Southern Forest Nursery Management Cooperative™

RESEARCH REPORT 24-03

VEXIS® (PYRIMISULFAN) TRIALS FOR NUTSEDGE CONTROL IN BAREROOT HARDWOOD SEEDLING BEDS

by
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INTRODUCTION

Of the 30 nurseries currently operated by members of the Southern Forest Nursery Management Cooperative (SFNMC), eight produce bareroot hardwood seedlings. Although this is a small number of nurseries, it is estimated that they produce approximately half of all bareroot hardwood seedlings in the U.S. (Pike et al, 2023). Most of these member nurseries are operated by state forestry agencies. One of these state nurseries, Arkansas Forestry Commission's Baucum Nursery, produced more bareroot hardwood seedlings in 2022 than any other nursery in the U.S. These production figures emphasize the importance of continuing research to improve seedling quality and increase production efficiently.

Weed control in hardwood nurseries continues to be a costly endeavor as fuel, chemical, and labor costs increase while labor availability has decreased. Herbicide trials are rarely conducted in these nurseries by manufacturers, so the SFNMC conducts trials for hardwood growers as potential herbicides are identified for use. The most recent SFNMC herbicide trials in hardwood beds were installed in 2020 (Research Report 21-02). A review of SFNMC herbicide trials done since 1995 showed that only 6% were placed in hardwood nurseries. The paucity of trials conducted is a function of the complexity of testing in a large variety of crop species on a variety of weeds. Labeling herbicides for these nurseries can also be problematic. If a herbicide currently labeled for other sites is identified as safe on certain hardwood species, the labeling process is more difficult than in conifer nurseries due to the even smaller acreages available for treatment by the 'new' herbicide.

The current (2021-2024) SFNMC focus on testing pyrimisulfan in two formulations in conifer seedbeds led to the decision to test pyrimisulfan in member hardwood nurseries. One of these products produced by PBI-Gordon, Vexis®, was selected for use in these initial trials. Vexis® is a selective, postemergent granular herbicide containing 0.025% pyrimisulfan for the control of annual sedge, yellow and purple nutsedge and broadleaf weeds. It is currently labeled for use in turf, non-production areas and sod production, but not bareroot hardwood nurseries. The purpose of these trials was to evaluate several hardwood species' tolerance to the herbicide for SFNMC members and to provide data to the manufacturer.

METHODOLOGY

One goal of the 2023 Vexis® hardwood trials was to provide as much data on as many hardwood species as possible within the limitations of the SFNMC staff and hardwood species' availability. With this in mind, two SFNMC nurseries offered seedlings of six species for testing. The nurseries, their soil types, and species tested are listed below:

Nursery	Soil type	Species
Georgia Forestry Commission Flint River Nursery Byromville, GA	Eustis loamy sand, 0-2% slopes (0-68 inches loamy sand, 68-72 inches sand)	Catalpa, thuja, yellow poplar, sawtooth oak, persimmon
North Carolina Forest Service Claridge Nursery Goldsboro, NC	Wickham loamy sand, 0-2% slopes (0-6 inches fine sandy loam, 6-50 inches sandy clay loam, 50-80 inches loamy sand)	White oak

At the recommendation of PBI-Gordon, two rates of Vexis® were tested: 1) the label rate of 2 pounds per 500 square feet, and 2) two times the label rate (4 pounds per 500 square feet). One application was made, with the timing of this application based on nutsedge appearance in the beds and the availability of staff to make applications. Herbicide application procedures duplicated those in SFNMC pine Vexis® trials, with the use of a PVC pipe frame (4' X 5') placed at each plot to identify the application area. Premeasured Vexis® samples were applied by hand by SFNMC staff on corresponding plots which were measured and flagged prior to herbicide application. Three to five replications were installed in the various species, depending on bed space availability, using 45 feet to 75 feet of bed space per species. Field plot layouts are shown in Figure 1. If rainfall did not occur, the SFNMC staff recommended that the 'watering window' of 48 hours recommended on the label be shortened to 24 hours. Irrigation or rainfall is significant when using granular herbicides in hardwood species, as granules remaining on leaves for a longer period of time may cause damage to the desired crop.

Treatment information is listed below:

Treatment No.	Description	Vexis® Rate
1	control	no treatment
2	1X rate @ various ages based on species' sow date	2 lbs./500 ft^2
3	2X rate @ various ages based on species' sow date	4 lbs./500 ft^2

At the end of the growing season, hardwood seedling samples were collected from each plot in each installation. All seedlings within a 12-inch by 4-foot counting frame placed in each plot were lifted by hand and taken to the SFNMC laboratory in Auburn, Alabama for measurements. Visual inspections of nutsedge and other weeds were noted.

Seedlings collected from each plot were sorted based on root collar diameter and height, with minimums set for each species by the nursery growing the seedlings. The number of merchantable seedlings per square foot and culls per square foot were determined from this sorting procedure. All merchantable seedlings were measured for shoot height, ground line diameter, shoot dry weight, and root dry weight. Data was analyzed using R Statistical Software (v4.1.2; R Core Team 2021) to identify significant differences between the means of each measured characteristic with Tukey's Honest Significant Difference (HSD) post hoc test. A significance level at alpha = 0.05 was used for comparisons.

RESULTS

When evaluating herbicide tolerance in hardwood species, it should be noted that comparisons to more uniform pine seedling characteristics should not be made. Fewer hardwood seeds are initially sown than in pine, with much more variation in quantities and sizes realized.

Catalpa: No statistically significant negative effects of Vexis® were quantified in any seedling characteristic in any application. Data and analyses from the catalpa installation is reported in Table 1. Because fewer seedlings per square

foot were growing in the treated plots, their characteristics measured were larger numerically, particularly in shoot and root dry weights. Culls of catalpa were those with a ground line diameter of less than 6.0 millimeters and a height of less than 60 centimeters.

Thuja: Negative effects of Vexis® on thuja seedlings were visually evident in the field and were determined to be statistically evident during data analysis. Fewer seedlings per square foot, higher number of culls, shorter seedlings, smaller diameter seedlings, and less dry weight of shoots and roots were measured in treated plots' seedlings than those seedlings from plots that were not treated. Data and analyses from the thuja installation is reported in Table 2. Culls of thuja were those with a ground line diameter of less than 3.0 millimeters.

Yellow poplar: No statistically significant negative effects of Vexis® were quantified in any seedling characteristic in any application. Data and analyses from the yellow poplar installation is reported in Table 3. Culls of yellow poplar were those with a ground line diameter of less than 4.0 millimeters and a height of less than 20 centimeters.

Sawtooth oak: No statistically significant negative effects of Vexis® were quantified in any seedling characteristic in any application. Data and analyses from the sawtooth oak installation is reported in Table 4. Culls of sawtooth oak were those with a ground line diameter of less than 4.0 millimeters and a height of less than 20 centimeters.

Persimmon: Treated plots in the persimmon bed contained no seedlings at the end of the growing season. Damage to and mortality of treated seedlings was evident shortly after Vexis® applications. Because no seedling samples were collected in the treated plots, no data was recorded, nor statistical analysis done.

White oak: No statistically significant negative effects of Vexis® were quantified in any seedling characteristic in any application. Data and analyses from the white oak installation is reported in Table 5. Culls of white oak were those with a ground line diameter of less than 6.35 millimeters and a height of less than 36 centimeters.

Nutsedge: Evidence of the effect of competition from nutsedge was visible in those beds with nutsedge, with fewer, smaller trees noted in the nontreated control plots. The boundary lines between control and treated plots were evident in those beds with nutsedge.

MANAGEMENT IMPLICATIONS

Of the six hardwood species treated with Vexis®, two (persimmon and thuja) should not be included in a pyrimisulfan herbicide regimen for nutsedge control due to the negative effects of the herbicide on seedlings.

The remaining four species, catalpa, yellow poplar, sawtooth oak, and white oak showed tolerance to the granular pyrimisulfan product in a single application in these trials. Future trials should retest Vexis® in these four species with more replications per installation if possible to mitigate the effects of small numbers of seedlings per sample collected. The manufacturer of Vexis® recommends future testing be focused on the hardwood species with the largest quantities and highest profit margin grown at SFNMC member nurseries.

Because these SFNMC trials were the first testing of Vexis® in hardwood, any member nursery growing hardwoods that wishes to conduct in-house trials should follow the guidelines for testing contained in "How To Test Herbicides In Forest Tree Nurseries", USFS General Technical Report PNW- 127, accessible at https://research.fs.usda.gov/treesearch/7521.

ACKNOWLEDGEMENTS

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15 feet	REP 5		2X rate
			control
			1X rate
15 feet	REP 4		1X rate
			2X rate
			control
15 feet	REP 3		control
			2X rate
			1X rate
15 feet	REP 2		2X rate
			1X rate
			control
15 feet	REP 1		1X rate
			control
			2X rate

Figure 1. Field layout of plots in pyrimisulfan (Vexis®) hardwood trials conducted by the SFNMC in 2023.

Table 1. Bareroot catalpa seedling characteristics treated with pyrimisulfan (Vexis®) at 5 weeks post-sowing on May 30, 2023, at Georgia Forestry Commission Flint River Nursery, Byromville, GA.

Treatment	Rate (lbs./500 ft²)	Merchantable density (seedlings/ft²)	Culls (seedlings/ft²)[3]	Shoot Height (cm)	Ground line diameter (mm)[1,2]	Shoot dry weight (g)	Root dry weight (g)
Control	0.0	4.43 ± 0.07	5.33 ± 2.33	92.9 ± 2.38	13.7 ± 0.6 b	21.2 ± 2.1	16.3 ± 1.2
1X label rate	2.0	3.00 ± 0.76	4.00 ± 2.31	94.2 ± 2.93	15.7 ± 1.0 ab	35.0 ± 13.0	30.9 ± 12.0
2X label rate	4.0	2.37 ± 0.43	2.33 ± 1.45	97.8 ± 4.05	**17.4 ± 1.3** a	38.9 ± 6.1	36.0 ± 7.1
p>f		*0.068*	*0.616*	*0.527*	*0.016*	*0.359*	*0.277*

[1]Bold within a seedling characteristic indicates significant difference between that rate and control.
[2]Different letters within a seedling characteristic indicate significant differences in rates.
[3]Culls = GLD<6.0 mm, height<60 cm.

Table 2. Bareroot thuja seedling characteristics treated with pyrimisulfan (Vexis®) at 5 weeks post-sowing on May 30, 2023, at Georgia Forestry Commission Flint River Nursery, Byromville, GA.

Treatment	Rate (lbs./500 ft²)	Merchantable density (seedlings/ft²)	Culls (seedlings/ft²)[3]	Shoot Height (cm)	Ground line diameter (mm)[1,2]	Shoot dry weight (g)[1,2]	Root dry weight (g)
Control	0.0	5.50 ± 0.76	5.00 ± 1.73 a	31.6 ± 1.11 a	5.06 ± 0.18 a	4.44 ± 0.82 a	2.13 ± 0.38
1X label rate	2.0	2.77 ± 1.46	**13.00 ± 1.20** b	27.8 ± 1.03 ab	**3.92 ± 0.17** b	2.53 ± 0.23 ab	1.70 ± 0.19
2X label rate	4.0	2.03 ± 1.13	11.30 ± 1.20 ab	**26.5 ± 1.27** b	**3.76 ± 0.14** b	**1.95 ± 0.20** b	1.45 ± 0.11
p>f		*0.162*	*0.021*	*0.009*	*<0.001*	*0.029*	*0.243*

[1]Bold within a seedling characteristic indicates significant difference between that rate and control.
[2]Different letters within a seedling characteristic indicate significant differences in rates.
[3]Culls = GLD<3.0 mm.

Table 3. Bareroot yellow poplar seedling characteristics treated with pyrimisulfan (Vexis®) at 5 weeks post-sowing on May 30, 2023, at Georgia Forestry Commission Flint River Nursery, Byromville, GA.

Treatment	Rate (lbs./500 ft²)	Merchantable density (seedlings/ft²)	Culls (seedlings/ft²)[1]	Shoot Height (cm)	Ground line diameter (mm)	Shoot dry weight (g)	Root dry weight (g)
Control	0.0	6.03 ± 1.95	22.00 ± 1.53	37.1 ± 1.17	6.36 ± 0.20	1.67 ± 0.35	2.58 ± 0.05
1X label rate	2.0	6.77 ± 0.79	22.70 ± 6.94	34.9 ± 1.20	6.67 ± 0.21	2.14 ± 0.33	3.47 ± 0.20
2X label rate	4.0	6.43 ± 1.59	26.70 ± 4.26	37.8 ± 1.20	6.14 ± 0.17	1.94 ± 0.20	2.76 ± 0.38
p>f		*0.944*	*0.766*	*0.269*	*0.138*	*0.577*	*0.091*

[1]Culls = GLD<4.0 mm, height<20 cm.

Table 4. Bareroot sawtooth oak seedling characteristics treated with pyrimisulfan (Vexis®) at 10 weeks post-sowing on May 30, 2023, at Georgia Forestry Commission Flint River Nursery, Byromville, GA.

Treatment	Rate (lbs./500 ft²)	Merchantable density (seedlings/ft²)	Culls (seedlings/ft²)[3]	Shoot Height (cm)[1,2]	Ground line diameter (mm)[1,2]	Shoot dry weight (g)[1,2]	Root dry weight (g)[1,2]
Control	0.0	5.97 ± 0.60	1.33 ± 0.67	49.6 ± 1.38 a	6.56 ± 0.19 a	4.20 ± 0.18 a	13.20 ± 0.68 a
1X label rate	2.0	6.10 ± 0.21	3.67 ± 2.67	**54.6 ± 1.22** b	7.21 ± 0.25 ab	5.80 ± 0.68 ab	15.40 ± 0.44 a
2X label rate	4.0	5.27 ± 0.37	0.67 ± 0.33	**59.6 ± 1.24** c	**7.85 ± 0.25** b	**7.69 ± 0.48** b	**18.10 ± 0.40** b
p>f		*0.389*	*0.431*	*<0.001*	*<0.001*	*0.007*	*0.002*

[1]Bold within a seedling characteristic indicates significant difference between that rate and control.
[2]Different letters within a seedling characteristic indicate significant differences in rates.
[3]Culls = GLD<4.0 mm, height<20 cm.

Table 5. Bareroot white oak seedling characteristics treated with pyrimisulfan (Vexis®) at 23 weeks post-sowing on June 21, 2023, at North Carolina Forest Service Claridge Nursery, Goldsboro, NC.

Treatment	Rate (lbs./500 ft²)	Merchantable density (seedlings/ft²)	Culls (seedlings/ft²)[1]	Shoot Height (cm)	Ground line diameter (mm)	Shoot dry weight (g)	Root dry weight (g)
Control	0.0	2.78 ± 0.25	8.00 ± 1.10	29.1 ± 1.6	8.37 ± 0.30	4.97 ± 0.92	15.30 ± 1.73
1X label rate	2.0	2.88 ± 0.55	8.20 ± 1.74	28.4 ± 2.0	8.33 ± 0.31	4.43 ± 0.40	14.30 ± 0.61
2X label rate	4.0	3.28 ± 1.32	11.20 ± 4.47	24.4 ± 1.6	7.86 ± 0.24	3.48 ± 1.11	12.10 ± 2.72
p>f		*0.906*	*0.680*	*0.125*	*0.362*	*0.490*	*0.492*

[1]Culls = GLD<6.35 mm, height<36 cm.