2019 HERBICIDE TRIAL RESULTS

SFNMC 2020 VIRTUAL CONTACT MEETING

JULY 20, 2020

Southern Forest Nursery Management Cooperative

Nina Dowling Payne

RESULTS OF TRIALS INSTALLED IN 2019

- CONTAINER Ronstar®Flo Pre-emergent Herbicide Trial – 3 years
- BAREROOT Post-Emergent Herbicide Screening Trial – 4 years

Southern Forest
Nursery Management Cooperative

Southern Forest
Nursery Management Cooperative

RESEARCH REPORT 20-02

APPLICATION OF RONSTAR®FLO (OXADIAZON) FOR WILLOW CONTROL IN CONTAINERIZED GROWING SYSTEMS: A SUMMARY OF THREE YEARS OF TRIALS

by
Nina Payne, Ryan Nadel, and Scott Enebak

INTRODUCTION

As the quantity of pine seedlings grown for reforestation steadily increases annually, the percentage increase in the number of containerized seedlings produced in the southern U.S. has outpaced those grown in bareroot nurseries. Between 2012 and 2018, the number of bareroot seedlings grown in 13 southern states has increased by 12%. In contrast, the number of container seedlings has increased by 19% in the same 6-year time period (Harper et al 2013, Haase et al 2019).

As production increases, so does the need for information and technologies developed specifically for the management of containerized growing systems, including weed control products suitable for these nurseries. Few of the herbicides currently used operationally in bareroot nurseries have been tested in, or are labeled for use in container nurseries. In the southern U.S., one unwanted plant that continually presents a problem in containers is black willow (*Salix nigra*) (Starkey et al 2015). The presence of a black willow seedling growing within a pine seedling container plug diminishes the pine seedling's value and decreases its viability (Starkey 2014). The current method of controlling black willow infestations in containers is primarily their removal by hand, which is a costly, labor-intensive operation further compounded by the potential shortage of available workers to perform this nursery sanitation task (Starkey et al 2015).

The Southern Forest Nursery Management Cooperative (SFNMC) has tested potential herbicides for use in controlling black willow in containerized growing systems since 2014. Multiple testing trials are required prior to operational use as herbicidal active ingredients interact differently in container growing media than in bareroot growing systems. One herbicide tested was Marengo® (indaziflam) (Bayer CropScience, North Carolina), which was tested in 2014, 2016 and 2017. A second herbicide tested was Pendulum®AquaCap™ (pendimethalin) (BASF, North Carolina) in 2015, 2016, and 2017. Both Marengo® and Pendulum®AquaCap™ were found to be unacceptable for use in containerized nurseries due to decreased plug weights in treated seedlings and inconsistencies in effects on most seedling characteristics (Enebak et al 2015, Payne et al 2016a, b, 2017a, b and 2018). The selection of Ronstar®Flo (oxadiazon) (Bayer CropScience, North Carolina) for testing was a result of its successful testing in 2012 and 2013 in bareroot nurseries (Enebak et al 2013 and 2014). The product is labeled for use in conifer nurseries in pre-emergent applications or as a directed spray to the soil in postemergent

RONSTAR®FLO PRE-EMERGENT HERBICIDE TRIALS IN CONTAINERS – 3 YEARS OF STUDY

3 YEARS OF STUDY: 2017, 2018, 2019

- To identify safe (seedling tolerant) herbicide providing control of black willow in containers
- 2017: 1 nursery, 4 species, 4 rates, sample size of 15 trays
- 2018: 1 nursery, 3 rates, 2 species, sample size of 15 trays
- 2019: 2 nurseries, 1 rate, 4 species, sample size of 50 trays

Southern Forest
Nursery Management Cooperative

RESULTS

- SEEDLING TOLERANCE BY SPECIES
- WILLOW CONTROL
- WEED CONTROL

Southern Forest
Nursery Management Cooperative

Container **longleaf** pine seedling characteristics treated with RonstarFlo in 3 years

Year	Application Date	Rate	Survival[1] (% Fill)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Plug Weight[2] (g)
2017	3/23/17	0 oz./ac	83.4	26.6	8.10	3.12	13.73
		40 oz./ac	82.9	26.4	8.18	3.08	13.77
		80 oz./ac	83.7	26.1	8.18	3.10	13.69
		122 oz./ac	79.8	26.3	8.30	3.18	13.89
2018	3/21/18	0 oz./ac	85.0	29.6	8.86 a	4.10 a	13.74 a
		40 oz./ac	83.1	29.6	8.49 b	3.71 b	13.61 a
		80 oz./ac	84.2	29.9	8.83 ab	4.11 a	14.08 b
	3/28/18	0 oz./ac	88.1 a	28.8	7.66 ab	3.50	12.07
		40 oz./ac	83.5 b	28.6	7.95 a	3.54	11.83
		80 oz./ac	87.0 a	29.3	7.45 b	3.58	11.81
2019	3/11/19	0 oz./ac	83.2	28.0	9.55	3.40	12.04
		40 oz./ac	78.8	29.1	9.48	4.08	12.33
	3/18/19	0 oz./ac	83.3	31.1	9.40	3.92	12.32
		40 oz./ac	86.5	30.1	9.19	3.45	12.13

Southern Forest Nursery Management Cooperative

Container **loblolly** pine seedling characteristics treated with RonstarFlo in 3 years

Year	Application Date	Rate	Survival[1] (% Fill)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Plug Weight[2] (g)
2017	4/10/17	0 oz./ac	92.7 a	26.2	3.72	2.05	11.38
IFCO		40 oz./ac	93.2 a	26.6	3.75	2.09	11.52
		80 oz./ac	90.2 a	26.7	3.78	2.12	11.69
		122 oz./ac	86.5 b	26.1	3.78	2.07	11.81
2018	4/2/18	0 oz./ac	97.8	30.1	3.65 a	2.00	10.39
IFCO		40 oz./ac	98.0	30.3	3.72 ab	1.99	10.29
		80 oz./ac	95.3	30.3	3.78 b	1.95	10.39
	4/10/18	0 oz./ac	98.2	31.5	3.94	2.35 a	11.77 a
		40 oz./ac	97.4	31.2	3.89	2.25 a	11.21 b
		80 oz./ac	97.4	31.2	3.85	2.10 b	11.23 b
2019	4/2/19	0 oz./ac	94.9	25.7	3.71	1.54	10.19
IFCO		40 oz./ac	87.1	24.4	3.70	1.46	9.96
	4/15/19	0 oz./ac	96.8	33.6	3.98	2.72	10.61
		40 oz./ac	97.1	32.9	3.87	2.60	10.39
2019	4/11/19	0 oz./ac	95.8	38.9	3.70	2.14	7.01
Westervelt		40 oz./ac	94.0	38.5	3.77	2.18	6.91
	4/17/19	0 oz./ac	92.4	32.2	3.66	1.86	6.95
		40 oz./ac	92.8	31.5	3.70	1.82	6.94

-10 seedlings per tray

-4 seedlings per tray

Southern Forest Nursery Management Cooperative

SUMMARY OF SEEDLING TOLERANCE IN 2 SPECIES

- LONGLEAF (5 installations)
  - Plug weights: no differences
  - Shoot weights: lower in 2 of 5, <0.5 grams
  - Shoot height: lower in 1 of 5, 1.0 cm
  - Survival: lower in 1 of 5, 6 seedlings per tray

- LOBLOLLY (7 installations)
  - Plug weights: lower in 3 of 7, 0.22 – 0.56 grams
  - Shoot weights: lower in 1 of 7, 0.08 grams
  - Shoot height: lower in 3 of 7, 0.7 – 1.3 cm
  - Survival: lower in 2 of 7, 4 – 10 seedlings per tray

Southern Forest
Nursery Management Cooperative

Container **slash** pine seedling characteristics treated with RonstarFlo in 2 years

Year	Application Date	Rate	Survival[1] (% Fill)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Plug Weight[2] (g)
2017	4/21/17	0 oz./ac	93.5	28.7	4.22	2.77	12.61
		40 oz./ac	92.5	28.4	4.21	2.66	12.77
		80 oz./ac	89.9	27.8	4.14	2.61	12.78
		122 oz./ac	90.2	27.6	4.18	2.64	12.62
2019	4/30/19	0 oz./ac	79.6	27.2	3.85	2.37	10.98
		40 oz./ac	81.7	28.5	3.88	2.39	10.80

Southern Forest Nursery Management Cooperative

Container **shortleaf** pine seedling characteristics treated with RonstarFlo in 2 years

Year	Application Date	Rate	Survival[1] (% Fill)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Plug Weight[2] (g)
2017	4/20/17	0 oz./ac	88.0	21.5	3.99	1.86	11.22
		40 oz./ac	89.1	21.8	3.92	1.90	11.37
		~~80 oz./ac~~	~~86.7~~	~~21.9~~	~~3.98~~	~~1.92~~	~~11.38~~
		~~122 oz./ac~~	~~88.0~~	~~22.0~~	~~3.98~~	~~1.90~~	~~11.36~~
2019	5/9/19	0 oz./ac	75.9	21.5	3.71	1.56	8.85
		40 oz./ac	76.5	19.9	3.70	1.51	9.02

Southern Forest Nursery Management Cooperative

Percent likelihood of
0 willows present
in longleaf and loblolly pine
containers
treated with RonstarFlo
in three years of study

Year	Nursery	Species	Application Date	Rate	% likelihood of 0 willows present in 1 container tray
2017	IFCO	Longleaf	3/23/17	0 oz./ac	53.3
				40 oz./ac	100.0
		Loblolly	4/10/17	0 oz./ac	20.0
				40 oz./ac	86.7
2018	IFCO	Longleaf	3/21/18	0 oz./ac	86.7
				40 oz./ac	100.0
		Longleaf	3/28/18	0 oz./ac	73.3
				40 oz./ac	100.0
		Loblolly	4/2/18	0 oz./ac	13.3
				40 oz./ac	100.0
		Loblolly	4/10/18	0 oz./ac	26.7
				40 oz./ac	73.3
2019	IFCO	Longleaf	3/11/19	0 oz./ac	22.0
				40 oz./ac	90.0
		Longleaf	3/18/19	0 oz./ac	34.0
				40 oz./ac	98.0
		Loblolly	4/2/19	0 oz./ac	25.0
				40 oz./ac	100.0
		Loblolly	4/15/19	0 oz./ac	84.0
				40 oz./ac	100.0
	Westervelt	Loblolly	4/11/19	0 oz./ac	62.0
				40 oz./ac	100.0
		Loblolly	4/17/19	0 oz./ac	22.0
				40 oz./ac	94.0

Southern Forest
Nursery Management Cooperative

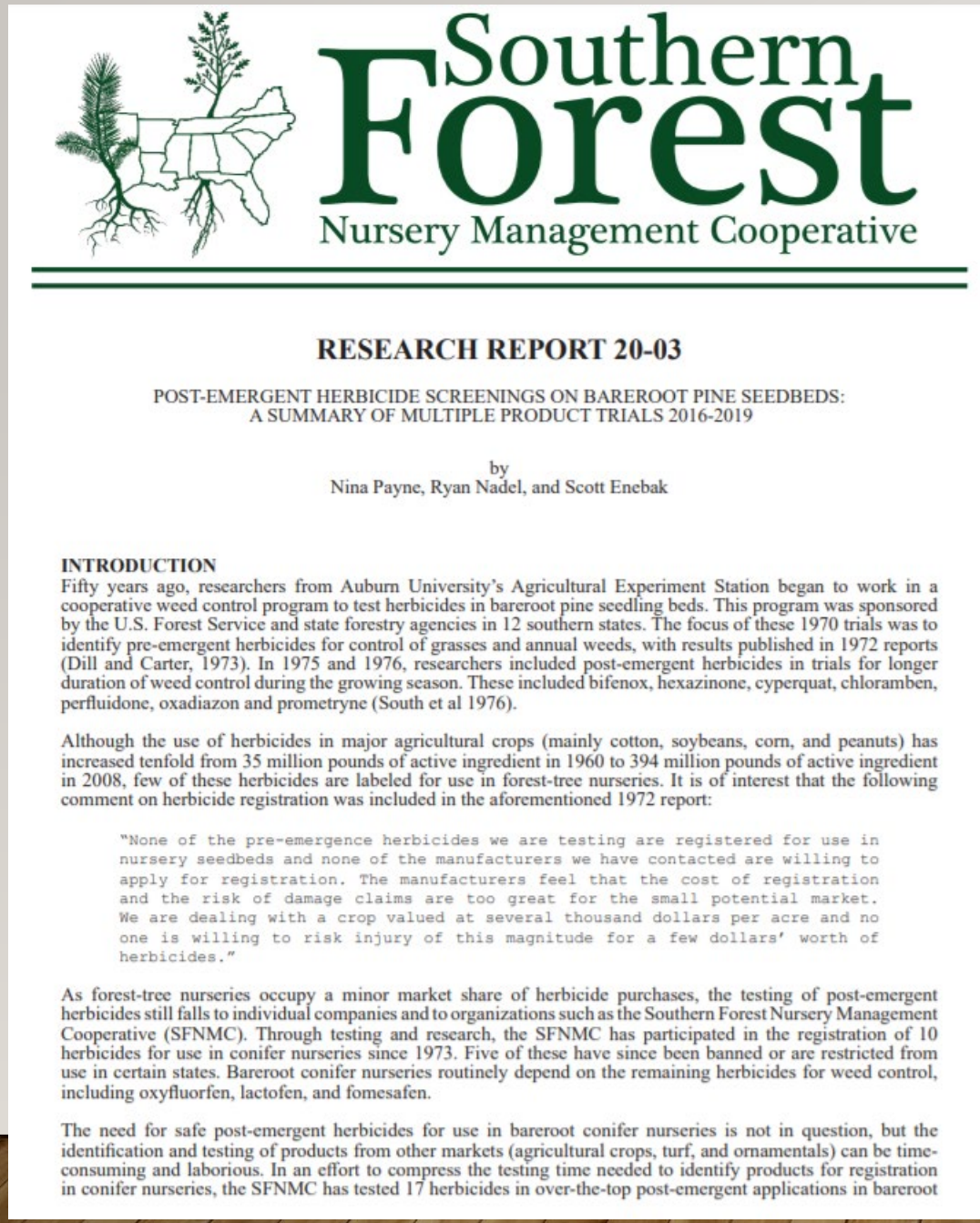
Percent likelihood of
0 'other' weeds present
in longleaf, loblolly and slash pine
containers
treated with RonstarFlo
in three years of study

Year	Nursery	Species	Application Date	Rate	% likelihood of 0 other weeds present in 1 container tray
2017	IFCO	Longleaf	3/23/17	0 oz./ac	86.7
				40 oz./ac	100.0
		Loblolly	4/10/17	0 oz./ac	80.0
				40 oz./ac	100.0
		Slash	4/21/17	0 oz./ac	66.7
				40 oz./ac	100.0
2018	IFCO	Longleaf	3/21/18	0 oz./ac	93.3
				40 oz./ac	100.0
		Longleaf	3/28/18	0 oz./ac	80.0
				40 oz./ac	100.0
		Loblolly	4/2/18	0 oz./ac	40.0
				40 oz./ac	73.3
		Loblolly	4/10/18	0 oz./ac	73.3
				40 oz./ac	100.0
2019	IFCO	Longleaf	3/11/19	0 oz./ac	78.0
				40 oz./ac	96.0
		Longleaf	3/18/19	0 oz./ac	90.0
				40 oz./ac	98.0
		Loblolly	4/2/19	0 oz./ac	97.9
				40 oz./ac	96.0
		Loblolly	4/15/19	0 oz./ac	98.0
				40 oz./ac	100.0
		Slash	4/30/19	0 oz./ac	83.3
				40 oz./ac	100.0
	Westervelt	Loblolly	4/11/19	0 oz./ac	100.0
				40 oz./ac	100.0
		Loblolly	4/17/19	0 oz./ac	96.0
				40 oz./ac	100.0

Southern Forest
Nursery Management Cooperative

QUESTIONS?

Southern Forest
Nursery Management Cooperative



Southern Forest Nursery Management Cooperative

RESEARCH REPORT 20-03

POST-EMERGENT HERBICIDE SCREENINGS ON BAREROOT PINE SEEDBEDS:
A SUMMARY OF MULTIPLE PRODUCT TRIALS 2016-2019

by
Nina Payne, Ryan Nadel, and Scott Enebak

INTRODUCTION

Fifty years ago, researchers from Auburn University's Agricultural Experiment Station began to work in a cooperative weed control program to test herbicides in bareroot pine seedling beds. This program was sponsored by the U.S. Forest Service and state forestry agencies in 12 southern states. The focus of these 1970 trials was to identify pre-emergent herbicides for control of grasses and annual weeds, with results published in 1972 reports (Dill and Carter, 1973). In 1975 and 1976, researchers included post-emergent herbicides in trials for longer duration of weed control during the growing season. These included bifenox, hexazinone, cyperquat, chloramben, perfluidone, oxadiazon and prometryne (South et al 1976).

Although the use of herbicides in major agricultural crops (mainly cotton, soybeans, corn, and peanuts) has increased tenfold from 35 million pounds of active ingredient in 1960 to 394 million pounds of active ingredient in 2008, few of these herbicides are labeled for use in forest-tree nurseries. It is of interest that the following comment on herbicide registration was included in the aforementioned 1972 report:

> "None of the pre-emergence herbicides we are testing are registered for use in nursery seedbeds and none of the manufacturers we have contacted are willing to apply for registration. The manufacturers feel that the cost of registration and the risk of damage claims are too great for the small potential market. We are dealing with a crop valued at several thousand dollars per acre and no one is willing to risk injury of this magnitude for a few dollars' worth of herbicides."

As forest-tree nurseries occupy a minor market share of herbicide purchases, the testing of post-emergent herbicides still falls to individual companies and to organizations such as the Southern Forest Nursery Management Cooperative (SFNMC). Through testing and research, the SFNMC has participated in the registration of 10 herbicides for use in conifer nurseries since 1973. Five of these have since been banned or are restricted from use in certain states. Bareroot conifer nurseries routinely depend on the remaining herbicides for weed control, including oxyfluorfen, lactofen, and fomesafen.

The need for safe post-emergent herbicides for use in bareroot conifer nurseries is not in question, but the identification and testing of products from other markets (agricultural crops, turf, and ornamentals) can be time-consuming and laborious. In an effort to compress the testing time needed to identify products for registration in conifer nurseries, the SFNMC has tested 17 herbicides in over-the-top post-emergent applications in bareroot

POST-EMERGENT HERBICIDE SCREENING TRIALS IN BAREROOT NURSERIES – 4 YEARS OF STUDY

4 YEARS OF STUDY: 2016, 2017, 2018, 2019

- To identify safe post-emergent herbicides applied over-the-top to provide weed control later in growing season
- 17 herbicides
- 9 manufacturers
- 10 SFNMC nurseries
- 107 loblolly pine installations, 34 slash pine installations

Southern Forest
Nursery Management Cooperative

17 POST-EMERGENT HERBICIDES TESTED 2016-2019

- Basagran® (bentazon)
- Beacon® (primisulfuron)
- Defendor ® (florasulam)
- Dismiss ® (sulfentrazone)
- Envoke ® (trifloxysulfuron)
- Frequency ® (topramezone)
- Grasp ® (penoxsulam)
- Mission™ (flazasulfuron)
- Plateau ® (imazapic)
- Ronstar®Flo (oxadiazon)*
- ShieldEx ® (tolpyralate)
- Strada ® (orthosulfamuron)
- TapOut ® (clethodim)**
- Tenacity® (mesotrione)
- Valor ® (flumioxazin)
- Velocity ® (bispyribac)
- Venue™ (pyraflufen)

Southern Forest Nursery Management Cooperative

* Labeled for pre-emergent use in conifer nurseries
** Labeled to control grasses in conifer nurseries

SORTED HERBICIDES BY:

- Those causing evident, quantifiable damage to seedlings
- Those causing little or no quantifiable effects on seedlings – test for 3+ years

Southern Forest
Nursery Management Cooperative

Evaluation of loblolly pine tests

Herbicide active ingredient	Product used	Total no. of loblolly pine test installations	No. of installations reporting negative seedling characteristics in treated seedlings[1]				
			Density	Height	RCD	Root wt.	Shoot wt.
bentazon	Basagran®	4	2 of 4	2 of 4	1 of 4	0 of 4	0 of 4
bispyribac	Velocity®	4	0 of 4	2 of 4	1 of 4	0 of 4	0 of 4
clethodim	TapOut®	6	0 of 6	1 of 6	0 of 6	0 of 6	0 of 6
flazasulfuron	Mission®	2	0 of 2	1 of 2	2 of 2	0 of 2	0 of 2
florasulam	Defendor™	13	0 of 13	3 of 13	2 of 13	0 of 13	0 of 13
flumioxazin	Valor®EZ	4	1 of 4	2 of 4	0 of 4	0 of 4	0 of 4
imazapic	Plateau®	1	0 of 4	1 of 1	1 of 1	1 of 1	1 of 1
mesotrione	Tenacity®	4	0 of 4	1 of 4	0 of 4	0 of 4	0 of 4
orthosulfamuron	Strada®	6	0 of 6	3 of 6	0 of 6	0 of 6	0 of 6
oxadiazon	Ronstar®Flo	6	0 of 6	2 of 6	0 of 6	0 of 6	0 of 6
penoxsulam	Grasp®SC	12	0 of 12	6 of 12	3 of 12	0 of 12	1 of 12
primisulfuron	Beacon®	4	0 of 4	2 of 4	0 of 4	1 of 4	0 of 4
pyraflufen	Venue®	6	0 of 6	2 of 6	1 of 6	0 of 6	0 of 6
sulfentrazone	Dismiss®	5	0 of 5	2 of 5	4 of 5	2 of 5	2 of 5
tolpyralate	Shieldex®	6	0 of 6	0 of 6	0 of 6	0 of 6	0 of 6
topramezone	Frequency®	10	0 of 10	1 of 10	1 of 10	0 of 10	0 of 10
trifloxysulfuron	Envoke®	14	0 of 14	1 of 14	0 of 14	0 of 14	0 of 14

Southern Forest Nursery Management Cooperative

17 POST-EMERGENT HERBICIDES TESTED 2016-2019

- ~~Basagran® (bentazon)~~
- retest • Beacon® (primisulfuron)
- ✓ • Defendor ® (florasulam)
- ~~Dismiss ® (sulfentrazone)~~
- ✓ • Envoke ® (trifloxysulfuron)
- ✓ • Frequency ® (topramezone)
- ~~Grasp ® (penoxsulam)~~
- ~~Mission™ (flazasulfuron)~~
- ~~Plateau ® (imazapic)~~
- ✓ • Ronstar®Flo (oxadiazon)*
- retest • ShieldEx ® (tolpyralate)
- retest • Strada ® (orthosulfamuron)
- ✓ • TapOut ® (clethodim)**
- retest • Tenacity® (mesotrione)
- ~~Valor ® (flumioxazin)~~
- ~~Velocity ® (bispyribac)~~
- retest • Venue™ (pyraflufen)

Southern Forest Nursery Management Cooperative

* Labeled for pre-emergent use in conifer nurseries
** Labeled to control grasses in conifer nurseries

2019 RETESTING

- ShieldEx ® (tolpyralate) – corn herbicide
  lists grasses and broadleaf weeds
- Strada ® (orthosulfamuron) – rice herbicide
  lists rice flatsedge and yellow nutsedge
- Tenacity® (mesotrione) – turf herbicide
  lists grasses, broadleaf weeds, yellow nutsedge

Southern Forest
Nursery Management Cooperative

✓ 3+ YEARS OF GOOD RESULTS – NOW WHAT?

- Defendor ® (florasulam) – 4 years, Dow, for turf, lists broadleaf weeds
- Envoke ® (trifloxysulfuron) – 4 years, Syngenta, for cotton, lists yellow nutsedge, broadleaf weeds, some grasses
- Frequency ® (topramezone) – 3 years, BASF, conifer plantations and right-of-ways, lists grasses and broadleaf weeds

Southern Forest
Nursery Management Cooperative

- Survey SFNMC nurseries for interest in use of specific herbicides

- Contact manufacturers with data for new labeling

> "None of the pre-emergence herbicides we are testing are registered for use in nursery seedbeds and **none of the manufacturers we have contacted are willing to apply for registration.** The manufacturers feel that the cost of registration and the risk of damage claims are too great for the small potential market. We are dealing with a crop valued at several thousand dollars per acre and no one is willing to risk injury of this magnitude for a few dollars' worth of herbicides." Dill, T. R. and M. C. Carter. 1973. Pre-emergence weed control in southeastern forest nurseries. *Weed Science* 21(4):363-366.

- Test these herbicides in SFNMC nurseries at earlier times in growing season (tested at 9-11 weeks post-sowing, weeds should be sprayed at 2-4 inches tall for effective herbicide control)

CONTACT

Nina Payne
334-844-4917
nina.payne@auburn.edu

Southern Forest
Nursery Management Cooperative