Pre-Plant Chemical Site Preparation Options to Establish Loblolly, Longleaf, and Slash Pine Plantations on Cut-over Sites

9 November 2015

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Some form of site preparation is needed to establish a southern pine (loblolly, longleaf, slash, Virginia, shortleaf) plantation. This is the case whether the site was just harvested of the last crop of trees, or converting a pasture or cropland site. Southern pines are shade intolerant, and require a “free to grow” environment. Like all plants, Southern pines have three major requirements: water, sunlight, and nutrients. Site preparation treatments should optimize all three of these requirements. In most cases, competition control is the most important objective in preparing a site to plant pine seedlings. On soils that are somewhat poorly to very poorly drained (many Atlantic and Gulf Flatwoods soils), mechanical bedding is often needed to ensure adequate seedling survival and early growth. Some site preparation activities can also enhance the ease of planting the site by reducing or moving logging debris. This paper will discuss the chemical site preparation treatment options for establishing loblolly, longleaf and slash pine in South Georgia and North Central Florida.

Residual hardwoods pose a severe competitive threat to pines planted on cut-over sites. Glover and Zutter (1993) examined the stocking of planted loblolly pine at age 27 years based on the amount of residual hardwood stems in established in the stand at age 3 years. Figure 1 illustrates that when residual hardwood stem count at age 3-years is less than 600 stems/acre (on nine study areas) loblolly pine basal area, at age 27-years, ranges from 120 to 225 square feet/acre and pine survival and growth is good to excellent. When residual hardwood stems count at age 3-years is greater than 1,200 stems/acre (on six study areas), pine basal area is less than 60 square feet by age 27-years. Pine basal area decreases to almost zero by age 27 when the number of residual hardwoods stems approach 5,500 stems/acre. This shows the importance of controlling hardwoods at planting to insure good pine survival and growth.

Generally, in the first three years in the life of a pine stand, competition primarily comes from grasses and broadleaf weeds. Starting around age 4-years hardwood, volunteer pines, and woody shrubs become the main competitors in pine plantations on cut-over sites as they compete with the planted pines for sunlight, water and nutrients. Preplant site preparation is key to cost-effective control of volunteer pines, woody shrubs, and hardwoods and, when possible, herbaceous weeds.
Once the seedlings have been planted, herbicide choices are more limited to cost-effectively provide control of woody vegetation.

A number of forest herbicides, available as brand name and generic formulations, are commonly used for site preparation to establish loblolly, longleaf and slash pine plantations. Imazapyr (Chopper) and Accord (glyphosate) are often tank mixed in the middle to upper Coastal Plain and Piedmont while Chopper and Triclopyr (Garlon) are tank mixed in the flatwoods to control waxy leaf shrubs. Escort or Oust Extra is often tank mixed with Chopper and Accord or Chopper and Garlon to control spring herbaceous weeds and blackberry. Oust XP is tank mixed to provide spring herbaceous weed control (HWC) when blackberry is not a problem on the site.

The key to effective site preparation, is to control as much of the unwanted hardwoods, woody shrubs, volunteer pines and perennial herbaceous weeds pre-plant to allow the planted pines to survive and grow well. Percent bare ground (at least 50-60%) around the seedlings into the early July can be very important for survival and growth in droughty first year springs and for growth if the first year spring has normal to better than normal rain. Generally, applying the herbicide when there is 2 to 4 feet of growth on the woody vegetation to be controlled provides the best control. Herbicides applied on bare ground (soon after a clear-cut) or when woody vegetation and volunteer pines heights are greater and 5-6 feet and multi-canopied do not generally work as well and higher herbicide rates may be needed. Studies completed in the last 10 years have found that Chopper, one of the most common forest herbicides used in the Southeast for site preparation applied at 48 oz per acre prior to August, resulted in 26% and 46% greater 2-year growth response for loblolly ad slash pine, respectively, than treatments made in August and later. (Figure 2). Another study by Yeiser (1999) found that 32 oz/ac Chopper applied in September gave slightly better control than 64 oz/ac of Chopper applied in May (Figure 3). Based on these studies we may be able to lower the Chopper rate as we go from May to September.

The addition of Oust, Escort or Oust Extra to the tank mix if the herbicide application is made after early to mid-August can provide good to excellent herbaceous weed control into the following spring as noted by work done Ezell in Mississippi (Figure 4). The goal is to get 50-60% bare ground around the seedlings to late June as most years the great majority (75-85%) of mortality occurs prior to July.

Figure 5 includes herbicides to add to the tank to control volunteer pines. It is best and easiest to control volunteer pines when they are less than 3 feet tall. A site preparation burn, 6 to 8 weeks after the herbicides have been applied, can help reduce volunteer pine numbers.

Tables 4 and 5 list the common forest site preparation herbicides, the highly susceptible woody plants, and the resistant plants for each herbicide.
HERBICIDES FOR PRE-PLANT SITE PREPARATION (typically applied in 10 to 40 gallons/acre water by air or with ground equipment; with a surfactant, crop oil or methylated seed oil to improve leaf penetration for foliar active herbicides)

ARSENAL® AC (BASF; 53% imazapyr; 4 lb acid equivalent (ae) per gallon) or 27% imazapyr; CHOPPER ® or CHOPPER GEN 2 ® (BASF; 27% imazapyr; 2 lbs ae per gallon) or generic imazapyr products (Polaris AC, Polaris SP, Rotary 2SL, Imazapyr 4SL)

♦ A soil and foliar active herbicide

♦ Effective control of:

   50 species of annual and perennial grasses including difficult to control species like Bermudagrass and seedling Johnsongrass as well as, but not limited to: bahiagrass, barnyardgrass, bluegrass (annual, Kentucky), crabgrass, fescue, foxtail, Italian ryegrass, lovegrass, panicums, sandbur, wild oats, witchgrass, camphorweed, carpetweed, chickweed, clovers, cocklebur, dandelion, dogfennel, horseweed, goldenrod, knotweed, lambsquarters, milkweed, ragweed (common, giant), pepperweed, pigweed, plantain, pokeweed, purslane, pusley (Florida), shepard’s pursue, sowthistle, stinging nettle, annual spurge, sunflower, tansymustard, wild carrot, wild parsnip, wild turnip

♦ Effective control of:

   73 broadleaf weed species, 12 vines and brambles species, and 65 woody trees and brush species (see Arsenal or Chopper label for complete list)

♦ Weak on broadleaf weeds in the composite group (see Oust XP®), blackberry, and most legumes

♦ Optimum timing: May into early October (refer to http://www.bugwood.org/Imazapyr_Site_Prep_6-2012.pdf for application and planting interval timing)

♦ Rates: Typically 16 to 24 oz/ac for the 4 lb ae/gallon product (Arsenal AC) and 32 to 48 oz/ac for the 2 lb ae/gallon product (Chopper). Rates can change depending on tank mixing, application timing, pine species planted behind imazapyr, and planned planting date.

♦ Notes: Imazapyr is a widely use forest herbicide due to its relatively broad spectrum of control, residual soil activity and residual control, and is often tanked mixed with other products to enhance the spectrum of control.
VELPAR L® (25% hexazinone, 2 lb active ingredient per gallon) and VELPAR DF ® (75% hexazinone) or generic hexazinone products

♦ Rate is based on soil texture. Refer to tables 1 and 2.

♦ A soil active herbicide

♦ Broad spectrum weed control of broadleaf weeds and most grasses, weak on Bermudagrass, some panicums, and broomsedge. Grass & broadleaf control including, but not limited to: chickweed, crabgrass, dogfennel, fescue, fireweed (willowweed), goldenrod, horseweed, Kentucky bluegrass, nutsedge (yellow), panicum (broadleaf), pokeweed, ragweed, shepherd’s purse, white snakeroot, yellow sweetclover, annual bluegrass, barnyardgrass, foxtail barley, foxtail fescue, Italian ryegrass, jointed goatgrass, bromes (red, ripgut), reed canarygrass, signalgrass, yellow foxtail, mustard, pepperweed, pigweed, sunflower, vetch, wild carrot, wild oats, asters, brackenfern, fleabane

♦ Woody plants and vines controlled: ash, aspens, birch, blackgum, black cherry, deerbrush, flowering dogwood, elm, hawthorn, hickory, honeysuckle, red maple, oaks, balsam poplar, sourwood, sweetgum, and willows (listed but not limited to; see DuPont Velpar L or DF labels for all species controlled).

♦ Optimum timing: late March into early June (apply when competition to be controlled is in the half to full leaf expansion phase for best control)

♦ Rates: Typically 1 to 2.5 gallons/acre for Velpar L. Rate will depend on soil texture (course soils = 1 to 1.5 gallons/acre, medium textured soils = 1.5 to 2 gallons/acre and fine textured soils = 2 to 2.5 gallons/acre) and % organic matter. For Veplar DF 2.67 to 6.67 lbs/acre (course soils = 2.67 to 4 lbs/ac, medium textured soils = 4 to 5.33 lbs/ac, and fine soils = 5.33 to 6.67 lbs/acre)

♦ Notes: hexazinone works well on sandy, sandy loams, and loamy sand soils and is considered the best product to eradicate most oak species.

ACCORD XRT® (DOW; 53.5% glyphosate, 5 lb glyphosate a.e. per gallon) or generic glyphosate products labeled for forestry site prep use

♦ A foliar active herbicide; no soil activity (herbicide must come in contact with foliage to enter the plant)

♦ Effective control of a broad spectrum of grasses, broadleaf weeds, vines, most hardwoods, and small (less than 2 feet tall) volunteer loblolly and slash pines (when applied in June to early August)

♦ Rates of 3 to 6 qts/ac from mid-July to early October @ 15 to 25 GPA
FORESTRY GARLON XRT® (DOW; 83.9% triclopyr, 6.3 lb triclopy a.e. per gallon) or generic triclopyr products labeled for forestry site prep use

♦ A foliar active herbicide only; no soil activity (herbicide must come in contact with foliage primarily to enter the plant)

♦ Best herbicide for control of waxy leaf flatwoods species such as gallberry, titi, wax myrtle, and saw palmetto (with Escort) as well as good control of most hardwoods, broadleaf weeds, vines and small (less than 2 feet tall) volunteer loblolly and slash pines (when applied in June to early August)

♦ A grass friendly herbicide – will not kill most native (and non-native) grasses

♦ Rates of 1 to 3 qts/ac from mid-July to early October @ 15 to 25 GPA (caution – do not use older ester based products like Garlon 4 when temps are greater than 86 degrees F due to volatilization issues and possible off target foliage burn/mortality)

TANK MIXES:

♦ Flatwoods sites ➔ 32 to 48 oz/ac Chopper + 1 – 2 qt/ac Garlon with 1 qt/ac methylated seed oil (MSO) @ 15 to 25 GPA applied from mid-July to early October will control most Flatwoods woody waxy leaf shrubs

♦ Middle to Upper Coastal Plain sites ➔ 32 to 48 oz/ac Chopper + 3 to 4 qts/ac Accord @ 15 to 25 GPA applied from June to early October will control most Coastal Plain woody plants

HERBICIDES AS PART OF A TANK MIX WITH THE ABOVE PRODUCTS (when application is after mid-August):

OUST® XP (Bayer; 75 % sulfometuron methyl)

♦ For pre-plant use to establish loblolly and slash pine (not labeled for longleaf)

♦ Add 3 to 4 oz/ac Oust XP product per acre to Chopper, Chopper + Accord or Chopper + Garlon when applied after 15 August

♦ Very effective on a broad spectrum of broadleaf weeds, including composites

♦ Weak on perennial grasses including Bermudagrass, some panicums, and broomsedge species (see Arsenal® AC)
♦ Pre-emergence to early post emergence
♦ Do not use Oust when soil pH > 6.2
♦ Grass & broadleaf control including, but not limited to: chickweed, crabgrass, dogfennel, fescue, fireweed (willowweed), goldenrod, horseweed, Kentucky bluegrass, nutsedge (yellow), panicum (broadleaf), pokeweed, ragweed, shepherd’s purse, white snakeroot, yellow sweetclover, annual bluegrass, barnyardgrass, foxtail barley, foxtail fescue, Italian ryegrass, jointed goatgrass, bromes (red, ripgut), reed canarygrass, signalgrass, yellow foxtail, mustard, pepperweed, pigweed, sunflower, vetch, wild carrot, wild oats
♦ For pre-plant use to establish loblolly, longleaf, and slash pine

**OUST® EXTRA** (Bayer; 56.25 % sulfometuron methyl + 15% metsulfuron methyl)
♦ Add 3-4 oz Oust Extra product per acre to Chopper, Chopper + Accord or Chopper + Garlon when applied after 15 August
♦ Pre to early post emergence
♦ Note Escort XP + Oust XP for plants controlled
♦ For pre-plant use to establish loblolly and slash pine (not labeled for longleaf)

**ESCORT® XP** (Bayer; 60% metsulfuron methyl)
♦ Add 1/3 - 2 oz Escort XP product per acre to Chopper, Chopper + Accord or Chopper + Garlon when applied after 15 August (typically Oust Extra is used due to having two herbicides to increase spectrum of control)
♦ Pre to early post emergence
♦ Blackberry control + broadleaf weeds & grasses: annual sowthistle, aster, bahiagrass, beebalm, bittercress, bitter sneezeweed, blackberry, blackeyed-susan, blue mustard, bull thistle, buttercup, chicory, cocklebur, common chickweed, common groundsel, common purslane, common yarrow, common sunflower, conical catchfly, corn cockle, crown vetch, curly dock, dandelion, dewberry, dogfennel, false chamomile, fiddleneck tarweed, field pennycress, garlic mustard, goldenrod, henbit, honeysuckle, multiflora rose and other wild roses, lambsquarters, lettuce (miners, wild), marestail/horseweed*, maximilian sunflower, mustard (transy-, treacle, wild), oxeye daisy, Pennsylvania smartweed, plantain, pigweed (redstem, smooth), plumless thistle, prostate knotweed, redstem
filaree, sericea lespedeza, sheperd’s purse, silky crazyweed (locoweed), false flax, sweet clover, tansey ragwort, teasel, wild carrot, wild garlic, woolly croton, wood sorrel, yankeeweed with the use of Escort XP.

* Certain biotypes of marestail/horseweed are less sensitive to Escort XP.

Figure 1. Pine basal area at age 27-years as a function of number of hardwoods at age 3-years from 15 study areas (Glover and Zutter 1993)
Table 1. Velpar L rate per acre based on soil texture

Pre-plant Chemical Site Prep

• Early season (late March –late May) = hexazinone (soil active):

• Velpar L (liquid), *rate based on soil texture, % OM

• Great oak sp. Control, weak on sassafras, y. poplar

<table>
<thead>
<tr>
<th>Soil texture</th>
<th>Velpar L rate (qts/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse –sand , loamy sand, sandy loam</td>
<td>4 – 6</td>
</tr>
<tr>
<td>Medium – loam, silt loam, sandy clay loam</td>
<td>6 – 8</td>
</tr>
<tr>
<td>Fine – silty clay loam, clay loam, sandy clay, silt, silty clay, clay</td>
<td>8 - 10</td>
</tr>
</tbody>
</table>

Table 2. Velpar DF rate per acre based on soil texture

Pre-plant Chemical Site Prep

• Early season (late March – late May) = hexazinone (soil active herbicide)

• Velpar DF (dry flowable), *rate based on soil texture, % OM

• Great oak sp. Control, weak on sassafras, y. poplar

<table>
<thead>
<tr>
<th>Soil texture</th>
<th>Velpar DF rate (lbs/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse –sand , loamy sand, sandy loam</td>
<td>2.67 – 4.0</td>
</tr>
<tr>
<td>Medium – loam, silt loam, sandy clay loam</td>
<td>4.0 – 5.33</td>
</tr>
<tr>
<td>Fine – silty clay loam, clay loam, sandy clay, silt, silty clay, clay</td>
<td>5.33 – 6.67</td>
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</tbody>
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Table 3. Chopper and Chopper + Garlon (Flatwoods) or Chopper + Accord (glyphosate) rate per acre based on physiographic region and timing

**Pre-plant Chemical Site Prep**

- **Mid-late season (June – early October)** = imazapyr (soil and foliar active):
  - Chopper @ 40 to 48 oz/ac → can go to 64 oz/ac (not recommended) but need longer wait period to plant pine seedlings > 4-5 months)
  - Arsenal is Chopper @ 2x strength without a surfactant
  - Great sweetgum control, weak on blackberry, legumes
- * add Oust XP or Oust Extra (except longleaf) if application date is after early August to control anticipated following spring herbaceous weeds

<table>
<thead>
<tr>
<th>Physiographic region</th>
<th>Chopper rate (oz/ac)</th>
<th>Glyphosate rate (41% ae) (qts/ac)</th>
<th>Garlon 4 ultra (qts/ac)</th>
<th>Oust XP or Oust Extra* (oz/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flatwoods (waxy leaf species present)</td>
<td>48; before 1 August</td>
<td>1 - 3</td>
<td></td>
<td>4 – 5 (except PD soils)</td>
</tr>
<tr>
<td>Coastal Plain, Sand Hills</td>
<td>40; 1 Aug – 15 Sept; &gt;15 Sept</td>
<td>3 - 5</td>
<td></td>
<td>After early August in tank mix</td>
</tr>
<tr>
<td>Piedmont</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 2. Chopper @ 48 oz/ac site preparation studies illustrating timing and 2-year volume index for slash and loblolly pine (46% greater 2-yr volume index for slash pine when Chopper was applied prior to August and 26% greater 2-yr volume index for loblolly pine when Chopper was applied prior to August at the 48 oz/ac rate). (Lauer and Quicke 2006, SJAF)
Figure 3. Chopper timing and dosage study illustrating the effect of hardwood control. Note that 32 oz/ac in Sept gave slightly better hardwood control than 64 oz/ac in May. Overall control was better later in the year than earlier in the year (Sept > July > May).

Figure 4. Percent bare ground as of 15 June the following year after September site prep treatments. Note that adding 3 oz/ac Oust gave 82 to 89% bare ground compared to their counterpart treatment without Oust having only 21% bare ground.
Figure 5. Herbicides to add to the tank to control volunteer pines. Shorter (<2 feet) volunteer pines are easier to control. A prescribe fire 2 months after the herbicide(s) have been applied can reduce volunteer pine numbers.

Table 4. Susceptibility of woody species to commonly used site prep (soil or foliage+soil active) herbicides

<table>
<thead>
<tr>
<th>Herbicide name</th>
<th>Highly susceptible</th>
<th>“Resistant”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexazinone</td>
<td>most red oaks and white oaks, sweetgum, winged elm, blackberry, basswood, hawthorn</td>
<td>yellow poplar, Eastern red cedar, sassafras, blackgum, holy, American beautyberry</td>
</tr>
<tr>
<td>Imazapyr</td>
<td>sweetgum, red oak, water oak, willow, red maple, sumac, blackgum, post oak</td>
<td>elm, locust, redbud, buckeye, blackberry, waymyrtle</td>
</tr>
</tbody>
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Table 5. Susceptibility of woody species to commonly used site prep foliar active herbicides

<table>
<thead>
<tr>
<th>Herbicide name</th>
<th>Highly susceptible</th>
<th>“Resistant”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate</td>
<td>sweetgum, blackgum, white oak, water oak, willow, birch, blackberry</td>
<td>red maple, black cherry, ash, hickory, dogwood</td>
</tr>
<tr>
<td>Triclopyr</td>
<td>yellow poplar, hickory, blackgum, elm, locust, waxmyrtle, ash, willow, sassafras, blackberry</td>
<td>black cherry, Eastern red cedar, hawthorn, persimmon, sumac, American beautyberry</td>
</tr>
</tbody>
</table>