
Researcher: Hannah Mathers, PhD **Date:** 5/11/2020
Project Title: 2018 In Season Pre-Emergent Herbicide Crop Safety
Protocol #: 18-012 **PRnumbers:** 31785

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.

The results presented are for one species (Table 3 and 3B) that received applications of Dimension 2EW (dithiopyr 24%) (Dow AgroSciences LLC, Indianapolis, IN) as part of protocol 18-012. *Rhamnus frangula* 'Fineline' measured by rated scores were significantly injured by Dimension 2EW at 0.5, 1.0 and 2.0 lb ai/ac after one application and increasingly so after two applications (Table 3). When the trial was initiated on 05/23/2018 all plants were in good health. There were no significant difference in height or growth index (GI) with any treatment compared to the control (Table 3B). By the end of the study, however, there were significant reductions in plant volumes with the 4X, 2X and 1X expressing 62% (729.6 in³), 57% (837.1 in³), 33% (1300.0 in³), respectively, relative to the control (1927.6 in³) (Table 3B). These GI values coincided with the rated scores of 7 (4X), 5 (2X) and 3 (1X) (Table 3). The *Rhamnus frangula* 'Fineline' received commercially unacceptable injury at 2X and 4X by 4WAT and 6WAT (Table 3). After the second treatment the 1X, 2X and 4X were all injured beyond commercially unacceptable (Table 3).

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 3. Phytotoxicity ratings on selected ornamentals at Acorn Farms, Galena, OH

Rhamnus frangula 'Fineline'- #5 pot - PR# 31785- Acorn Farms

Treatment	Rate(ai) ^v	1 WAT ^z	2 WAT	4 WAT	6WAT	1 WA2T	2 WA2T	4 WA2T
Dimension 2EW	0.5 lb	0.0	0.0	2.0 *	1.2	1.0✓	3.0 *	3.0 *
Dimension 2EW	1.0 lb	0.0	0.2	4.0 *	3.1 *	2.5✓ *	5.0 **	5.0 **
Dimension 2EW	2.0 lb	0.0	2.0 *	4.0 *	4.6 *	4.0✓ *	7.0 **	7.0 **
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 (α = 0.10, 0.05, respectively).

✓ indicates reapplication at this date

^v = All rates of Dimension 2EW (dithiopyr 24%) are listed as active ingredient (ai) per ac.

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Table 3B. Phytotoxicity measures as a companion table to Table 3 above.

Rhamnus frangula 'Fineline'- #5 pot - PR# 31785- Acorn Farms

Treatment	Rate (ai) ^v	HT ⁱ WAT ^z	HT6WA2T	GI ^t 0WAT ^z	GI6WA2T	Δ ^w HT	ΔGI
Dimension 2EW	0.5 lb	20.8 ^y	38.9	1299.8	1300.0 *	18.1	0.2 *
Dimension 2EW	1.0 lb	19.5	38.6	1413.0	837.1 **	19.1	-575.9 **
Dimension 2EW	2.0 lb	20.0	33.4 *	1311.3	729.6 **	13.4 *	-581.7 **
Untreated	--	18.3	40.7	1464.4	1927.6	22.4	463.2

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 of Dimension (dithiopyr 24%) 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 in inches.
t = GI represents Growth index (in³) and was calculated as GI=Pi (Ht)(r)², where Ht. (in) was the starting or final height, respectively, r was half of the average of W1+W2 (two perpendicular measurements taken of plant diameter (in)) and Pi 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.
w = Δ represents delta or the change in average heights and average GI's from the start to completion of the trial.

Materials & Methods/Recordkeeping

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

Four replications with three plants per replication, four treatments, 0, 1, 2 and 4X rates of Dimension 2EW (dithiopyr 24%) were applied to *Rhamnus frangula* 'Fineline' plants in 5-gallon containers (Table 3) for 48 plants per protocol (PR#: 31785). Rates are listed in pounds of active ingredient (a.i)/acre with 1X being 0.5 lb ai/ac (Table 3). Evaluations were conducted at 1, 2 and 4 weeks after treatment (WAT). A reapplication was conducted at 7 WAT, and evaluations occurred 1, 2, and 4 weeks after second treatment (WA2T). *Rhamnus frangula* 'Fineline' were located at Acorn Farms, Galena, OH. Weather records for Columbus, OH are presented as Acorn Farms is in the greater Columbus, OH region. All plants were grown in standard container media (85% pine bark and 15% Comtil) (Kruz 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 at Acorn were conducted on May 23, 2018, 7 days after potting. Herbicides were applied over-the-top and watered-in within 2 hr. of application.

Name(s) of Personnel Conducting Research: Dr. Hannah Mathers
Location of Trial (city/state): Acorn Farms Inc., Galena, OH
Use Site (greenhouse/shade house/field container/etc.): Field container

Crop History

Crop Cultivar/Variety: *Rhamnus frangula* 'Fineline'
Purchased from: Acorn – Zanesville farm
Date of Transplanting: May 16,2018
Potting Mix: See above
Pot size & spacing: 5-gallon on 2ft centers

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Product(s) applied prior to start of experiment:

Product	Rate	Application Type	Date of Application	Crop Growth Stage
Dimension 2EW	0			Shoot expansion
	0.5 lb a.i./ac	Liquid - applied via CO ₂ backpack	05/23/2018	Shoot expansion
	1.0 lb a.i./ac	Liquid - applied via CO ₂ backpack	05/23/2018	Shoot expansion
	2.0 lb a.i./ac	Liquid - applied via CO ₂ backpack	05/23/2018	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

Photos

Please embed photos here or send jpg, tiff, or bmp.



Fig. 5.1. (Above) *Rhamnus frangula* ‘Fineline’ located at Acorn Farms, Galena, OH. This photo was taken 2 WAT. From left to right Control, 1X, 2X and 4X rates are shown. At the initiation of the trial all plants had less volume versus the control, but only the 4X significantly. subsamples and only the 4X had time of application all peonies were in flower bud and weed control in the rows and between rows was poor. Photo taken by: H. Mathers.

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Fig. 5.2. (Above) *Rhamnus frangula* 'Fineline' located at Acorn Farms, Galena, OH. This photo was taken 7 WAT but before reapplication. From left to right 4X, 2X, 1X and control are shown. All treatment plants have less volume than the controls but the 4X is also showing significant height reduction as indicated in the rated scores (Table 3). Photo taken by: H. Mathers.



Fig. 5.3. (Above) *Rhamnus frangula* 'Fineline' located at Acorn Farms, Galena, OH. This photo was taken at 6WA2T, two weeks after the trial conclusion. The size reduction with the 4X and 2X rates is visual evident as it is with the 1X but not as severely (Table 3B). Growth reduction as injury increased significantly after the 2nd application of Dimension (Table 3). Photo taken by: H. Mathers.

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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 represented 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 heights, and two perpendicular measurements of diameter were taken per plant. These measures were used to calculate Growth index (GI) (in³) as $GI = \pi (Ht)(r^2)$, where Ht. (in) was the starting height, r was half of the average of W1+W2 [two perpendicular measurements taken of plant diameter (in)] and Pi 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*. Final growth measures could not be taken as the grower inadvertently cut-back the plants (i.e. their normal practices).

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/2018-8>

Date	Temperature (° F)			Humidity (%)			Precipitation
	Max	Avg	Min	Max	Avg	Min	Total
May 1	81	64.6	45	68	38.2	17	0
2	85	73.0	59	60	46.8	36	0
3	80	74.1	69	87	61.1	47	0
4	82	70.8	60	84	63.5	42	0.09
5	68	60.8	51	93	71.5	50	1.8
6	77	64.4	56	90	65.9	27	0
7	72	62.1	52	93	63.4	38	0.06
8	79	64.8	49	80	52.0	32	0
9	83	73.9	56	84	49.1	28	0
10	80	72.0	64	90	55.8	29	0.17
11	78	66.5	57	83	60.3	46	0
12	85	72.7	62	78	57.5	40	0
13	86	72.2	59	87	67.4	46	0
14	84	74.4	64	90	66.7	46	0
15	86	73.7	66	100	75.5	35	0
16	78	68.2	62	93	82.2	62	0.66
17	80	71.7	61	87	69.8	52	0.05



Ornamental Horticulture Program Research Report Form

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Date	Temperature (° F)			Humidity (%)			Precipitation
18	74	69.7	66	84	70.9	61	0.03
19	81	73.5	66	87	71.7	56	0.09
20	78	70.1	66	93	76.1	54	0.01
21	82	69.4	61	94	75.9	52	0.08
22	81	71.8	66	96	80.1	58	0.82
23 -Start	77	67.6	63	87	69.0	43	0.04
24	83	70.7	55	84	51.9	29	0
25	87	74.4	58	87	52.6	29	0
26	84	73.8	65	100	71.9	25	0
27	89	78.0	68	97	70.2	45	1.57
28	91	80.0	68	93	64.9	40	0
29	89	80.0	69	90	61.5	40	0
30 -1WAT	85	77.4	71	93	74.5	55	0
31	86	77.2	71	87	75.9	53	0.28

Date	Temperature (° F)			Humidity (%)			Precipitation (in)
Jun	Max	Avg	Min	Max	Avg	Min	Total
1	81	73.2	68	87	77.5	62	0.42
2	83	73.5	67	90	74.0	53	0.00
3	83	73.6	65	90	65.5	29	0.00
4	76	68.2	59	78	50.8	31	0.08
5	67	62.1	59	96	78.3	49	0.00
6 -2WAT	68	59.4	50	93	68.3	45	0.57
7	81	67.5	53	83	62.2	45	0.00
8	84	71.4	66	93	75.9	47	0.00
9	87	72.9	66	93	76.6	46	0.54
10	82	73.7	67	93	76.2	56	0.44
11	73	70.5	67	87	81.6	73	0.00
12	80	71.8	65	93	84.4	67	0.02
13	86	74.3	69	97	84.1	57	0.42
14	83	71.8	58	87	55.3	27	1.11
15	86	74.7	61	84	55.2	32	0.00
16	88	77.6	68	85	67.1	49	0.00
17	91	81.8	70	93	68.8	50	0.04
18	93	84.1	73	87	62.8	45	0.00
19	87	80.6	75	90	75.3	63	0.00
20 -4WAT	87	77.2	72	93	81.5	55	0.38
21	74	70.1	66	94	88.3	76	0.15
22	84	74.4	69	93	79.9	49	1.67
23	79	72.5	68	90	75.7	60	0.22
24	83	75.7	69	84	63.7	46	0.03
25	79	71.7	63	87	69.1	52	0.00
26	83	70.1	64	93	80.3	54	0.00
27	83	72.8	67	93	80.5	58	0.99
28	86	75.9	68	90	70.3	48	0.05
29	88	79.5	68	90	67.6	46	0.00



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Date	Temperature (° F)			Humidity (%)			Precipitation
30	91	81.4	69	90	63.8	36	0.00

Date	Temperature (° F)			Humidity (%)			Precipitation (in)
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Date	Max	Avg	Min	Max	Avg	Min	Total
1	94	82.8	71	87	63.7	43	0.00
2	90	78.9	74	85	73.8	55	0.00
3	92	80.7	71	93	71.4	48	0.00
4	92	81.2	74	91	75.3	50	0.94
5	93	82.2	74	94	72.4	48	0.36
6	81	74.0	63	93	66.9	42	0.66
7	80	69.5	58	90	57.1	32	0.00
8	86	72.4	59	78	54.0	31	0.00
9	89	77.0	62	84	58.1	32	0.00
10	91	78.9	69	87	68.9	42	0.00
11	84	74.9	64	78	53.4	37	0.00
12 -7WAT Reapply	85	74.4	63	72	51.5	33	0.00
13	89	79.0	67	68	51.2	35	0.00
14	92	82.5	70	87	58.7	33	0.00
15	86	81.5	75	84	66.2	51	0.00
16	88	79.5	74	91	76.9	55	0.00
17	86	78.2	70	91	59.8	33	0.24
18	83	73.7	64	84	58.3	37	0.00
19 -1WA2T	84	74.2	63	75	52.3	33	0.00
20	77	71.6	67	91	81.8	66	0.00
21	78	70.0	65	93	83.7	64	0.53
22	80	71.8	66	94	78.4	58	0.32
23	82	72.1	66	94	82.2	60	0.01
24	81	73.5	69	97	81.8	58	1.30
25	87	77.1	69	90	68.4	51	0.00
26 -2WA2T	85	75.2	66	93	68.9	46	0.00
27	80	73.0	67	93	67.1	46	0.24
28	80	70.7	61	81	60.4	42	0.00
29	80	71.5	61	90	66.7	39	0.00
30	81	73.0	66	93	70.8	41	0.03
31	75	71.9	68	96	86.5	76	0.05

Date	Temperature (° F)			Humidity (%)			Precipitation (in)
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Date	Max	Avg	Min	Max	Avg	Min	Total
Aug 1	75	71.2	68	93	81.8	66	0.78
2	81	73.7	67	93	76.6	50	0.01
3	84	76.2	67	93	71.4	47	0.00
4	89	79.1	69	87	66.3	39	0.06
5	89	81.0	72	91	68.2	46	0.00
6	89	81.3	73	90	69.1	50	0.00
7	86	76.3	72	91	77.3	54	0.00



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Date	Temperature (° F)			Humidity (%)			Precipitation
8	83	75.3	71	96	83.3	60	0.31
9 -4WA2T	85	75.0	68	93	72.9	44	0.11
10	81	73.5	69	96	84.3	67	0.00
11	79	72.1	68	93	83.5	60	0.00
12	84	73.9	61	93	65.1	44	0.19
13	84	73.3	64	93	70.6	46	0.00
14	84	74.7	63	93	68.6	46	0.00
15	84	75.4	67	93	75.4	51	0.00
16	77	73.6	70	93	84.2	76	0.24
17 -Photos	81	74.8	72	94	88.0	77	0.51