Research Report Form



Researcher:	Hannah Mathers, PhD		Date:	12/21/2016
Project Title:	Ornamental Grasses herbicide Crop	Safety		
Protocol #:	15-010	PRnumbers:	31968, 31976, 3	1977

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 three species (Table 4) that received applications of Gallery SC (Isoxaben 45.45 2%) (Dow AgroSciences, Indianapolis, IN) as part of protocol 15-010Gallery SC caused no unacceptable commercial injury at any rate, even after two applications at 6 weeks apart for Panicum vigratum 'Heavy Metal' (Switch Grass) (Table 4). The Calamagrostis x acutiflora 'Karl Foerster' showed only transitory injury at the 2 X rate of Gallery SC, 2 WAT and 1 WA2T (table 4). However, there was phytotoxicity throughout the trial with the 4X Gallery SC application to 'Karl Foerster' (Table 4). Nassella tenuissima (Mexican feather grass) had unacceptable phytotoxicity starting at 4 WAT with the 1X and 2X rates and at 2 WAT with the 4X rate. Phytotoxicity with Nassella tenuissima was decreasing by 6 WAT for all rates, although it was still above commercially acceptable (Table 4). It is important to note the controls were also showing phytotoxicity at 4 and 6 WAT and at a commercially unacceptable level (3.0) at 1 WA2T (Table 4). One week after the second application all treatments, including the control, had unacceptable injury. At 2, 4 and 6 WA2T the only treatments with unacceptable phytotoxicity was the 4X rate. Nassella tenuissima is a coolseason, Zone 6-10 plant and as such was not well suited for evaluation in Columbus, OH during the summer of 2015. Shortly after trial initiation, June 3, 2015 the temperatures reached into the 90's and continued above the 30 yr. average into mid-June. Again in mid-late July and additionally in early to mid-August the temperatures were above the 30 yr. average with many days in the high 80's into the 90's F. For a cool-season grass these temperatures were problematic. The controls showed heat stress with the center part of the plant burning out (Table 4) similar to injury seen with the Pendulum 2G plants (Table 3). The treatments seemed to add to the plants' inability to handle the hot weather. In a cooler, central Ohio summer, phytotoxicity may have been reduced. In these 2015 evaluations, phytotoxicity with Gallery SC was above commercially acceptable >3, at the 4X rate starting at 2 WAT and for all subsequent evaluation dates (Table 4). At the 2X rate phytotoxicity was above commercially acceptable from 4WAT to 1 WA2T; however, plants had grown out by 2WA2T and until trial completion (Table 4). However, if you adjust for the phytotoxicity to the controls, the 1X and 2X rate were never above commercially acceptable. However, the 4X rate was still unacceptable from 2WAT to trial completion (Table 4).

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 4. Phytotoxicity on selected ornamentals at two locations Mathers Environmental, Gahanna, OH and Klyn Nurseries,

 Perry, OH.

Treatment	Rate(ai) ^v	1 WAT ^z	2 WAT	4 WAT	6WAT	1 WA2T	2 WA2T	4 WA2T	6 WA2T
Gallery SC	1.0 lb/ac	0.7 ^{yx}	0.8	2.7 *	2.0√ ∗	2.8 *	1.5	2.0 *	2.0 *
Gallery SC	2.0 lb/ac	2.7 ^{yx} *	4.7 **	2.8 *	2.3√ *	3.9 *	1.9 *	2.2 *	2.8 **
Gallery SC	4.0 lb/ac	3.7 ^{yx} *	5.0 **	5.8 **	4.3✓ **	5.9 **	5.1 **	5.7 **	6.0 **

Calamagrostis x acutiflora 'Karl Foerster' #1 pot – PR31968 – Mathers Environmental

Mathers Table 4 2015



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Project Title:	Orname	ental Grass	ses herbici	de Crop S	Safety				
Protocol #:	15-010				PRnumbers:	_31968, 31	976, 3197	7	
Untreated		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Panicum vigra	<i>tum '</i> Heavy N	Metal' #2 po	t - PR31977 ·	- Klyn Nurse	eries				
Treatment	Rate(ai) ^v	1 WAT	2 WAT	4 WAT	6 WAT	1 WA2T	2 WA2T	4 WA2T	6 WA2T
Gallery SC	1.0 lb/ac	0.0	0.0	0.0	0.0√	0.0	0.0	0.0	0.0
Gallery SC	2.0 lb/ac	0.0	0.0	0.0	0.0✓	0.0	0.0	0.0	0.0
Gallery SC	4.0 lb/ac	0.0	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	0.0
Nassella tenuis	ssima #1 pot	– PR31976	– Mathers Ei	nvironment	al				
Treatment	Rate(ai) ^v	1 WAT	2 WAT	4 WAT	6 WAT	1 WA2T	2 WA2T	4 WA2T	6 WA2T
Gallery SC	1.0 lb/ac	1.2	2.3 *	4.0 *	3.0√	3.6	1.0	1.0	0.0
Gallery SC	2.0 lb/ac	1.8 *	2.5 *	5.8 *	4.0✓ *	4.5 *	2.0 *	2.0 *	2.0 *
Gallery SC	4.0 lb/ac	2.4 *	4.1 **	7.2 **	5.0√ *	5.7 *	5.0 **	5.0 **	7.6 **
Untreated		0.0	0.0	2.0	2.0	3.0	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 \leq 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).

 \checkmark indicates reapplication at this date

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

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Materials & Methods/Recordkeeping

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

Four replications, with three plants per replication and four treatments 0, 1, 2, 4 X rates of Gallery SC were applied to plants grown in the pot sizes listed in the Table 4, for 48 plants per protocol (PR#: 31968, 31976, 31977). Rates are listed in pounds of active ingredient (ai)/acre with 1X being 1 lb ai/ac (Table 4). Evaluations were conducted at 1, 2, 4, weeks after treatment (WAT). A reapplication was conducted at 6WAT and evaluations occurred 1, 2, 4 and 6 weeks after second treatment (WA2T). One species was located at Klyn Nurseries, Inc., Perry, OH. Two species, *Calamagrostis x acutiflora* 'Karl Foerster' and *Nassella tenuissima* were grown at Mathers Environmental Science Services, LLC, Gahanna, OH. The location of each species is listed in Table 4. 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 were conducted soon after covers are removed from polyhouses, May 13, 2015 at Klyn's and June 3, 2015 at Mathers'. On May 13 the weather in Perry, OH was cloudy and cool, the wind was NE at 5 mph and it was 47°F. On June 3 in Gahanna, OH it was clear, sunny and 63°F wind was 2 mph. All plants were freshly upshifted two weeks before applications at Klyn and Mathers' and all were watered within 2 hours following applications.

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

Location of Trial (city/state): Klyn Nurseries, Inc., Perry, OH & Mathers Enviro. Sci. Serv., LLC, Gahanna, OH Use Site (greenhouse/shadehouse/field container/etc): Field container

Crop History

Crop Cultivar/Variety:	Calamagrostis x acutiflora 'Karl Foerster'
Purchased from:	Hoffman Nursery, Inc., Rougemont, NC as full 4" pots
Date of Transplanting:	May 19, 2015
Potting Mix:	See above
Pot size & spacing:	1 gallon pots on 1 foot centers
Crop Cultivar/Variety:	Panicum vigratum 'Heavy Metal'
Purchased from:	Grown at Klyn Nurseries, Inc., Perry, OH
Date of Transplanting:	May 12, 2015
Potting Mix:	See above
Pot size & spacing:	2 gallon pots on 1 foot centers
Crop Cultivar/Variety:	Nassella tenuissima
Purchased from:	Hoffman Nursery, Inc., Rougemont, NC as full 4" pots
Date of Transplanting:	May 19, 2015
Potting Mix:	See above
Pot size & spacing:	1 gallon pots on 1 foot centers



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Protocol #:	15-010	PRnumbers: 31	968, 31976, 3 ⁻	1977

Product(s) applied prior to start of experiment:

Product	Rate	Application	Date of Application	Crop Growth Stage	Application Volume
Gallery SC (Isoxaben 45.45%) <u>2 at MESS</u> : Calamagrostis x acutiflora 'Karl Foerster' and Nassella tenuissima	0			Shoot expansion	25 gal/ac
	31 fl. oz (1.0 lb a.i/ac	Liquid - applied via CO ₂ backpack	06/03/2015	Shoot expansion	25 gal/ac
	62 fl. oz (2.0 lb a.i/ac	Liquid - applied via CO ₂	06/03/2015	Shoot expansion	25 gal/ac
	124 fl. oz (4.0 lb a.i/ac	Liquid - applied via CO ₂ backpack	06/03/2015	Shoot expansion	25 gal/ac
Gallery SC (Isoxaben 45.45%) <u>1 species at Klyn</u> <u>Nurseries</u> Panicum vigratum 'Heavy Metal'	0			Shoot expansion	
	31 fl. oz (1.0 lb a.i/ac	Liquid - applied via CO ₂ backpack	05/13/2015	Shoot expansion	25 gal/ac
	62 fl. oz (2.0 lb a.i/ac	Liquid - applied via CO ₂ backpack	05/13/2015	Shoot expansion	25 gal/ac
	124 fl. oz (4.0 lb a.i/ac	Liquid - applied via CO ₂ backpack	05/13/2015	Shoot expansion	25 gal/ac



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Add more rows as needed.

Experiment Information

Experimental Design: Number of Reps: Completely randomized design with species 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. 4.1. A and B. (Above) *Calamagrostis X acutiflora* 'Karl Forester' at Mathers Environmental Science Services, LLC, Gahanna, OH. **A.** was taken 1 WAT and **B.** at 1WA2T with Gallery SC. For both photos going from left to right is the – control, 1X, 2X and 4X. Reduction in growth is apparent as the rate increases. Photo taken by: H. Mathers

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Fig. 4.2. (Above) *Nassella tenuissima* at Mathers Environmental, Gahanna, OH, taken 4WA2T with Gallery SC from left to right control, 1X, 2X and 4X. Note all plants are suffering from heat stress including control; however, the 4X rate is smaller and has very little green growth the 2X rate is also showing some damage but not commercially unacceptable compared to the control. Photo taken by: H. Mathers



Fig. 4.3. (Left) *Calamagrostis X acutiflora* 'Karl Forester' at Mathers Environmental Science Services, LLC, Gahanna, OH. Picture taken 4WA2T with Gallery SC. From left to right the treatments are – control, 1X, 2X and 4X. Reduction in growth is apparent at 2X and especially at 4X with commercially unacceptable injury occurring for both rates. Photo taken by: H. Mathers



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Fig. 4.4. (Above) *Panicum vigratum* 'Heavy Metal' at Klyn Nurseries, Perry, Ohio taken 6WA2T with Gallery SC showing left (control) and right (4X). Note there was no injury to any 'Heavy Metal' plants at any rate or evaluation date. 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 represented no phytotoxicity, \geq 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. Symptoms were also noted if significant and photos were conducted *in situ*.

Raw Data

Insert raw data below or send separate file containing raw data.

See attached excel files

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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 course of the experiment.

Environmental Conditions in Gahanna, OH. Source: http://www.accuweather.com for plants at MESS

Events in June 2015	Date (yr. 2015)	Hi/Low	Precipitation/ Irrigation	Average Hi/Low
Trial	Wed 6/3	73°/59°	0 in/ 0.5in	78°/58°
initiation				
	Thu 6/4	81°/60°	0 in/ 0.5in	78°/58°
	Fri 6/5	86°/62°	0.25 in/ 0.25in	79°/59°
	Sat 6/6	79°/61°	0 in/ 0.5in	79°/59°
	Sun 6/7	85°/56°	0 in/ 0.5in	79°/59°
	Mon 6/8	79°/61°	0.09 in/ 0.5in	80°/60°
	Tue 6/9	76°/57°	0.03 in/ 0.5in	80°/60°
1WA1T	Wed 6/10	91°/58°	0 in/ 0.5in	80°/60°
	Thu 6/11	92°/67°	0 in/ 0.5in	81°/60°
	Fri 6/12	93°/70°	0.04 in/ 0.5in	81°/61°
	Sat 6/13	90°/69°	0.17 in/ 0.4in	81°/61°
	Sun 6/14	91°/69°	0.10 in/ 0.4in	82°/61°
	Mon 6/15	87°/71°	0.44 in	82°/62°
	Tue 6/16	83°/71°	0.87 in	82°/62°
2WA1T	Wed 6/17	72°/61°	0.44 in	82°/62°
	Thu 6/18	87°/69°	0 in/ 0.5in	82°/62°
	Fri 6/19	76°/67°	0.01 in	83°/63°
	Sat 6/20	73°/67°	2.00 in	83°/63°
	Sun 6/21	86°/68°	0 in	83°/63°
	Mon 6/22	86°/64°	0 in/ 0.5in	83°/63°
	Tue 6/23	85°/67°	0 in/ 0.5in	84°/64°
	Wed 6/24	83°/61°	0 in/ 0.5in	84°/64°
	Thu 6/25	77°/66°	0.27 in	84°/64°
	Fri 6/26	78°/67°	0.65 in	84°/64°
	Sat 6/27	71°/58°	0.55 in	84°/64°
	Sun 6/28	75°/58°	0.03 in/ 0.5in	84°/64°
	Mon 6/29	66°/60°	0.40 in	84°/65°
	Tue 6/30	77°/60°	0.35 in	85°/65°
Events in July 2015	Date (yr. 2015)	Hi/Low	Precipitation/ Irrigation	Average Hi/Low
4WA1T	Wed 7/1	78°/59°	0 in/ 0.5in	85°/65°
	Thu 7/2	74°/62°	0 in/ 0.5in	85°/65°
	Fri 7/3	76°/61°	0 in/ 0.5in	85°/65°
	Sat 7/4	79°/59°	0 in/ 0.5in	85°/65°
	Sun 7/5	79°/61°	0 in/ 0.5in	85°/65°
	Mon 7/6	84°/64°	0 in/ 0.5in	85°/65°
	Tue 7/7	84°/69°	0.55 in	85°/65°
	Wed 7/8	70°/62°	0.17 in	85°/66°
	Thu 7/9	78°/67°	0.02 in/ 0.5in	85°/66°



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Protocol #:	15-010		PRnumbers: 31968, 31976, 31977		
	Sat 8/22	81°/59°	0 in/ 0 5in	84°/64°	
	Sun 8/23	84°/59°	0.23 in	83°/64°	
	Mon 8/24		0 in/ 0.5in		
	Tue 8/25	68°/56°	0 in/ 0.5in	83°/63°	
6WA2T Trial completion	Wed 8/26	68°/57°	0 in/ 0.5in	83°/63°	

Environmental Conditions in Perry, OH. Source: http://www.accuweather.com for plants at Klyn's

Events in May 2015 Perry, OH	Date (yr. 2015)	Hi/Low	Precipitation/ Irrigation	Average Hi/Low
Trial initiation	Wed 5/13	50°/38°	0 in/ 0.5in	68°/47°
	Thu 5/14	59°/33°	0 in	68°/48°
	Fri 5/15	78°/47°	0.29 in/ 0.25in	69°/48°
	Sat 5/16	71°/61°	0 in/ 0.5in	69°/48°
	Sun 5/17	80°/60°	0.10 in/ 0.5in	69°/49°
	Mon 5/18	80°/68°	0.28 in/ 0.25in	70°/49°
	Tue 5/19	72°/51°	0 in/ 0.5in	70°/49°
1WA1T	Wed 5/20	53°/43°	0 in	70°/50°
	Thu 5/21	60°/46°	0 in	71°/50°
	Fri 5/22	63°/43°	0.01 in/ 0.5in	71°/50°
	Sat 5/23	N/A	N/A	71°/51°
	Sun 5/24	81°/53°	0 in/ 0.5in	72°/51°
	Mon 5/25	84°/66°	0 in/ 0.5in	72°/51°
	Tue 5/26	85°/69°	0.09 in/ 0.5in	72°/52°
2WA1T	Wed 5/27	82°/61°	0.49 in	73°/52°
	Thu 5/28	74°/55°	0 in/ 0.5in	73°/52°
	Fri 5/29	84°/56°	0.02 in/ 0.5in	73°/53°
	Sat 5/30	82°/55°	0.82 in	74°/53°
	Sun 5/31	58°/46°	1.00 in	74°/53
Events in June 2015	Date (yr. 2015)	Hi/Low	Precipitation/Irrigation	Average Hi/Low
	Mon 6/1	53°/46°	0.01 in	74°/54°
	Tue 6/2	64°/48°	0 in/ 0.5in	75°/54°
	Wed 6/3	73°/46°	0 in/ 0.5in	75°/54°
	Thu 6/4	79°/58°	0 in/ 0.5in	75°/54°
	Fri 6/5	76°/59°	0 in/ 0.5in	75°/55°
	Sat 6/6	66°/49°	0 in/ 0.5in	76°/55°
	Sun 6/7	82°/46°	0.01 in/ 0.5in	76°/55°
	Mon 6/8	78°/63°	0.29 in/ 0.25in	76°/56°
	Tue 6/9	71°/59°	0.12 in/ 0.5in	77°/56°
	Wed 6/10	87°/61°	0.38 in/ 0.5in	77°/56°
4WA1T	Thu 6/11	75°/61°	0.04 in/ 0.5in	77°/56°
	Fri 6/12	88°/60°	0.39 in/ 0.5in	77°/57°



Research Report Form

12/21/2016 Researcher: Hannah Mathers. PhD Date: Ornamental Grasses herbicide Crop Safety Project Title: Protocol #: 15-010 PRnumbers: 31968, 31976, 31977 Sat 6/13 74°/58° 0.27 in/ 0.5in 78°/57° Sun 6/14 83°/64° 78°/57° 0.05 in/ 0.5in Mon 6/15 80°/69° 0.12 in/ 0.5in 78°/58° Tue 6/16 73°/59° 78°/58° 0.10 in/ 0.5in Wed 6/17 72°/54° 0 in/ 0.5in 78°/58° Thu 6/18 78°/66° 0.06 in/ 0.5in 79°/58° Fri 6/19 70°/58° 0 in/ 0.5in 79°/59° Sat 6/20 79°/58° 0 in/ 0.5in 79°/59° Sun 6/21 77°/65° 0 in/ 0.5in 79°/59° Mon 6/22 79°/59° 85°/67° 0.26 in/ 0.5in 79°/59° Tue 6/23 0.87 in 80°/59° 6WA1T 73°/54° Wed 6/24 0 in/ 0.5in 80°/60° Reapply 72°/53° 80°/60° Thu 6/25 0 in/ 0.5in Fri 6/26 72°/54° 0 in/ 0.5in 80°/60° 71°/61° 1.78 in 80°/60° Sat 6/27 Sun 6/28 66°/54° 0.09 in 80°/60° 74°/54° Mon 6/29 0.02 in/ 0.5in 80°/60° 81°/61° Tue 6/30 71°/60° 0.06 in Date (yr. 2015) Hi/Low **Precipitation/Irrigation** Average Events in Hi/Low July 2015 Wed 7/1 70°/62° 0.23 in/ 0.5in 81°/61° **1WA2T** Thu 7/2 81°/61° 72°/55° 0 in/ 0.5in Fri 7/3 73°/49° 0 in/ 0.5in 81°/61° Sat 7/4 72°/51° 81°/61° 0 in/ 0.5in Sun 7/5 76°/53° 81°/61° 0 in/ 0.5in Mon 7/6 78°/57° 81°/61° 0 in/ 0.5in Tue 7/7 85°/60° 81°/62° 0.07 in/ 0.5in **2WA2T** Wed 7/8 69°/60° 0 in/ 0.5in 81°/62° Thu 7/9 72°/62° 81°/62° 1.30 in Fri 7/10 71°/58° 81°/62° 0.17 in/ 0.5in Sat 7/11 76°/53° 81°/62° 0.06 in/ 0.5in Sun 7/12 78°/60° 81°/62° 0.03 in/ 0.5in Mon 7/13 82°/61° 0.04 in/ 0.5in 82°/62° Tue 7/14 80°/68° 0.02 in/ 0.5in 82°/62° Wed 7/15 69°/54° 82°/62° 0.01 in/ 0.5in Thu 7/16 74°/48° 0 in/ 0.5in 82°/62° Fri 7/17 84°/60° 0.01 in/ 0.5in 82°/62° Sat 7/18 85°/74° 0 in/ 0.5in 82°/62° 88°/69° Sun 7/19 0 in/ 0.5in 82°/62° 78°/64° 82°/62° Mon 7/20 0 in/ 0.5in Tue 7/21 75°/60° 82°/62° 0 in/ 0.5in Wed 7/22 73°/58° 0 in/ 0.5in 82°/62° 4WA2T Thu 7/23 76°/56° 82°/62° 0 in/ 0.5in 79°/60° 82°/62° Fri 7/24 0 in/ 0.5in Sat 7/25 84°/64° 81°/62° 0 in/ 0.5in



Ornamental Horticulture Program Research Report Form

Researcher:	Hannah Mathers, I	PhD		Date: 12/21/2016		
Project Title:	Ornamental Grass	es herbicide	e Crop Safety			
Protocol #:	15-010		PRnumbers: 31968, 31976, 31977			
		-				
	Sun 7/26	80°/64°	0 in/ 0.5in	81°/62°		
	Mon 7/27	82°/58°	0 in/ 0.5in	81°/62°		
	Tue 7/28	85°/60°	0 in/ 0.5in	81°/62°		
	Wed 7/29	89°/63°	0.03 in/ 0.5in	81°/62°		
	Thu 7/30	82°/72°	0 in/ 0.5in	81°/62°		
	Fri 7/31	84°/67°	0 in/ 0.5in	81°/62°		
Events in	Date (yr. 2015)	Hi/Low	Precipitation/ Irrigation	Average		
August 2015				Hi/Low		
	Sat 8/1	79°/62°	0 in/ 0.5in	81°/62°		
	Sun 8/2	89°/62°	0 in/ 0.5in	81°/62°		
	Mon 8/3	77°/62°	0.38 in/ 0.5in	81°/62°		
	Tue 8/4	80°/65°	0 in/ 0.5in	81°/62°		
6WA2T						
Trial	Wed 8/5	75°/65°	0 in/ 0.5in	81°/62°		
completion						