Southern Forest
Nursery Management Cooperative

# RESEARCH REPORT 21-02

## TOLERANCE OF 13 HARDWOOD SPECIES TO AT-SOWING APPLICATIONS OF FLUMIOXAZIN

by
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### INTRODUCTION

Consistent, dependable weed control in bareroot hardwood growing systems has been a challenge to growers since their addition into SFNMC member nurseries' production inventories. Because of the large variety of hardwood species grown and the number of weed species needed to control, targeting a specific weed in a specific hardwood crop with an untested herbicide active ingredient (with its combinations of rates, timings and application methods) has been a task not undertaken lightly or often. In a review of 173 trials conducted by the SFNMC since 1995, only 11 (6.4%) were performed for identification of herbicides for weed control in hardwoods. Much information is available in the horticultural market for hardwoods grown in containers for ornamental purposes, but that information is often not transferable to the bareroot growing systems found in Cooperative member nurseries. It has been far easier to identify herbicides for use in conifer growing systems than for hardwoods.

Because weeds continue to inhibit hardwood seedling production efficacy, this trial was installed at the request of a member nursery who had applied a specific herbicide to small test areas with variable results in the prior year. Based on their findings and a survey of all hardwood species grown by Cooperative members, this trial was designed for one herbicide to be applied at a single rate and a single application in 13 common hardwood species grown. The purpose of the trial was to quantify those species' tolerance to spray treatments of this herbicide made at the time of sowing. The 13 species included in the trial were:

| Hardwood common name | Scientific name | No. of SFNMC nurseries producing | Hardwood common name | Scientific name | No. of SFNMC nurseries producing |
|---|---|---|---|---|---|
| Baldcypress | *Taxodium distichum* | 7 | Persimmon | *Diospyros virginiana* | 7 |
| Catalpa | *Catalpa bignonioides* | 1 | Redbud | *Cercis canadensis* | 5 |
| Chickasaw plum | *Prunus angustifolia* | 5 | Sawtooth oak | *Quercus acutissima* | 6 |
| Crabapple | *Malus* spp. | 5 | Swamp chestnut oak | *Quercus michauxii* | 5 |
| Crepe myrtle | *Lagerstroemia* | 1 | White oak | *Quercus alba* | 7 |
| Dogwood | *Cornus florida* | 6 | Yellow poplar | *Liriodendron tulipifera* | 4 |
| Northern red oak | *Quercus rubra* | 5 | | | |

## METHODOLOGY

This trial was installed at the Georgia Forestry Commission Nursery near Montezuma, Georgia in February and May of 2020. The six February-sown species included crabapple, dogwood, northern red oak, sawtooth oak, swamp chestnut oak, and white oak. Beds sown to crabapple and dogwood were treated three days post-sowing and oaks were treated the day of sowing. The seven May-sown species included baldcypress, catalpa, chickasaw plum, crepe myrtle, persimmon, redbud, and yellow poplar. Seedbeds of these seven species were treated one day after sowing.

Trial installations in each species included randomized block designs with plots being one seedling bed wide and either 5 or 10 feet in length, depending on seedbed availability. Each treatment was replicated five times, with each of the 13 resulting trial beds containing 5 non-treated control plots and 5 treated plots. All treated plots in seedbeds were sprayed with 10 ounces per acre of 51.0% flumioxazin as a water dispersible granule product after seedbeds had been sown and mulched. The product was watered in with irrigation after spray treatments. Applications were made by SFNMC personnel using a handheld 3-nozzle boom sprayer covering the width of one bed per pass and calibrated to apply the equivalent of 25 gallons per acre.

Germination counts were made in plots of early-sown seedbeds in May 2020 at 12 weeks post-sowing; counts in later-sown species were made in June 2020 at 8 weeks post-sowing. The results of these germination counts are in Table 1 and Figure 1. Based on low germination counts in some seedbeds, the decision was made to discontinue any collection or measurement work in 7 species: baldcypress, crabapple, crepe myrtle, dogwood, redbud, white oak, and yellow poplar. It should be noted that this decision was made not only for those species with evidently fewer treated seedlings than non-treated seedlings, but also for species whose seedbeds had washed out during heavy rains shortly after sowing.

In February 2021, staff and crew members from SFNMC, GFC and a contract lifting crew collected sample seedlings from all plots in the remaining 6 species: catalpa, Chickasaw plum, northern red oak, persimmon, sawtooth oak, and swamp chestnut oak. Prior to the lifting operation, counting frames (4 feet by 12 inches) were laid in the approximate center of each plot (60 plots) and stems of each seedling within each counting frame were spray-painted to designate them as to be collected. As the lifter passed over each plot, seedlings marked for collection were gathered and placed in pre-labeled bags for packing. All other seedlings were collected for shipment to customers. Bags of all seedlings collected from the trial were bundled and transported to the SFNMC greenhouse and lab for processing.

Measurements of seedling counts, ground line diameters, shoot heights, and shoot and root dry weights were made on samples collected in the field. For seedling counts, GFC guidance of a minimum height of 18 inches, or slightly less if seedling had a large diameter, was used to discard those small seedlings which would be considered not saleable by the nursery. Results of these measurements are included in Table 2. All data was analyzed and examined using Duncan's Multiple Range test and Dunnett's t-test at alpha = 0.05.

## RESULTS

The effect of a single application of 10 ounces per acre of 51.0% flumioxazin at sowing was species-dependent. The germination of four species was negatively affected by the herbicide

application (crabapple, crepe myrtle, dogwood, and redbud). Inconclusive treatment results were found in trial beds of baldcypress, white oak, and yellow poplar due to insufficient sample sizes resulting from beds being washed out. Of the six remaining species, four showed no differences in seedling characteristics when compared to the non-treated seedlings. These unaffected seedlings were catalpa, Chickasaw plum, persimmon and sawtooth oak. Two species showed negative effects in seedling height and/or ground line diameter when treated with the herbicide. Treated northern red oak seedlings had smaller ground line diameters (by 0.09 millimeters) and swamp chestnut oak had shorter stems (by 28.3 centimeters) and smaller ground line diameters (by 2.32 millimeters) than non-treated control seedlings.

## MANAGEMENT IMPLICATIONS

The use of flumioxazin **at sowing** in hardwood seedling nurseries can be considered as an option for weed control in catalpa, Chickasaw plum, persimmon, sawtooth oak, northern red oak, and swamp chestnut oak. However, prior to its operational use in these 6 species or its use in any other hardwood species, it is recommended that small test plots be established where it has not been previously used. The use of these test plots by nursery personnel will enable growers to quickly determine detrimental effects to species less tolerant of this herbicide.

## ACKNOWLEDGEMENTS

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**Table 1.** Germination density per square foot (at 8 or 12 weeks post-sowing) of 13 hardwood species treated with flumioxazin at sowing.

| Species | Treatment | Germination Density/ft$^2$ |
|---|---|---|
| Baldcypress[1] | Control | 0.0 |
| | Treatment | 0.0 |
| Catalpa | Control | 8.2 |
| | Treatment | 5.4 |
| Chickasaw plum | Control | 3.1 |
| | Treatment | 2.9 |
| Crabapple | Control | 5.0 |
| | Treatment | 0.6 |
| Crepe myrtle | Control | 13.2 |
| | Treatment | 0.0 |
| Dogwood | Control | 14.8 |
| | Treatment | 1.2 |
| Northern red oak | Control | 3.6 |
| | Treatment | 3.8 |
| Persimmon | Control | 3.6 |
| | Treatment | 3.2 |
| Redbud | Control | 11.4 |
| | Treatment | 1.6 |
| Sawtooth oak | Control | 5.8 |
| | Treatment | 6.8 |
| Swamp chestnut oak | Control | 4.8 |
| | Treatment | 4.4 |
| White oak[1] | Control | 2.0 |
| | Treatment | 1.4 |
| Yellow poplar[1] | Control | 0.6 |
| | Treatment | 0.3 |

Single underlined means within a seedling characteristic indicate significant treatment difference from that of the non-treated control at that rate according to Dunnett's T-test at alpha = 0.05.

[1]Beds of baldcypress, white oak, and yellow poplar were washed out prior to germination counts.

**Table 2.** Hardwood seedling characteristics (measured at 10 or 13 months old) treated with flumioxazin at sowing.

| Species | Treatment | Density/ft$^2$ | Shoot Height (cm) | GLD (mm) | Shoot Weight (g) | Root Weight (g) |
|---|---|---|---|---|---|---|
| Catalpa | Control | 8.0 | 78.0 | 10.25 | 11.69 | 10.22 |
| | Treatment | 6.0 | 84.5 | 11.93 | 15.23 | 13.79 |
| Chickasaw plum | Control | 3.2 | 63.8 | 6.56 | 8.64 | 6.57 |
| | Treatment | 2.3 | 76.0 | 8.74 | 20.4 | 14.92 |
| Northern red oak | Control | 2.2 | 83.0 | 13.00 | 25.88 | 47.76 |
| | Treatment | 2.2 | 71.5 | 12.11 | 20.32 | 42.71 |
| Persimmon | Control | 3.6 | 52.9 | 7.51 | 5.34 | 15.71 |
| | Treatment | 3.2 | 64.6 | 8.55 | 8.04 | 20.63 |
| Sawtooth oak | Control | 4.6 | 92.5 | 10.50 | 37.87 | 37.87 |
| | Treatment | 4.4 | 94.0 | 10.46 | 41.91 | 41.91 |
| Swamp chestnut oak | Control | 2.6 | 77.9 | 12.40 | 23.49 | 23.49 |
| | Treatment | 2.1 | 49.6 | 10.08 | 18.47 | 18.47 |

Single underlined means within a seedling characteristic indicate significant treatment difference from that of the non-treated control at that rate according to Dunnett's T-test at alpha = 0.05.

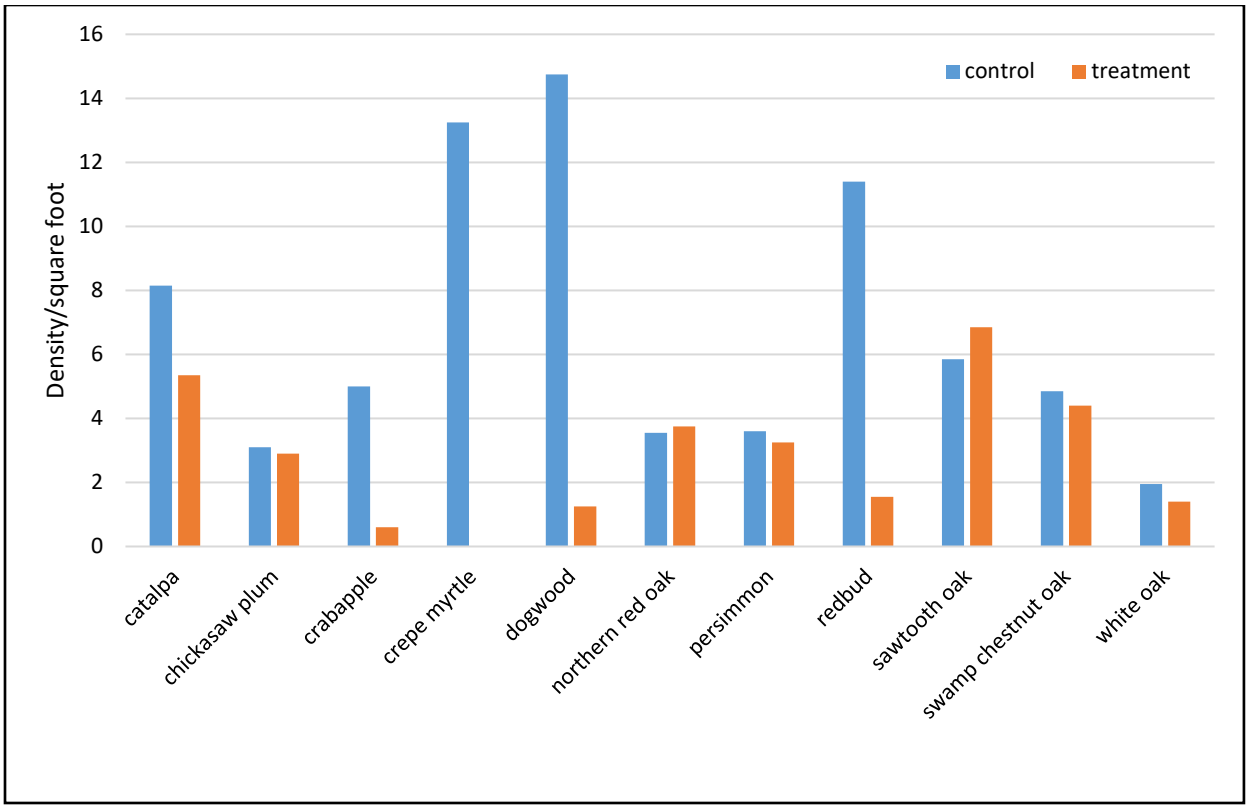


**Figure 1.** Germination density per square foot at 8 or 12 weeks post-sowing of 13 hardwood species treated with flumioxazin at sowing.