Auburn University
Southern Forest Nursery
Management Cooperative

RESEARCH REPORT 14-04

EFFECT OF TIMING AND RATE OF MARENGO® (INDAZIFLAM) APPLICATIONS ON WEED CONTROL AND LOBLOLLY PINE SEEDLING CHARACTERISTICS AT THE ARBORGEN SUPERTREE NURSERY IN SHELLMAN, GA

by
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INTRODUCTION

Marengo® (indaziflam) is a selective preemergent and early postemergent herbicide produced by OHP, Inc. and made available to the public in January 2013. Its active ingredient, indaziflam, is one of the first from Mode of Action Group 29, which includes herbicides that inhibit cellulose biosynthesis; in this case, the chemical inhibits cell wall formation, division and elongation primarily in growing roots (Summary of Herbicide Mechanism of Action According to the Weed Science Society of America, http://wssa.net/wp-content/uploads/WSSA-Mechanism-of-Action.pdf). The current Marengo® label lists 23 grasses and sedges and 61 broadleaf weeds, including spurge (Euphorbia spp.), as those being controlled. Eastern white pine (Pinus strobus) and Scotch pine (Pinus sylvestrus) are currently the only pine species listed as tolerant, according the OHP's testing date of 2012. The manufacturer's studies (Marengo® Technical Research Update, Summer 2013) showed that the herbicide offers significantly longer weed control in light or sandy soils compared to heavy soils. The current label recommends to water-in the product within 2 days of application; however, an amended label will allow users up to 21 days to water following application. We could not find any trials that studied the effect of Marengo® on loblolly pine (Pinus taeda) and therefore began some of the first tests of this new action group herbicide. The objectives of this trial were to 1) evaluate loblolly pine seed and seedling tolerance to different pre- and postemergent application rates of Marengo® (7.4% indaziflam) and 2) determine its efficacy on weed control following different pre-and postemergent application rates.

METHODOLOGY

This trial was conducted at ArborGen's Supertree Nursery in Shellman, Georgia on loblolly pine seedbeds and seedlings at three application rates (3.75 oz/ac, 7.5 oz/ac and 11.25 oz/ac) applied three times over the growing season (preemergent at 0 weeks, 6 weeks postemergent and 12 weeks postemergent), as shown in Table 1. All herbicide applications were made by Nursery Cooperative personnel with a CO2 hand sprayer calibrated to broadcast spray 25 gallons per acre. Watering-in, as recommended on the Marengo® label, was done operationally on the nursery's irrigation schedule after the herbicide was applied.

Each treatment plot was one seedling bed wide and 10 feet long and was replicated five times along the bed. All weed and seedling density measurements were made from within a 9" x 4' counting frame placed within each treatment plot during the growing season. At the end of the growing season in November 2013, all seedlings from within the counting frame placed on each treatment plot were removed and brought to the Nursery Cooperative laboratory for evaluation. The number of plantable and cull seedlings were recorded and of the plantable, 25 seedlings were evaluated for shoot height, RCD and root and shoot dry weights for biomass determinations.

RESULTS AND DISCUSSION

Due to the resignation of Ben Whitaker, weed control data was not collected from the treatment plots in a manner that would permit evaluation of treatment effectiveness. At 16 weeks post sowing, spurge and other weed counts were made. Field data sheets from Ben Whitaker note that at the 12 week post sowing treatment "*perhaps seedlings were too large and they shielded the weeds*"; this notation is the only weed control available from this study. Weeds were present within all the plots following the application of Marengo® at 12 weeks post-sowing, although there were statistically no differences in the percentage of weed coverage (Table 2 and Figure 1). The "0"s in the Check plots for weeds at 0 and 6 weeks make any comparison to the other rates moot. There appears to be a rate effect, with the highest rate given the greatest control, however, this is non-significant. While the lack of weed control data is disappointing, we do know about loblolly pine's tolerance to indaziflam at various application times. When comparing the time of application, significantly fewer seedlings were seen in all herbicide rates when sprayed at the time of sowing (0 weeks). Thus, loblolly pine is sensitive to Marengo® when used as a pre-emergent at the time of sowing. The sensitivity to Marengo® is short-lived and rate dependent as at the 6 week post-sowing time of application, no differences were seen when Marengo® was applied at the low (3.75 oz/ac) or medium (7.5 oz/ac) rates of spraying (Table 2, Figure 2). However, fewer seedlings were observed at the highest (11.25 oz/ac) application rate at 6 weeks. No differences in seedling quantity were observed at the 12 week post-sowing application date for any of the rates used. Thus, post-emergent applications of Marengo® appear to be safe over loblolly pine.

With respect to seedling size, the effect of Marengo® on loblolly pine appears to be at the seed germination phase as there was no effect on seedling shoot height for any of the rates or times of application (Table 3, Figure 3). Thus, while loblolly pine was sensitive to indaziflam at germination, the compound did not affect seedling growth as measure by seeding height. The same effect was observed with RCD as root collar diameters were similar for all rates at all application times (Table 3, Figure 4) except for the higher (11.25 oz/ac) application rate. This may be attributed to the beds with the slightly lower seedling densities.

Dry shoot weight and dry root weight measurements were measured from the seedlings collected in November 2013 (Table 4) and root-weight ratios were calculated with this data (Table 5). Differences were observed with larger root and shoot weights of seedlings that were treated with the medium (7.5 oz/ac) and high (11.25 oz/ac) rates when applied at the time of sowing (0 weeks). The larger sizes of these seedlings were due to the low number of seedlings and greater availability of bed space due to those seedlings that survived. While the root-weight ratio (Table 5, Figure 5) shows no statistical differences across the three times of treatment and three

application rates, the 12 week application resulted in numbers that were higher than the either the 0 or 6 week applications (Figure 5). Further trials using Marengo® are planned that look at weed control in a more rigorous fashion and the timing of its application.

MANAGEMENT IMPLICATIONS

- Because seedling density was greatly reduced by the use of Marengo® at all rates (3.75, 7.5, 11.25 oz/ac) at the time of sowing (0 weeks, preemergent), the application of Marengo® to loblolly pine at the time of sowing is not recommended. Later in the season, that is, at least 6 weeks and 12 weeks post-sowing, there were no significant differences in seedling densities, shoot heights and root-weight ratios, at the low (3.75 oz/ac) and medium (7.5 oz/ac) spray rate applications. It is possible that the lower rate of chemical could be selected as part of a program to reduce herbicide expense.

- The application of Marengo® at 12 weeks post-sowing (at all rates) was least effective in controlling weeds. However, due to the recommendation that Marengo® not be applied at the time of sowing, an application at 6 weeks post-sowing could provide acceptable weed control without reducing seedling density or diminishing seedling growth.

Table 1. Herbicide treatments applied to loblolly pine seedbeds and seedlings at the ArborGen Supertree Nursery, Shellman, Georgia 2013.

Application Time *(Weeks Post-Sow)*	**Treatment** *(Trade Name)*	**Product** *(oz/ac)*
0	*Check*	0.0
0	Marengo®	3.75
0	Marengo®	7.5
0	Marengo®	11.25
6	*Check*	0.0
6	Marengo®	3.75
6	Marengo®	7.5
6	Marengo®	11.25
12	*Check*	0.0
12	Marengo®	3.75
12	Marengo®	7.5
12	Marengo®	11.25

Table 2. Effect of Marengo® (indaziflam) and application time (0, 6, or 12-wks post sowing) on weed coverage and loblolly pine seedling density at the ArborGen Supertree Nursery, Shellman, GA 2013.

	Weeds (%)				Density (ft²)			
	Herbicide Rate[1]				Herbicide Rate[1]			
Application Time	Check	Low	Med	High	Check	Low	Med	High
0 Wks	0	0	0	0	28.6	20.2*	12.4*	6.0*
6 Wks	0	0	0	0	27.2	26.5	25.5	20.6*
12 Wks	19	17	17	14	29.9	26.4	29.4	26.2

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.

[1]Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam), respectively.

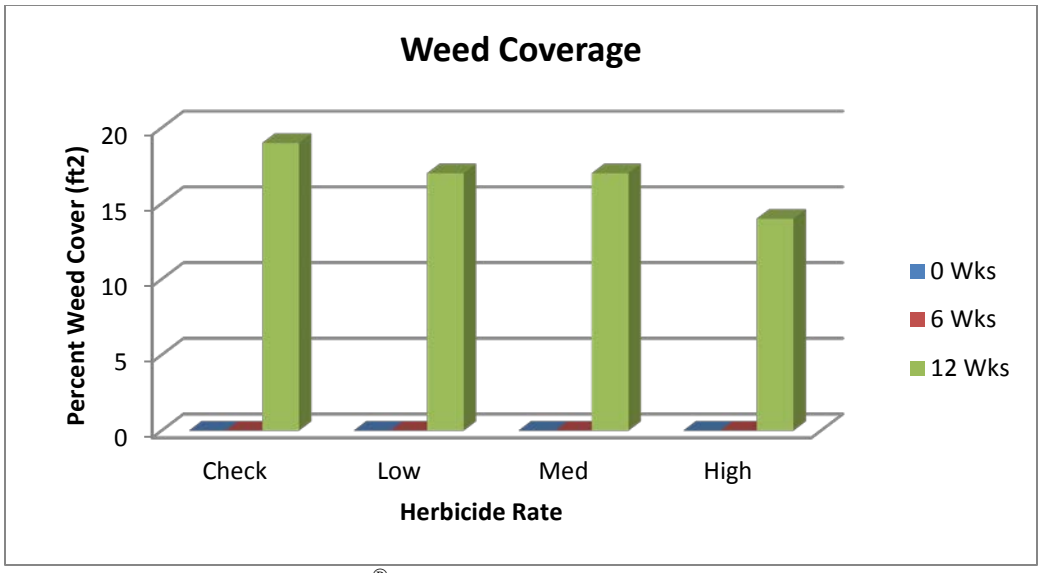

Figure 1. Effect of Marengo® and application time on weed coverage at the ArborGen Supertree Nursery, Shellman, GA 2013.

Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.

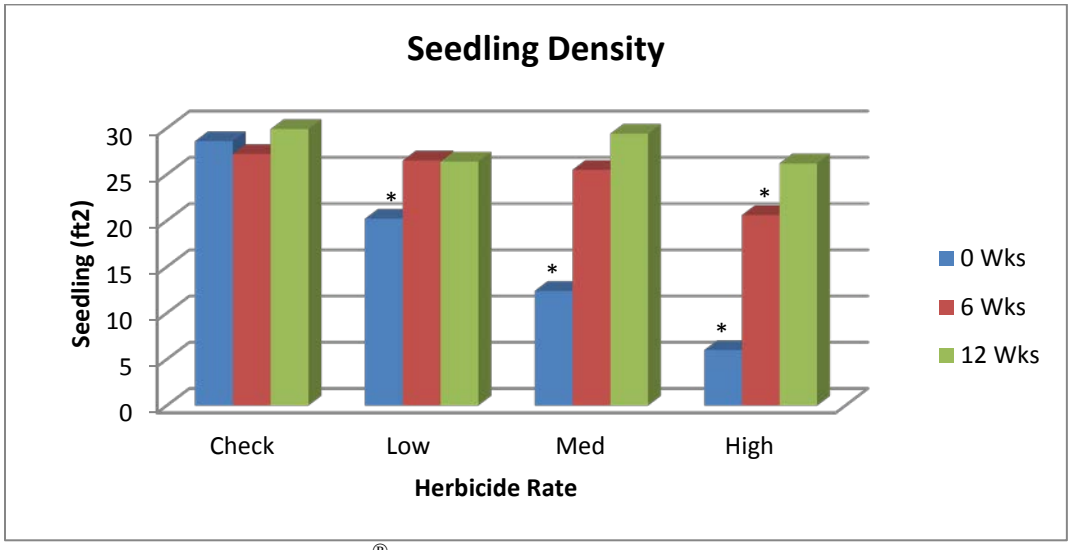

Figure 2. Effect of Marengo® and application time on loblolly pine seedling density at the ArborGen Supertree Nursery, Shellman, GA 2013

Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.

Table 3. Effect of Marengo® (indaziflam) and application time (0, 6, or 12-wks post sowing) on loblolly pine seedling characteristics at the ArborGen Supertree Nursery, Shellman, GA 2013.

	ShtHgt (cm)				RCD (mm)			
	Herbicide Rate[1]				Herbicide Rate[1]			
Application Time	Check	Low	Med	High	Check	Low	Med	High
0 Wks	24.7	23.4	22.6	22.5	3.9	4.1	4.2	4.6*
6 Wks	25.5	25.5	25.2	24.7	3.9	4.1	3.9	4.2
12 Wks	24.0	27.6	24.1	24.4	3.8	3.8	3.9	4.1*

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.

[1]Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

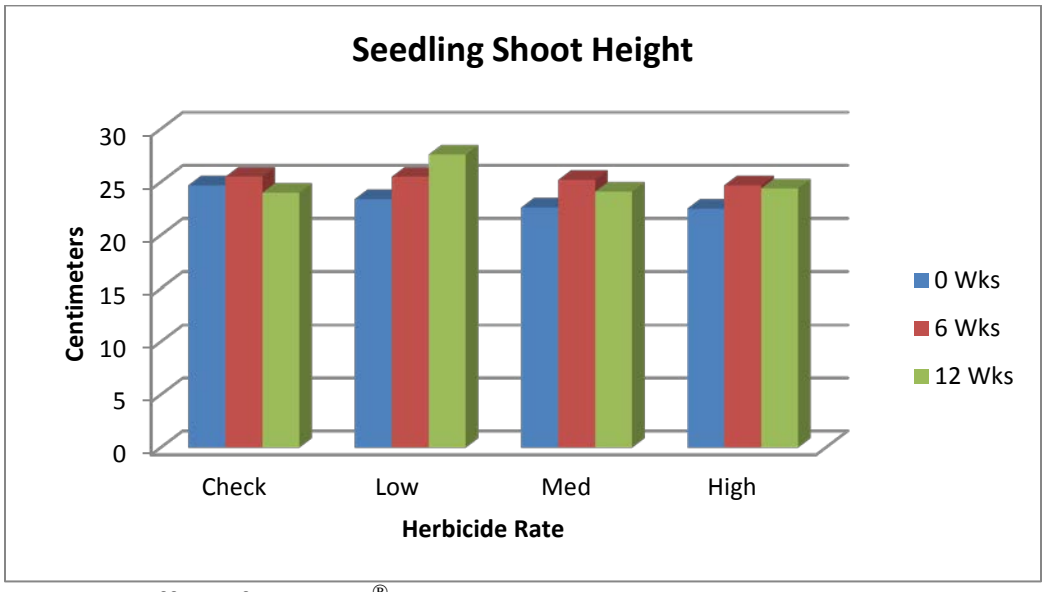

Figure 3. Effect of Marengo® and application time on loblolly pine seedling shoot height at the ArborGen Supertree Nursery, Shellman, GA 2013.

Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.

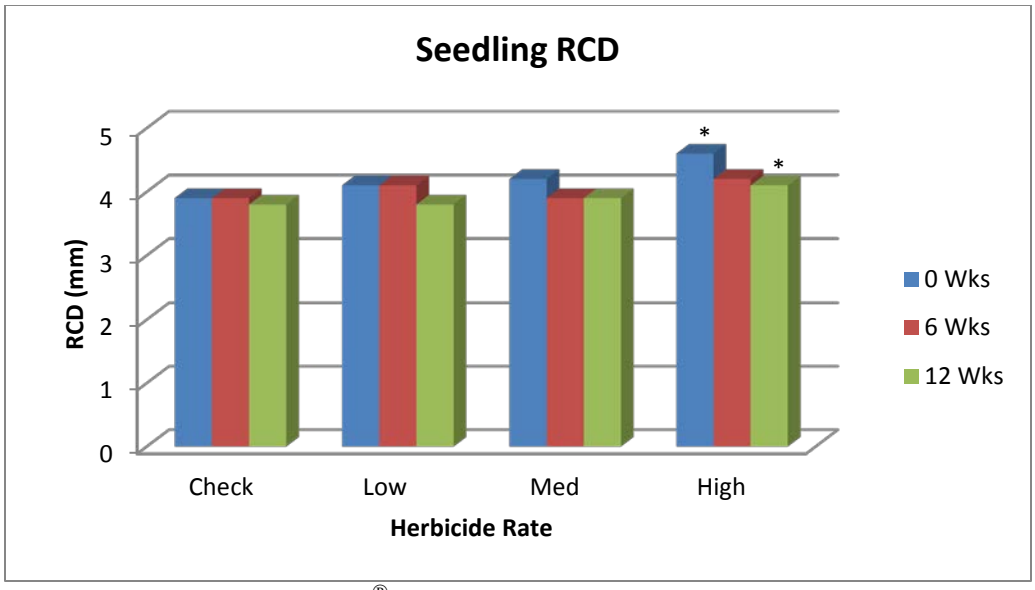

Figure 4. Effect of Marengo® and application time on loblolly pine seedling root collar diameter at the ArborGen Supertree Nursery, Shellman, GA 2013.

Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.

Table 4. Effect of Marengo® (indaziflam) and application time (0, 6, or 12-wks post sowing) on loblolly pine seedling dry root and shoot weights at the ArborGen Supertree Nursery, Shellman, GA 2013.

	RtWgt (g)				ShtWgt (g)			
	Herbicide Rate[1]				Herbicide Rate[1]			
Application Time	Check	Low	Med	High	Check	Low	Med	High
0 Wks	0.52	0.61	0.75*	0.97*	2.75	2.94	3.37*	4.14*
6 Wks	0.49	0.54	0.51	0.65	2.41	2.59	2.37	2.83
12 Wks	0.44	0.41	0.41	0.43	1.55	1.49	1.48	1.62

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05

[1]Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

Table 5. Effect of Marengo® (indaziflam) and application time (0, 6, or 12-wks post sowing) on loblolly pine seedling root-weight ratio at the ArborGen Supertree Nursery, Shellman, GA 2013.

	RWR%			
	Herbicide Rate[1]			
Application Time	Check	Low	Med	High
0 Wks	16.0	17.0	18.0	19.0
6 Wks	17.0	17.0	17.0	18.0
12 Wks	22.0	21.0	22.0	21.0

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.

[1]Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

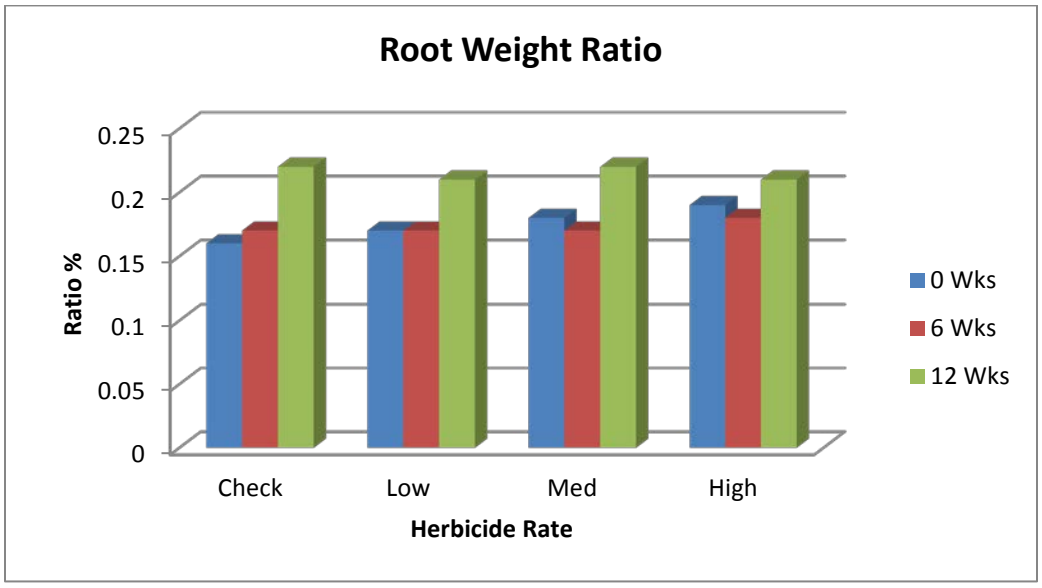

Figure 5. Effect of Marengo® and application time on loblolly pine seedling root-weight ratio at the ArborGen Supertree Nursery, Shellman, GA 2013.

Check, Low, Med & High = 0.0, 3.75, 7.5 and 11.25 oz/acre of Marengo® (indaziflam) respectively.

*If present, an asterisk next to a treatment mean indicates a significant difference from the Check Trt at that time of application according to Dunnett's T-test; alpha = 0.05.