

Researcher:	Hannah Mathers, PhD	Date:	2/16/2021
Project Title:	2019 In Season Pre-emergence Herbicide Crop Safety		
Protocol #:	19-012	PRnumbers:	30927, 30952, 33178, 33183 and 33188

Narrative Summary (Results/Discussion)

Please keep text to one page if possible. Include summary of trial results and a brief discussion including how any changes from the protocol may have affected results. Results for multiple PRnumbers can be summarized together, but please list all PRNumbers in the header and in the summary data table.

Dramatic

The results presented are for five species *Buxus* 'Green Mountain', *Ilex* x *meserveae* 'Berri-Magic', *Juniperus horizontalis* 'Wiltonii', *Picea abies* 'Nidiformis' and *Pinus nigra* (Table 1A, B, C, D and E, respectively) that received applications of Marengo 74SC (indaziflam 7.4%) (EPA Reg. No. 432-1518) (Bayer Environmental Science LP, Research Triangle, NC) as part of protocol 19-012. *Juniperus horizontalis* 'Wiltonii' and *Pinus nigra* (Table 1C and E, respectively) sustained no injury after one and two applications of Marengo 74SC at 0.044, 0.088, or 0.175 lb ai/ac. By growth index (GI) all *Juniperus horizontalis* 'Wiltonii' and *Pinus nigra* plants increased in growth compared to the controls even after two applications (Table 1 iii and v, respectively) and Figs. 1.3 and 1.5, respectively). *Buxus* 'Green Mountain' and *Picea abies* 'Nidiformis' had passing injury after the first application with all treatments, and at the trial completion with the 4X (0.175 lb ai/ac) rate (Table 1 A and D, respectively). However, the injury with *Buxus* 'Green Mountain' and *Picea abies* 'Nidiformis' never went above commercially acceptable (≤ 3). Growth reduction (GI and Ht) was noted for *Buxus* 'Green Mountain' and *Picea abies* 'Nidiformis' (Table 1i and iv, respectively) with all treatments; still, only the 4X rates were considered significant. The *Buxus* 'Green Mountain' 2X rate (Table 1i) appeared significant; however, the 2X plants were much larger initially (Fig. 1.1 A) and growth remained relative to the control (Fig. 1.1 B). The *Picea abies* 'Nidiformis' 2X appears significantly reduced in growth at the trial conclusion (Table 1iv); nevertheless, the 2X plants were smaller initially (Fig. 1.4 A) and had but on a good amount of growth by the end of the trial relative to the controls (Fig. 1.4 B). *Ilex* x *meserveae* 'Berri-Magic' was the only species treated with Marengo 74SC in these studies that showed commercially unacceptable injury (≥ 3) (Table 1B). Only with the 4X rate did the *Ilex* x *meserveae* 'Berri-Magic' injury go above commercially acceptable at any point in the trial (Table 1B). At 4 WAT the injury was 5.0, injury then varied between 3.0 and 3.3 for the remainder of the trial (Table 1B). This resulted in a significant growth reduction, with the 4X rate at the trial conclusion (Table 1ii). The main effect on growth reduction was retardation of new growth (Fig. 1.2 A). This effect continued with the 4X rate until the last evaluations when some new growth flushes were seen (Fig. 1.2 B).

Results Table

Please insert results table here. Include PRnumbers for each treatment if multiple PRnumbers are included in this summary. Please include product, active ingredient, and statistics.

Table 1A. Phytotoxicity ratings on selected ornamentals at Acorn Farms, Galena, OH

Buxus 'Green Mountain' #3 pots - PR# 30927 - Acorn

Treatment	Rate(ai) ^v	1 WAT ^z	2 WAT	4 WAT	6WAT	1 WA2T	2 WA2T	4 WA2T
Marengo 74SC	0.044 lb	1.1	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.088 lb	1.5	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.175 lb	2.6	0.0	0.0	0.0✓	0.0	0.0	1.6
Untreated	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Table 1B. Phytotoxicity ratings on selected ornamentals at Acorn Farms, Galena, OH

Ilex x meserveae 'Berri-Magic' #3 pots - **PR# 30952** - Acorn

Treatment	Rate(ai) ^y	1 WAT ^z	2 WAT	4 WAT	6WAT	1 WA2T	2 WA2T	4 WA2T
Marengo 74SC	0.044 lb	1.7	0.0	0.0	0.0✓	0.0	1.3	1.3
Marengo 74SC	0.088 lb	2.4	0.7	2.2	2.0✓	1.1	0.7	0.7
Marengo 74SC	0.175 lb	2.4	1.1	5.0	3.0✓	3.3	3.2	3.2
Untreated	--	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Table 1C. Phytotoxicity ratings on selected ornamentals at Acorn Farms, Galena, OH

Juniperus horizontalis 'Wiltonii' #3 pots - **PR# 33178** - Acorn

Treatment	Rate(ai) ^y	1 WAT ^z	2 WAT	4 WAT	6WAT	1 WA2T	2 WA2T	4 WA2T
Marengo 74SC	0.044 lb	0.0	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.088 lb	0.0	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.175 lb	0.0	0.0	0.0	0.0✓	0.0	0.0	0.0
Untreated	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1D. Phytotoxicity ratings on selected ornamentals at Acorn Farms, Galena, OH

Picea abies 'Nidiformis' #3 pots - **PR# 33183** - Acorn

Treatment	Rate(ai) ^y	1 WAT ^z	2 WAT	4 WAT	6WAT	1 WA2T	2 WA2T	4 WA2T
Marengo 74SC	0.044 lb	1.1	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.088 lb	1.5	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.175 lb	2.6	0.0	0.0	0.0✓	0.0	0.0	1.6
Untreated	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1E. Phytotoxicity ratings on selected ornamentals at Mathers Environmental Science Services (MESS), LLC, Gahanna, OH.

Pinus nigra #3 pots - **PR# 33188** - MESS

Treatment	Rate(ai) ^y	1 WAT ^z	2 WAT	4 WAT	6WAT	1 WA2T	2 WA2T	4 WA2T
Marengo 74SC	0.044 lb	0.0	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.088 lb	0.0	0.0	0.0	0.0✓	0.0	0.0	0.0
Marengo 74SC	0.175 lb	0.0	0.0	0.0	0.0✓	0.0	0.0	0.0
Untreated	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0

z = weeks after treatment

y = Phytotoxicity Ratings based on a 0-10 scale with 0 being no phytotoxicity and 10 death with ≤3 commercially acceptable.

x = Phytotoxicity ratings followed by *, ** are significantly different from control based on Dunnett's t-test ($\alpha = 0.10, 0.05$, respectively).

^y = All rates for Gemini G (prodiamine 0.40% + isoxaben 0.25%) are listed as lb. per ac.

✓ indicates reapplication at this date.

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Table 1i. Phytotoxicity ratings as a companion table to Table 1A above.

Buxus 'Green Mountain' #3 pots - PR# 30927 - Acorn

Treatment	Rate (ai) ^v	HT ⁱ WAT ^z	HT4WA2T	GI ⁰ WAT ^z	GI4WA2T	Δ ^w HT	ΔGI
Marengo 74SC	0.044 lb	11.4 ^y	15.4	542.9	718.4	4.0	175.5
Marengo 74SC	0.088 lb	11.9	18.0	614.9 *	641.6	6.1	26.7 *
Marengo 74SC	0.175 lb	11.9	15.8	532.6	667.6	3.9	135.0
Untreated	--	12.0	20.1	506.5	1001.6	8.1	495.1

Table 1ii. Phytotoxicity measures as a companion table to Table 1B above.

Ilex x meserveae 'Berri-Magic' #3 pots - PR# 30952 - Acorn

Treatment	Rate (ai) ^v	HT ⁱ WAT ^z	HT4WA2T	GI ⁰ WAT ^z	GI4WA2T	Δ ^w HT	ΔGI
Marengo 74SC	0.044 lb	12.5 ^y	15.8	1132.1	1995.5	3.3	863.4
Marengo 74SC	0.088 lb	11.7	15.9	883.4	1533.5	4.2	650.1
Marengo 74SC	0.175 lb	12.0	15.7	837.2	1309.9 *	3.7	472.7 *
Untreated	--	11.3	15.9	939.3	2256.2	4.6	1316.9

Table 1iii. Phytotoxicity measures as a companion table to Table 1C above.

Juniperus horizontalis 'Wiltonii' #3 pots - PR# 33178 - Acorn

Treatment	Rate (ai) ^v	HT ⁱ WAT ^z	HT4WA2T	GI ⁰ WAT ^z	GI4WA2T	Δ ^w HT	ΔGI
Marengo 74SC	0.044 lb	4.8	5.2	1014.1	13454.8	0.4	12440.7
Marengo 74SC	0.088 lb	5.0	5.3	895.0	13388.7	0.3	12493.7
Marengo 74SC	0.175 lb	4.8	5.3	920.3	14986.1	0.5	14065.8
Untreated	--	5.1	5.3	1010.8	12575.2	0.2	11564.4

Table 1iv. Phytotoxicity measures as a companion table to Table 1D above.

Picea abies 'Nidiformis' #3 pots - PR# 33183 - Acorn

Treatment	Rate (ai) ^v	HT ⁱ WAT ^z	HT4WA2T	GI ⁰ WAT ^z	GI4WA2T	Δ ^w HT	ΔGI
Marengo 74SC	0.044 lb	6.2 ^y	6.6	1094.0	1185.0	0.4	91.0
Marengo 74SC	0.088 lb	6.1	6.7	975.6	1041.1	0.6	65.5 *
Marengo 74SC	0.175 lb	6.0	6.2	1048.9	1106.4	0.2	57.5 *
Untreated	--	5.7	6.8	791.2	1018.6	1.1	227.4

Table 1v. Phytotoxicity measures as a companion table to Table 1F above.

Pinus nigra #3 pots - PR# 33188 - MESS

Treatment	Rate (ai) ^v	HT ⁱ WAT ^z	HT4WA2T	GI ⁰ WAT ^z	GI4WA2T	Δ ^w HT	ΔGI
Marengo 74SC	0.044 lb	18.9 ^y	18.7	757.3	1467.5	0.0	710.2
Marengo 74SC	0.088 lb	16.6	17.2	696.3	971.4	0.6	275.1
Marengo 74SC	0.175 lb	18.6	18.1	872.0	1288.6	0.0	416.6
Untreated	--	18.2	18.2	1380.3	1180.6	0.0	0.0

y = All measures are in inches and the calculated Growth Index measures are in in³.

x = Measures followed by *, ** are significantly different from control based on Dunnett's t-test (α = 0.10, 0.05, respectively).

v = All rates for Gallery SC (Isoxaben 45.45%) are listed as active ingredient (ai) per ac.

i = HT represents Height at start of trial and at the end of the trial or 4WA2T measured in inches.

t = GI represents Growth index (in³) and was calculated as GI=Pi (Ht)(r2), where Ht. (in) at start and final height, respectively, r was half of the average of W1+W2 (two perpendicular measurements of plant diameter (in)) and Pi was "π" to determine plant volume.

Researcher:	Hannah Mathers, PhD	Date:	2/16/2021
Project Title:	2019 In Season Pre-emergence Herbicide Crop Safety		
Protocol #:	19-012	PRnumbers:	30927, 30952, 33178, 33183 and 33188

Materials & Methods/Recordkeeping

Please fill out the information below or attach a separate document with comparable information.

Protocol 19-012 was followed with no changes, including four replications with three plants per replication and four treatments per species. 0, 1, 2 and 4X rates of Marengo 74SC (indaziflam 7.4%) (EPA Reg. No. 432-1518) (Bayer Environmental Science LP, Research Triangle, NC) with 3-gallon containers (Table 1, A, B, C, D and E) for 48 plants per protocol (PR#: 30927, 30952, 33178, 33183 and 33188). Evaluations were conducted at 1, 2 and 4 weeks after treatment (WAT). A reapplication was conducted at 6 WAT, and evaluations occurred 1, 2, and 4 weeks after second treatment (WA2T). Rates are listed in pounds of active ingredient (a.i)/ acre with 1X being 0.044 lb ai/ac (Table 1, A, B, C, D and E). Four species were located at Acorn Farms Inc., 7679 Worthington Rd., Galena, OH and one species, *Pinus nigra* was located at Mathers Environmental Science Services (MESS), LLC, Gahanna, OH. Weather records for Columbus, OH are presented as Galena and Gahanna, OH are in the greater Columbus, OH region. All plants were grown in standard container media (85% pine bark and 15% Comtil) (Krutz Bros. Central Ohio, LLC, Groveport, OH) and fertilized with The Anderson's 18-6-12 + minors, slow-release 8-9-month formulation and over-head irrigation. Applications for *Buxus* 'Green Mountain', *Ilex x meserveae* 'Berri-Magic' and *Juniperus horizontalis* 'Wiltonii', at Acorn were initiated on June 7, 2019. The *Picea abies* 'Nidiformis' at Acorn arrived later and the trial was initiated on June 21, 2019 or two weeks later. The *Pinus nigra* at MESS were initiated on May 26, 2019. All herbicides were applied within 7 days after potting as over the top applications and all were watered within 2 hours following applications.

Name(s) of Personnel Conducting Research: Dr. Hannah Mathers

Location of Trial (city/state): Acorn Farms Inc., Galena, OH and Mathers Envir. Sci. Serv., LLC, Gahanna, OH

Use Site (greenhouse/shade house/field container/etc.): Field container

Crop History

Crop Cultivar/Variety:	Buxus 'Green Mountain'
Purchased from:	Gold Hill Nursery, Hillsboro, OR
Date of Transplanting:	May 30, 2019
Potting Mix:	See above
Pot size & spacing:	3-gallon pots on 2-foot centers
Crop Cultivar/Variety:	Ilex x meserveae 'Berri-Magic'
Purchased from:	Gold Hill Nursery, Hillsboro, OR
Date of Transplanting:	May 30, 2019
Potting Mix:	See above
Pot size & spacing:	3-gallon pots on 2-foot centers
Crop Cultivar/Variety:	Juniperus horizontalis 'Wiltonii'
Purchased from:	Lawyer Nursery, Inc, MT
Date of Transplanting:	May 30, 2019
Potting Mix:	See above

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Pot size & spacing:	3-gallon pots on 1-foot centers
Crop Cultivar/Variety:	<i>Picea abies</i> 'Nidiformis'
Purchased from:	Eshraghi Nurseries, LLC, Hillsboro, OR
Date of Transplanting:	June 14, /2019
Potting Mix:	See above
Pot size & spacing:	3-gallon pots on 2-foot centers
Crop Cultivar/Variety:	<i>Pinus nigra</i>
Purchased from:	Vans Pines Nursery, West Olive, MI
Date of Transplanting:	May 20, 2019
Potting Mix:	See above
Pot size & spacing:	3-gallon pots on 2-foot centers

Product(s) applied prior to start of experiment:

Product	Rate	Application Type	Date of Application	Crop Growth Stage
Marengo 74SC	0			Shoot expansion
	0.044 lb a.i./ac	Liquid - applied via CO ₂ backpack	06/07/2019 – <i>Buxus</i> , <i>Ilex</i> and <i>Juniperus</i> 06/21/2019 – <i>Picea</i> 05/26/2019 - <i>Pinus</i>	Shoot expansion
	0.088 lb a.i./ac	Liquid - applied via CO ₂ backpack	06/07/2019 – <i>Buxus</i> , <i>Ilex</i> and <i>Juniperus</i> 06/21/2019 – <i>Picea</i> 05/26/2019 - <i>Pinus</i>	Shoot expansion
	0.175 lb a.i./ac	Liquid - applied via CO ₂ backpack	06/07/2019 – <i>Buxus</i> , <i>Ilex</i> and <i>Juniperus</i> 06/21/2019 – <i>Picea</i> 05/26/2019 - <i>Pinus</i>	Shoot expansion

Experiment Information

Experimental Design:

Completely randomized design with species

Number of Reps:

Four replicates with three plants per replicate or 12 plants/tmt/rate/species

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Photos



Fig. 1.1. and B. (Left) *Buxus* 'Green Mountain' #3 pots (PR# 30927) at Acorn Farms, Galena, OH. **A.** Photo taken on June 21, 2019 or 2WAT and **B.** taken on July 26, 2019 or 1WA2T



applications of Marengo 74SC. From left to right 0 (Control), 1X, 2X and 4X are shown in both **A** and **B**. Although the heights and growth index measures for the treatments were lower than the controls (Table 1i) no commercially unacceptable injury or growth reductions were attributed to the Marengo 74SC. The 2X treatment plants were larger initially and so the lower GI (Table 1i) at the trial conclusion was attributed to the treatment. Additionally, the 0X, 1X and 4X treatments difference remained relative to the controls throughout the study. Photo taken by: H. Mathers.

Researcher:	Hannah Mathers, PhD	Date:	2/16/2021
Project Title:	2019 In Season Pre-emergence Herbicide Crop Safety		
Protocol #:	19-012	PRnumbers:	30927, 30952, 33178, 33183 and 33188



Fig. 1.2. A and B (Above) *Ilex x meserveae* 'Berri-Magic' #3 pots (PR# 30927) located at Acorn Farms, Galena, OH. **A.** Photo taken on June 21, 2019 or 2WAT and **B.** taken on July 26, 2019 or 1WA2T applications of Marengo 74SC. **A.** From left to right 0 (Control), 1X, 2X and 4X are shown. **B.** From left to right 4X, 2X, 1X and 0X (control) are shown. The 4X treatment caused above commercially acceptable injury from 4 WAT to the trial completion (Table 1B). **A.** Even at 2WAT, the 4X plants were delayed in their new growth. Eventually branches sprouted from the lower crown but new growth flushes in the top were few. The decline in growth measured as GI was evident at the end of the trial with the 4X plants (Table 1ii). The 1X and 2X plants were not rated as commercially unacceptable as new growth flushes were numerous (**A and B**). Photo taken by: H. Mathers.

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188



Fig. 1.3. (Above) *Juniperus horizontalis* 'Wiltonii' #3 pots ((PR#33178) located at Acorn Farms, Galena, OH. This photo was taken on July 26, 2019 or 1WA2T applications of Marengo 74SC. From left to right 0 (Control), 1X, 2X and 4X plants are shown. Even after two applications of Marengo 74SC no injury (Table 1C) or growth reduction (Table 1iii) relative to the control has occurred. Photo taken by: H. Mathers.



Fig. 1.4. and B. (Left) *Picea abies* 'Nidiformis' #3 pots (PR# 33183) at Acorn Farms, Galena, OH. **A.** Photo taken on June 26, 2019 or 1WAT and **B.** taken 1WA2T applications of Marengo 74SC. From left to right 0 (Control), 1X, 2X and 4X are shown in both **A** and **B**. **A.** After the 2nd application of Marengo



74SC there was some stunting occurring with the 4X (Table 1D) by the trial end this contributed to its growth reduction (Table 1v) relative to the control. Photo taken by: H. Mathers.

Researcher:	Hannah Mathers, PhD	Date:	2/16/2021
Project Title:	2019 In Season Pre-emergence Herbicide Crop Safety		
Protocol #:	19-012	PRnumbers:	30927, 30952, 33178, 33183 and 33188



Fig. 1.5. (Above) *Pinus nigra* #3 pots (PR# 33188) located at Mathers Environmental Science Services, LLC, Gahanna, OH. This photo was taken on July 28, 2019 or 2 WA2T. From left to right Control, 1X, 2X and 4X plants are shown. Even after two applications of Marengo 74SC there was no injury (Table 1E) or growth reduction (Table 1v) relative to the control. Photo taken by: H. Mathers.

Data Collected

Please describe data collected and scoring system. Also include the dates data were collected.

All rated score evaluations of phytotoxicity (defined in report) were measured on a 0 to 10 scale where 0 representing no phytotoxicity, ≥ 3 represents commercially unacceptable injury, and 10 represented plant death (Barolli et al., 2005; Collins et al. 1999; Duray and Davies, 1989; Mathers and Case, 2010; Samtami et al., 2007). This rated score is a standard measure accepted in all major weed and horticultural science journals with each interval representing a 10% increase in injury over the whole plant (ex. 3 would be 30% injury, and 5 would be 50%, etc.). Starting and ending heights, and two perpendicular measurements of diameter were taken per plant. These measures were used to calculate Growth index (GI) (in^3) as $GI = \pi (Ht)(r^2)$, where Ht. (in) was the starting or ending height, (r) was half of the average of W1+W2 [two perpendicular measurements taken of plant diameter (in)] and (π) was “ π ”. The GI provides a volume measure of the plant which helps with quality determinations not necessarily evident by heights and widths alone or by visual observations. Symptoms were also noted if significant, and photos were conducted *in situ*.

Researcher: Hannah Mathers, PhD	Date: 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety	
Protocol #: 19-012	PRnumbers: 30927, 30952, 33178, 33183 and 33188

Raw Data

See attached excel files

Environmental conditions during the experiment:

Insert temperature, precipitation and/or irrigation, and relative humidity with a minimum of high, low and average daily temperatures. Or send separate file with this information.

Include a statement about any significant weather or environmental events during the experiment.

Source: <https://www.wunderground.com/history/monthly/us/oh/columbus/KCMH/date/2019-5> { or 2019-6, or 2019-7 or 2019-8}

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Total
May 1	83	68.7	53	61	56.9	52	96	69.2	41	29	11.6	0	29.2	29.2	29.1	0.00
2	77	65.6	59	62	60.5	58	100	85.1	57	14	4.5	0	29.3	29.2	29.2	0.09
3	69	63.1	54	62	59.9	53	97	89.4	68	14	4.7	0	29.2	29.1	29.0	0.01
4	56	54.2	51	54	51.7	50	100	91.3	86	13	6.5	0	29.1	29.0	29.0	0.30
5	66	52.9	0	51	45.8	0	97	75.6	0	15	8.9	3	29.1	29.0	28.9	0.21
6	75	60.9	44	49	45.8	42	93	61.8	37	10	3.3	0	29.2	29.2	29.1	0.00
7	77	63.9	53	54	50.4	48	86	63.8	36	15	5.0	0	29.3	29.2	29.2	0.00
8	80	65.1	50	54	48.5	41	77	56.9	39	12	7.3	3	29.3	29.2	29.1	0.00
9	79	70.5	63	63	58.6	52	93	67.2	51	23	13.3	5	29.1	29.0	29.0	0.00
10	63	59.1	50	62	53.4	42	97	82.3	62	15	9.3	3	29.3	29.1	29.0	0.73
11	67	55.7	44	46	42.9	40	89	64.3	45	15	8.7	0	29.3	29.1	28.9	0.00
12	56	50.7	46	51	47.9	44	96	90.3	77	14	6.5	0	28.9	28.9	28.8	0.16
13	56	51.4	46	49	46.3	43	97	83.1	66	17	9.5	5	29.1	28.9	28.8	0.11
14	65	54.0	42	44	39.9	37	93	63.2	37	13	6.8	0	29.2	29.1	29.1	0.01
15	71	59.1	44	47	42.1	39	90	57.9	32	13	6.0	0	29.1	29.1	29.1	0.00
16	75	65.7	53	55	50.2	47	83	59.6	37	15	7.5	0	29.1	29.1	28.9	0.00
17	80	67.1	61	66	61.0	57	97	82.3	52	16	8.6	0	29.1	29.0	28.9	0.93

Ornamental Horticulture Program Research Report Form

p 11

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
18	86	73.5	63	65	61.6	59	93	69.4	40	37	8.7	0	29.1	29.1	29.0	0.01
19	83	73.6	67	63	60.2	54	84	64.6	40	26	12.1	5	29.0	29.0	28.9	0.00
20	69	62.4	52	60	52.7	44	93	72.0	51	18	11.8	6	29.2	29.1	29.0	0.05
21	64	55.0	47	44	40.8	36	86	60.6	41	14	8.6	0	29.3	29.2	29.2	0.00
22	84	68.8	53	66	54.9	42	84	62.2	43	17	9.6	0	29.2	29.2	29.1	0.00
23	82	72.9	67	67	64.7	61	90	76.1	58	23	10.6	0	29.3	29.2	29.1	0.00
24	80	71.0	58	63	56.9	51	90	62.3	46	8	4.0	0	29.3	29.2	29.2	0.08
25	88	75.0	65	68	64.0	61	90	70.2	40	21	9.3	0	29.2	29.2	29.1	0.00
26	84	72.2	65	65	62.9	60	93	74.3	49	22	6.7	0	29.2	29.1	29.1	0.00
27	81	71.4	65	67	60.7	54	90	71.2	44	16	7.3	0	29.2	29.1	28.9	0.13
28	88	74.7	67	67	64.8	61	93	74.3	43	20	9.2	0	29.0	28.9	28.9	0.61
29	81	75.9	70	69	65.0	61	84	69.8	52	21	9.9	0	28.9	28.9	28.9	0.00
30	74	70.0	66	67	63.8	57	96	81.0	66	18	7.5	0	29.0	28.9	28.9	0.09
31	79	68.3	61	63	60.1	56	96	77.0	45	21	4.7	0	29.0	29.0	28.9	0.01

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
Jun	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Total
1	81	67.5	59	63	59.8	57	100	79.9	44	16	5.8	0	29.0	29.0	28.9	0.22
2	74	67.3	60	62	57.4	42	97	72.1	48	17	8.6	0	29.1	28.9	28.9	0.00
3	70	61.0	49	45	40.8	37	80	48.9	33	14	7.4	0	29.3	29.2	29.1	0.00
4	78	66.8	54	55	48.8	41	69	53.3	39	14	6.9	0	29.3	29.2	29.1	0.00
5	80	71.7	65	67	62.7	55	93	73.5	61	16	9.4	3	29.1	28.9	28.9	0.03
6	82	71.6	64	65	62.5	60	93	74.4	47	10	5.3	0	29.0	29.0	28.9	0.09
7	77	69.8	63	62	58.5	52	90	68.8	51	16	9.9	3	29.1	29.0	29.0	0.00
8	77	71.4	67	61	57.4	53	73	61.5	52	16	12.3	9	29.1	29.1	29.1	0.00
9	81	74.5	69	66	60.8	57	76	62.4	54	18	11.8	7	29.1	29.1	29.1	0.00
10	76	69.7	59	70	61.3	48	90	74.8	58	23	12.8	6	29.3	29.1	29.0	0.00

Ornamental Horticulture Program Research Report Form

p 12

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
11	78	65.0	49	50	45.8	42	93	55.0	29	14	5.4	0	29.4	29.3	29.2	0.06
12	77	64.9	57	61	52.2	44	96	67.0	37	20	10.5	5	29.3	29.1	28.9	0.00
13	64	59.2	53	59	52.6	45	93	79.5	60	24	14.4	0	29.1	28.9	28.8	0.53
14	74	63.3	49	46	42.6	39	83	50.9	28	17	10.5	3	29.3	29.2	29.1	0.00
15	76	67.7	61	66	57.0	46	93	69.8	48	20	8.5	3	29.1	29.1	29.0	0.00
16	79	71.0	66	70	66.5	64	100	86.2	64	21	9.6	3	29.0	29.0	28.9	0.93
17	77	70.8	66	70	66.4	64	94	86.4	66	13	5.9	0	29.1	29.1	29.0	0.18
18	78	70.6	67	70	66.4	65	97	86.9	66	12	5.1	0	29.1	29.1	29.0	0.75
19	82	72.0	67	70	67.5	65	97	86.3	60	17	4.9	0	29.0	28.9	28.8	0.26
20	76	68.5	64	67	64.8	60	97	88.1	69	23	10.9	5	28.9	28.8	28.7	2.66
21	77	68.0	61	61	54.9	51	90	65.3	42	14	8.0	3	29.1	29.1	28.9	0.01
22	80	71.2	64	57	52.3	49	75	52.5	38	12	6.5	3	29.2	29.2	29.1	0.00
23	82	71.4	55	66	54.3	47	89	57.7	32	10	5.2	0	29.2	29.1	29.0	0.00
24	83	72.4	68	70	66.8	64	96	83.2	54	16	8.9	5	29.0	28.9	28.8	0.34
25	84	75.1	66	65	60.1	55	93	62.8	38	16	10.2	5	29.1	29.1	28.9	0.86
26	89	78.6	68	66	62.3	60	78	59.0	38	13	6.8	0	29.3	29.2	29.2	0.00
27	87	77.5	71	68	64.9	61	84	66.3	48	18	5.1	0	29.3	29.3	29.3	0.00
28	90	79.3	70	69	65.3	62	90	65.0	39	12	5.6	0	29.4	29.3	29.2	0.00
29	91	81.0	69	67	64.6	63	84	59.2	39	17	8.4	0	29.3	29.2	29.1	0.00
30	89	80.3	72	70	63.8	59	84	59.0	37	14	6.3	0	29.1	29.1	29.1	0.00

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
Jul	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Total
1	89	78.2	65	68	61.0	57	81	57.4	39	9	5.0	0	29.2	29.1	29.1	0.00
2	93	80.0	70	73	67.3	64	90	67.5	39	25	7.1	0	29.1	29.1	29.0	0.00
3	84	73.2	69	72	68.9	67	97	87.0	58	14	6.8	0	29.1	29.1	29.1	0.35
4	86	73.3	67	71	68.4	66	100	86.1	51	9	3.1	0	29.2	29.1	29.1	0.51

Ornamental Horticulture Program Research Report Form

p 13

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
5	90	81.1	71	74	70.6	68	96	71.8	50	14	5.5	0	29.2	29.2	29.1	0.00
6	90	79.7	74	73	71.1	69	94	76.6	52	29	6.1	0	29.1	29.1	29.0	0.03
7	86	77.0	72	72	69.8	63	93	79.3	59	16	5.3	0	29.1	29.1	29.0	0.28
8	85	75.8	67	66	61.8	55	79	62.9	47	13	8.4	5	29.1	29.1	29.1	0.07
9	88	77.3	64	70	62.2	52	76	60.0	49	8	3.3	0	29.2	29.1	29.1	0.00
10	90	81.9	71	71	67.6	65	91	64.3	43	10	4.3	0	29.1	29.1	29.1	0.00
11	90	80.8	75	73	67.8	60	84	66.0	43	17	6.7	0	29.0	29.0	28.9	0.00
12	85	75.8	68	66	62.5	58	87	65.2	40	9	5.5	0	29.1	29.0	29.0	0.32
13	89	77.7	64	63	58.4	52	93	56.5	28	10	4.0	0	29.2	29.1	29.1	0.00
14	90	80.4	71	68	65.1	62	78	60.5	43	12	5.3	0	29.3	29.2	29.2	0.00
15	92	80.8	71	69	65.9	62	79	61.9	39	13	5.1	0	29.3	29.2	29.2	0.00
16	90	78.9	72	73	69.2	67	94	73.7	46	17	8.2	3	29.2	29.1	29.1	0.00
17	86	77.3	73	75	72.4	70	94	85.3	65	18	8.4	0	29.1	29.1	29.0	0.31
18	90	79.5	71	72	70.3	68	97	75.2	52	10	4.2	0	29.1	29.1	29.0	0.44
19	92	81.6	73	77	73.1	70	93	76.5	54	15	7.6	0	29.1	29.1	29.1	0.00
20	94	85.2	76	75	72.0	68	91	66.4	43	21	8.6	0	29.1	29.1	29.1	0.00
21	92	82.4	73	73	70.8	66	96	69.2	47	20	8.3	0	29.1	29.1	29.0	0.00
22	76	72.7	68	72	68.5	63	96	86.8	68	16	7.7	0	29.1	29.0	29.0	0.79
23	78	69.3	60	62	52.8	41	90	59.3	29	15	7.9	0	29.2	29.1	29.1	0.07
24	78	68.4	58	58	56.1	54	90	66.5	45	12	5.7	0	29.3	29.2	29.1	0.00
25	81	70.8	57	59	55.0	51	93	60.8	35	8	3.6	0	29.4	29.3	29.3	0.00
26	84	73.6	61	60	57.3	55	90	59.8	39	10	3.3	0	29.4	29.4	29.3	0.00
27	87	76.7	64	63	60.3	57	87	59.9	37	17	6.8	0	29.4	29.3	29.3	0.00
28	89	79.2	69	65	62.9	60	84	59.5	40	17	8.5	0	29.3	29.3	29.2	0.00
29	89	79.7	69	67	63.8	59	87	60.6	37	17	8.8	3	29.2	29.1	29.1	0.00
30	85	75.8	70	69	67.0	64	93	74.9	49	13	7.6	3	29.2	29.1	29.1	0.05

Ornamental Horticulture Program Research Report Form

p 14

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021
Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety
Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
31	87	76.8	68	66	64.2	61	93	67.6	41	13	4.9	0	29.2	29.2	29.1	0.00

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
Aug	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Total
1	84	75.6	69	65	62.9	60	87	66.6	44	14	7.1	0	29.3	29.2	29.2	0.00
2	87	76.8	67	61	58.0	56	73	54.1	36	10	6.6	0	29.2	29.2	29.2	0.00
3	87	75.1	63	61	56.6	50	87	56.1	28	9	5.8	0	29.2	29.2	29.1	0.00
4	89	75.1	61	67	58.1	50	90	59.8	30	26	5.5	0	29.2	29.1	29.1	0.00
5	89	78.2	67	68	63.9	59	93	64.1	39	15	4.6	0	29.1	29.1	29.0	0.71
6	86	75.2	68	69	65.2	60	93	72.8	43	18	7.5	0	29.1	29.0	28.9	0.01
7	84	75.9	68	68	64.3	55	96	69.5	37	15	7.3	0	29.0	29.0	28.9	0.11
8	89	77.5	65	67	62.1	60	87	61.3	39	26	11.3	0	29.0	29.0	28.9	0.00
9	83	73.6	65	65	54.5	46	90	55.7	29	10	6.1	3	29.1	29.1	29.0	0.01
10	83	71.1	60	58	54.5	51	87	59.0	34	12	5.6	0	29.2	29.1	29.1	0.00
11	84	72.6	58	59	55.0	53	90	56.7	35	8	4.3	0	29.2	29.2	29.1	0.00
12	85	76.5	65	65	60.0	56	84	58.0	38	12	5.7	0	29.1	29.1	29.0	0.00
13	83	75.6	71	72	69.6	65	96	81.9	63	14	8.1	3	29.0	28.9	28.9	0.29
14	85	74.6	68	69	65.5	60	96	75.9	43	12	4.8	0	29.1	29.0	29.0	0.00
15	85	76.0	67	66	62.5	58	93	65.8	40	15	7.6	0	29.1	29.1	29.0	0.00
16	84	75.8	64	65	61.4	53	93	63.4	34	12	4.7	0	29.1	29.1	29.1	0.00
17	90	77.8	67	69	64.5	61	87	65.4	39	16	5.8	0	29.1	29.1	29.1	0.00
18	93	82.0	72	69	67.8	65	87	64.3	41	36	7.7	0	29.1	29.1	29.0	0.00
19	89	76.2	66	70	65.9	63	93	72.2	46	20	6.4	0	29.2	29.1	29.1	0.50
20	91	79.7	71	71	68.4	66	90	69.3	48	18	6.2	0	29.2	29.1	29.1	0.00
21	85	75.5	69	67	65.6	64	90	72.7	49	15	7.8	3	29.1	29.1	29.1	0.01
22	78	72.2	69	69	66.5	62	93	82.7	66	13	6.4	0	29.1	29.1	29.1	0.00
23	76	68.1	59	61	54.4	50	79	63.2	40	16	8.3	3	29.3	29.2	29.1	0.27

Ornamental Horticulture Program

Research Report Form

p 15

Researcher: Hannah Mathers, PhD **Date:** 2/16/2021

Project Title: 2019 In Season Pre-emergence Herbicide Crop Safety

Protocol #: 19-012 **PRnumbers:** 30927, 30952, 33178, 33183 and 33188

Time	Temperature (° F)			Dew Point (° F)			Humidity (%)			Wind Speed (mph)			Pressure (Hg)			Precipitation (in)
24	77	66.2	55	55	50.7	47	89	60.5	36	14	7.9	0	29.4	29.3	29.3	0.00
25	80	68.1	57	55	52.1	50	78	58.6	38	13	8.8	5	29.3	29.3	29.2	0.00
26	68	65.6	63	65	60.2	52	97	83.3	65	15	9.9	7	29.2	29.1	29.1	0.00
27	76	70.6	67	70	68.0	65	97	91.8	79	16	7.5	0	29.1	29.0	29.0	0.61
28	79	69.9	63	70	58.8	47	100	73.0	33	17	6.0	0	29.1	29.1	29.0	0.76
29	81	69.4	57	58	54.6	52	93	62.3	36	17	6.8	0	29.2	29.1	29.1	0.00
30	87	74.9	66	65	60.4	55	79	62.0	33	13	6.9	3	29.3	29.2	29.1	0.00
31	77	69.8	66	60	56.9	54	79	64.0	46	12	6.6	0	29.4	29.3	29.3	0.00