species can form dense thickets capable of reducing available light to a point where native hardwood species cannot be regenerated under a canopy of trifoliate orange in the understory. 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 percent vol/vol Garlon® 4 in basal oil
- 10 percent vol/vol Perspective® in basal oil

Foliar spray (small stems):

- 4 percent 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 due to the ease with which its seeds are transported via 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 - September)
- 6 quarts/acre Garlon® 4 + an appropriate surfactant (November – February) (non-dormant 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 due to seed dispersal from birds and root sprouts, and 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 numerous herbicides including 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 percent 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 due to the evergreen status of Chinese privet. Aerial applications should be performed after hardwood leaf drop on non-target 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 non-native 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 tallowtree. The species exhibits very quick growth, produces large amounts of seeds at as early as three years of age, possesses extremely high seed germination rates, and decaying leaves are toxic to other species of plants. This listing of attributes enables Chinese tallowtree to serve in an extremely damaging capacity in hardwood systems. Recommended treatments for control are:

- 64 ounces/acre Clearcast® + Methylated Seed Oil (MSO) (aerial)
- 2 percent vol/vol Clearcast® + MSO (by hand)
- 30 percent vol/vol Krenite® S + an appropriate surfactant
- 3 percent vol/vol Garlon® 4 + an appropriate surfactant

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

Bamboo—Several species of bamboo have been introduced into southern ecosystems. All form extremely dense thickets where low levels of light preclude survival of native species. Most species reach heights that prevent “over-the-top” applications of herbicides by hand. Additionally, stem density and the quantity of foliage typical of escaped bamboo make obtaining adequate control through aerial applications of herbicides difficult. When control of established bamboo stands is desired, the best option is to cut/bulldoze the stand down. After stems resprout and are 1 -3 feet tall, herbicidal treatment is appropriate. Satisfactory control is obtained through the use of 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, include three species of native bamboos. Historically, these species formed dense cane brakes where other plant species could not survive. While the presence of switchcane is somewhat reduced from pre-European levels, the species can still prove problematic in hardwood management efforts.

If troublesome quantities of are encountered, the recommended treatment is:

> 4 - 5 percent vol/vol of a forestry labeled glyphosate product + an appropriate surfactant

On occasion, larger cane brakes may need bulldozer/cutting treatment similar to that described in the bamboo section.

Saw Palmetto—Saw palmetto is a small, slow growing palm that grows on a variety of sites across the southeast portion of the nation. 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 percent vol/vol MSO

Due to the dense and extensive nature of saw palmetto vegetation, spray volumes should be 20 – 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 utilizing herbicides in any forest management effort, but current herbicide options for use in hardwoods make suppressing unwanted vegetation both efficient and cost effective.