

# Weed Management in Switchgrass Produced for a Renewable Bioenergy Source Within a Loblolly Pine Plantation

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## INTRODUCTION

The American energy landscape continues to change with the adoption of flex-fuel vehicles and renewable energy sources. As the United States becomes less dependent on fossil fuel by blending it with renewable fuel, landowners and the private sector will be inclined to produce more bioenergy crops such as “Alamo” switchgrass (*Panicum virgatum* L.). Land with limited resources is good for production of both switchgrass and traditional timber commodities. Therefore, a silviculture system that includes switchgrass within a loblolly pine (*Pinus taeda*) plantation would help meet the demand for a bioenergy feedstock and timber. This sustainable approach would also provide an alternative market for landowners, promote a positive environmental impact, and preserve natural resources for future generations.

Weed management in switchgrass and loblolly pine can be achieved with labeled herbicides when they are grown in separate production systems. However, herbicide guidelines are not available for weed control when these two crops are grown together. In addition, the number of herbicides registered for use in switchgrass is limited, especially for grass control. Therefore, several herbicides that control grass and broadleaf weeds are being evaluated to determine the level of crop safety for switchgrass at different growth stages in the state of Mississippi and across the nation. Results from this research indicate that most herbicide options during the establishment of

switchgrass are applied over the top at the 3- to 4-leaf stage because switchgrass tolerance to many herbicides is low before this growth stage. In the future, we will have more weed control options as herbicides are registered for use in both switchgrass and loblolly pine, but even the best herbicide program may not control all weeds present in every situation. For this reason, it is important to identify weed species that exist in a field before planting switchgrass or loblolly pine in order to develop a weed management strategy given the options available. For example, selecting a bermudagrass pasture would not be a good idea since switchgrass is not tolerant to herbicides that control this weed species. In this case, an option would be to plant an herbicide-tolerant crop to eliminate the bermudagrass before planting switchgrass.

Several of the herbicides listed in this report are not labeled for use in switchgrass or loblolly pine. Therefore, this information should not be considered as a guideline. Instead, it is a review of herbicides that have been evaluated in switchgrass and loblolly pine production. This review was developed to provide the landowner with information based on federally registered herbicide labels, confirmed research, and scientific opinion where there was a lack of research. Mississippi State University will not be responsible for any crop injury resulting from an off-labeled use of any herbicide. Please read and follow all herbicide labels.

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# LOBLOLLY PINE PLANTATION

## SITUATION AND TARGET

### Woody Release

Hardwood sprouts and large trees in young (1- to 6-year-old) loblolly pine stands.

Same as above **plus** mixed hardwoods, winged elm, blackberry vines, etc.

### Site Preparation

Tracts of mixed brush and hardwoods for range and pasture establishment and all unwanted small trees and shrubs in advance of planting forest trees.

Tracts of mixed brush and hardwoods for range and pasture establishment and all unwanted small trees and shrubs in advance of planting forest trees.

## HERBICIDE SYSTEM

Apply **Arsenal AC** at 14–16 ounces per acre (imazapyr, 0.4–0.5 pound of active ingredient per acre) broadcast in 10–15 gallons of water per acre. Add nonionic surfactant at 0.5% v/v.

Apply **Arsenal AC** at 14–16 ounces per acre (imazapyr, 0.4–0.5 pound of active ingredient per acre) plus **Escort XP** at 1 ounce per acre (metsulfuron methyl, 0.6 ounce of active ingredient per acre). Apply broadcast in 10–15 gallons of water per acre. Add nonionic surfactant at 0.5% v/v.

Apply **Garlon XRT** at 41 ounces per acre (triclopyr, 2 pounds of active ingredient per acre) plus **Tordon K** at 0.5 gallon per acre (picloram, 1 pound of active ingredient per acre). Apply in 10–15 gallons of water per acre. Add nonionic surfactant at 0.5% v/v.

Apply **Velpar ULW** at 2.5–6.33 pounds per acre (hexazinone, 1.87–4.74 pounds of active ingredient per acre). The rate depends on soil texture (refer to label). Apply in 10–15 gallons of water per acre. Add nonionic surfactant at 0.5% v/v.

Apply **Chopper GEN II** at 24–32 ounces per acre (imazapyr, 0.375–0.5 pound of active ingredient per acre) plus **Accord XRT II** at 4–5 quarts per acre (glyphosate, 5.07–6.33 pounds of active ingredient per acre). Apply in 10–15 gallons of water per acre. Add nonionic surfactant at 0.5% v/v.

Apply **Chopper GEN II** at 32–36 ounces per acre (imazapyr, 0.5–0.56 pound of active ingredient per acre) plus **Escort XP** at 1 ounce per acre (metsulfuron methyl, 0.6 ounce of active ingredient per acre). Apply in 10–15 gallons of water per acre. Add nonionic surfactant at 0.5% v/v.

## SWITCHGRASS RESPONSE

Injury or death of established switchgrass will occur with imazapyr; germinating switchgrass may be killed up to 6 months after an imazapyr application.

Response to imazapyr is mentioned above. Metsulfuron will not injure switchgrass if applied alone.

**Other Notes:** If imazapyr is used alone or as a tank-mix partner, treatments should only be applied during the growing season before establishing switchgrass.

Even though triclopyr and picloram are used for the control of broadleaf weeds and woody plants, established switchgrass may be suppressed and temporarily injured with rates over 1 quart per acre. If these herbicides are applied alone at 1 quart per acre in the fall, switchgrass can be planted in the spring.

Unknown.

Injury or death of established switchgrass will occur with imazapyr; germinating switchgrass may be killed up to 6 months after an imazapyr application. Glyphosate can be applied alone before planting switchgrass and/or to dormant switchgrass before spring green up.

Response to imazapyr is mentioned above. Metsulfuron will not injure switchgrass if applied alone.

**SITUATION AND TARGET**  
*continued*

Same as above **plus** substantial amounts of native pine.

Same as above **plus** substantial amounts of waxy leaf species.

**HERBICIDE SYSTEM**  
*continued*

Apply **Chopper GEN II** at 24–32 ounces per acre (imazapyr, 0.375–0.5 pound of active ingredient per acre) plus **Krenite S** at 4–8 quarts per acre (fosamine, 4–8 pounds of active ingredient per acre) or **Accord XRT II** at 4–5 quarts per acre (glyphosate, 5.07–6.33 pounds of active ingredient per acre). Add non-ionic surfactant at 0.5% v/v. Apply in 15 gallons of water per acre to ensure coverage.

Apply **Tordon K** at 2 quarts per acre (picloram, 1 pound of active ingredient per acre) plus **Garlon XRT** at 32–48 ounces per acre (triclopyr, 1.6–2.4 pounds of active ingredient per acre). Apply in 10–15 gallons of water per acre. Add nonionic surfactant at 0.5% v/v.

Apply **Chopper GEN II** at 32–36 ounces per acre (imazapyr, 0.5–0.56 pound of active ingredient per acre) plus **Garlon XRT** at 20–25 ounces per acre (triclopyr, 1–1.25 pounds of active ingredient per acre). Apply in 10–15 gallons of water per acre. Add nonionic surfactant at 1 % v/v.

**SWITCHGRASS RESPONSE**  
*continued*

Response to imazapyr is mentioned above. Fosamine does not injure grasses at normal use rates. Glyphosate can be applied alone before planting switchgrass and/or to dormant switchgrass before spring green up.

Even though picloram and triclopyr are used for the control of broadleaf weeds and woody plants, established switchgrass may be suppressed and temporarily injured with rates over 1 quart per acre. If these herbicides are applied alone at 1 quart per acre in the fall, switchgrass can be planted in the spring.

Response to imazapyr and triclopyr is mentioned above.

**Other Notes:** If imazapyr is used alone or as a tank-mix partner, treatments should be applied only during the growing season before establishing switchgrass.

# SWITCHGRASS BIOENERGY FEEDSTOCK

SITUATION AND TARGET	HERBICIDE SYSTEM	LOBLOLLY PINE RESPONSE
<p><b>Established switchgrass or reseeded an existing stand</b> Broadleaf and some grass weeds early spring before green up <b>PRE</b> or over the top of switchgrass (3- to 4-leaf) <b>POST</b></p>	<p>Apply <b>Pastora</b> at 1 ounce per acre (nicosulfuron, 0.56 ounce of active ingredient per acre; plus metsulfuron methyl, 0.15 ounce of active ingredient). Apply <b>POST</b> (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre, and add NIS at 0.25% v/v for control of some grasses and several broadleaf weeds. <b>This treatment will not control crabgrass or dallisgrass. Temporary stunting of switchgrass is possible.</b></p>	<p>No injury to loblolly pine is expected, but this is not confirmed by research.</p>
	<p>Apply <b>Atrazine 4L</b> at 1–2 quarts per acre (1–2 pounds of active ingredient per acre). Apply <b>PRE</b> in early spring during switchgrass dormant period before green up or <b>POST</b> (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre. Add COC at 1% v/v to control annual, small-seeded broadleaf and some grass weeds; this treatment is most effective if applied before weed seedlings emerge.</p>	<p>No injury to loblolly pine is expected at these rates, but the risk of injury will increase at higher rates. It may be applied before planting, after planting, and in established stands of trees.</p>
	<p>Apply <b>Diuron 4L</b> at 1.6–2.4 quarts per acre (1.6–2.4 pounds of active ingredient per acre). Apply <b>PRE</b> during switchgrass dormant period before green up and weed seedling emergence for control of certain annual grasses and small-seeded broadleaf weeds. Apply in 15–20 gallons of water per acre.</p>	<p>Unknown</p>
	<p>Apply <b>Pursuit</b> at 2–4 ounces per acre (imazethapyr, 0.031–0.063 pound of active ingredient per acre) or <b>Cadre</b> at 2–4 ounces per acre (imazapic, 0.031–0.063 pound of active ingredient per acre). Apply in 15–20 gallons of water per acre. If applied <b>POST</b> (3- to 4-leaf switchgrass), add NIS at 0.25% v/v. Expect injury, reduced growth, and possibly death of switchgrass. <b>Do not use if this end result cannot be tolerated.</b></p>	<p>No injury to loblolly pine is expected, but this is not confirmed by research. There is some potential for reduced tree growth. <b>Do not use if this result cannot be tolerated.</b></p>

**SITUATION AND TARGET**  
*continued*

Broadleaf and some grass weeds early spring before green up **PRE** or over the top of switchgrass (3- to 4-leaf) **POST**

**HERBICIDE SYSTEM**  
*continued*

Apply **Cimarron Plus** at 0.125–0.625 ounce per acre (metsulfuron-methyl, 0.06–0.6 ounce of active ingredient per acre; plus chlorosulfuron, 0.019–0.094 ounce of active ingredient).\* Apply **POST** (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre with NIS at 0.25% v/v for control of most broadleaf weeds. **This system will not control grasses except Pensacola-type bahiagrasses.**

\* Metsulfuron-methyl and chlorosulfuron are available alone and in other premixes. Some trade names include Telar, Pastora, Cimarron Max, Cimarron X-tra, Chaparral, etc. Consult the labels.

Apply **2,4-D Amine** at 1–2 pints per acre (0.5–1 pound of active ingredient per acre). Apply **POST** (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre with NIS at 0.25% v/v for control of broadleaf weeds. **Do not expect grass control.**

Apply **Banvel or Clarity** at 0.5–1 pint per acre (dicamba, 0.25–0.5 pound of active ingredient per acre). Apply **POST** (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre with NIS at 0.25% v/v for control of broadleaf weeds. **Do not expect grass control.**

Apply **Outrider** at 1.25 ounces per acre (sulfosulfuron, 0.94 ounce of active ingredient per acre). Apply **POST** (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre with NIS at 0.25% v/v for control of several annual and perennial sedges, grass, and broadleaf weeds. There will be limited soil residual activity. **This treatment may cause chlorosis, stunting, and thinning of switchgrass.**

Apply **Prowl H<sub>2</sub>O** at 1.1–4.2 quarts per acre (pendimethalin, 1.05–4 pounds of active ingredient per acre). Apply **PRE** in 15–20 gallons of water per acre while switchgrass is dormant, before green up, and before weed seedlings emerge for control of most annual grasses and some broadleaf weeds.

**LOBLOLLY PINE RESPONSE**  
*continued*

The treatment can be used in a loblolly pine plantation.

Damage to loblolly pine can occur.

Damage to loblolly pine can occur. It may be used in site preparation or as a directed spray (in a way that does not contact loblolly pine) for the control of hardwood species.

No injury to loblolly pine is expected, but this is not confirmed by research.

No injury to loblolly pine is expected.

**SITUATION AND TARGET**  
*continued*

**Newly seeded switchgrass  
during establishment year**

Control of some annual and perennial weeds in pure stands of newly seeded switchgrass.

**HERBICIDE SYSTEM**  
*continued*

Apply **Pastora** at 1 ounce per acre (nicosulfuron, 0.56 ounce of active ingredient per acre; plus metsulfuron methyl, 0.15 ounce of active ingredient). Apply **POST** (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre with NIS at 0.25% v/v for control of some grasses and several broadleaf weeds. **This treatment will not control crabgrass and dallisgrass. Temporary stunning of switchgrass will occur.**

Apply **Atrazine 4L** at 1–2 quarts per acre (1–2 pounds of active ingredient per acre). Apply in 15–20 gallons of water per acre as **PRE** or **POST** (3- to 4-leaf switchgrass) to control annual, small-seeded broadleaf and some grass weeds; the treatment is most effective if applied before weed seedlings emerge. If small weeds are present, add COC at 1% v/v. If applied **PRE**, delayed emergence and less germination of switchgrass may occur.

Apply **2,4-D Amine** at 1–2 pints per acre (0.5–1 pound of active ingredient per acre). Apply **POST** (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre with NIS at 0.25% v/v for control of broadleaf weeds. **Do not expect grass control.**

Apply **Cimarron Plus** at 0.125–0.625 ounce per acre (metsulfuron-methyl, 0.06–0.6 ounce of active ingredient per acre; plus chlorosulfuron, 0.019–0.094 ounce of active ingredient)\*. Apply **POST** (3- to 4-leaf switchgrass) in 15–20 gallons of water per acre with NIS at 0.25% v/v for control of most broadleaf weeds. **Do not expect control of any grasses except Pensacola-type bahiagrasses.**

\* Metsulfuron-methyl and chlorosulfuron are available alone and in other premixes. Examples of trade names are Telar, Pastora, Cimarron Max, Cimarron X-tra, Chaparral, etc. Consult the labels.

**LOBLOLLY PINE RESPONSE**  
*continued*

No injury to loblolly pine is expected, but this is not confirmed by research.

No injury to loblolly pine is expected at these rates, but the risk of injury will increase at higher rates. It may be applied before planting, after planting, and in established stands of trees.

Damage to loblolly pine can occur.

The treatment can be used in a loblolly pine plantation.

## SITUATION AND TARGET

*continued*

Control of some annual and perennial weeds in pure stands of newly seeded, well-developed switchgrass.

## HERBICIDE SYSTEM

*continued*

Apply **GrazonNext HL** at 1.2–2.1 pints per acre (aminopyralid, 0.06–0.11 pound of active ingredient per acre; plus 2,4-D, 0.5–0.87 pound of active ingredient). Apply **POST** (after switchgrass is well established) in 15–20 gallons of water per acre with NIS at 0.25% v/v to control broadleaf weeds and certain woody plants. **Apply only after switchgrass has begun to tiller, developed a secondary root system, and shown good vigor.**

Apply **Milestone** at 4–7 ounces per acre (aminopyralid, 0.06–0.11 pound of active ingredient per acre). Apply **POST** (after switchgrass is well established) in 15–20 gallons of water per acre with NIS at 0.25% v/v to control broadleaf weeds and certain woody plants. **Apply only after switchgrass has begun to tiller, developed a secondary root system, and shown good vigor.**

## LOBLOLLY PINE RESPONSE

*continued*

Do not apply as a broadcast over the top of desired pines. Applications made as a side trim or in row middles may discolor or control contacted foliage.

Do not apply as a broadcast over the top of desired pines. Applications made as a side trim or in row middles may discolor or control contacted foliage.



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