

Potential for Phytotoxicity of
Pendulum 2G (Pendimethalin)
On Hen and Chicks
(*Sempervivum tectorum* 'Sunset')

By

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Project: Interregional Research Project #4
Project Number 23773A – June 22, 2004

Acknowledgements: Ahmet Gulcu

Donors/Supporters:
Yoder Bros./Green Leaf Perennials, Lancaster, PA

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PR.NO. :	23773A
TRIAL:	1
DATE:	6/22/04

IR-4 ORNAMENTAL DATA REPORTING FORM

Investigator (Name, Address, Phone#, e-mail, etc)	Dr. Heiner Lieth Department of Plant Sciences University of California One Shields Ave. Davis, CA 95616 Ph 530-752-7198 FAX 530-752-1819 Email: jhlieth@ucdavis.edu
Location of Trial	University of California, Davis CA
TRIAL TYPE: (field, container, greenhouse, etc)	Field Container
Chemical - Common Name	Pendimethalin
- Formulation	Granular, 2%
- Batch Number	
- Product	Pendulum 2G
- EPA Registration Number	241-375
- Manufacture	BASF
USE INFORMATION	
- Plant Common Name	Hen and Chicks
- Plant Scientific Name	<i>Sempervivum tectorum</i> 'Sunset'
- Pest (s)	Weeds
Soil Type or Type of Potting Mix:	UC Mix a)%Sand: 30 b)%Silt: c)%Clay: d)%OM: 70 e)%pH: 6.5
Enter each DATE for:	Seedling: Emergence: Transplanting: 3/29/04
Enter each SPACING for:	Plant or Pot: 6 inches Row: 6 inches
Enter each SIZE for:	Pot: 4-inch Plot: 50 sq ft
Experimental Design:	Randomized complete block (3 blocks X 4 reps)
Number of Reps:	12 reps total for each treatment

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APPLICATION PARAMETERS

Type of Application: (aerial, ground, foliar, drench, ppi, chemigation, broadcast, directed, etc)	Broadcast over the top
Number of Applications:	2, 30 days apart
Application Type:	Shaker container
Nozzle Type/Size:	
Nozzle Pressure:	
Delivery Rate:	
Calibration Date(s):	

APPLICATION SUMMARY

APPLICATION DATE	RATES (a.i./A) (Be sure to provide units)	Brief Description of Growth Stage (Dormant, New Growth Present, Bud, etc)
5/11/04	0, 2, 4, 8 lb. a.i./A	6 weeks post- transplant, actively growing
6/10/04	0, 2, 4, 8 lb. a.i./A	10 weeks post- transplant, actively growing

RAINFALL/IRRIGATION RECORDS: INCLUDE RAINFALL/IRRIGATION INFORMATION
(printouts, IR-4 forms, etc.)
See Table 1

OTHER PESTICIDES, FERTILIZER, LIME AND ADJUVANTS USED:

PRODUCT	AMOUNT	DATE
NONE		

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NARRATIVE SUMMARY OF METHODS AND RESULTS: (Use more pages if needed)

Materials and Methods

Plant Material and Culture. Young plants of *Sempervivum tectorum* ‘Sunset’ were received from Yoder Bros. on March 15, 2004. These were transplanted to 4-inch pots containing UC Mix on March 29, 2004 and maintained in a greenhouse under natural day length for 6 weeks until the experiment began on May 11, 2004. For the experiment, the plants were transferred to a 60% shade house in the outdoor nursery at the Environmental Horticulture Dept. at UC Davis. The plants were watered as needed (at least once daily) during the 6-week experiment with tap water. Environmental conditions during the 6-week experiment from May 11, 2004 to June 22, 2004 are summarized in Table 1 as data recorded at the nearest CIMIS (California Irrigation Management Information System) station (Davis #6).

Experimental Procedure. Forty-eight plants were randomly chosen and individually tagged for treatment with 0, 2 lb/A (1X), 4 lb/A (2X) or 8 lb/A (4X) Pendulum 2G (granular pendimethalin) with 12 replicates per treatment. These dosages were prescribed in IR4 Ornamental Protocol 001 dated 3/04 (Appendix A). The plants received the first of two applications of the material broadcast over the top on May 11, 2004 using a quart jar with perforated lid to distribute the granules over the plants (Figure 1). The second application was made 30 days later on June 10, 2004 using the same method. The plants were arranged in a randomized complete block design with 3 blocks and 4 treatment replicates per block. Phytotoxicity ratings, plant height and plant width measurements were taken at days 0, 7, 14, 30 and 42 (June 22, 2004). Visual phytotoxicity evaluations were based on a numerical rating scale ranging from 0 (no injury) to 10 (complete kill) (Table 2). Plant height (cm) was measured from the container soil surface to the top of the canopy. Width (cm) was measured twice along perpendicular lines at the widest part of the plant, resulting in W_1 and W_2 . For the first four observation dates, only the average of the width measurements was recorded (W). For each observation a canopy volume index was calculated so as to be able to determine if canopy volume was affected by the application of the herbicide. The calculation was made as $H*W_1*W_2$ for observations where two width measurements were available and as $H*W*W$ where only one width measurement was available. The usefulness of this index is based on the fact that many of the models for such a volume calculation are of the form $a*H*W_1*W_2$, where H is the height, W_1 and W_2 are two width measurements. The constant “a” depends on the assumption of the shape of the canopy. Since analyses of variance are scale-independent, the conclusion will thus be for the volume of the plant canopy.

Statistical Analysis. For each variable, the change in the variable from the start of the experiment was computed. Statistical analyses were carried out on these variables to determine if the application of herbicide affected growth and phytotoxicity index values.

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Results

Phytotoxicity. All average values of phytotoxicity for each treatment and observation date were at or below 0.5 (Table 3, Figure 2, Appendix B).

Plant size. *Sempervivum* plants showed height increases ranging from 0.75 to 2.0 cm over the 6 week trial period (Table 3, Figures 2 and 3, Appendix C). All plants initially showed some height decreases with the plants in the Pendulum treatments showing slightly greater reductions. This was attributed to experimental error since different people recorded data on days 0 and 7. No overall differences in plant height increase were observed due to Pendulum. The plants grew more rapidly in width than in height, increasing through day 30 (Table 3, Figures 2 and 3, Appendix D). No treatment effects were noted during this time. After day 30 many plants decreased in width but it is unlikely that this is related to the herbicide treatments. This was attributed to experimental error since different people recorded data on days 30 and 42. It should be noted that there was significant variation in the degree to which individual plants initiated pups (propagules) (Figure 3) with some plants throwing no pups while other threw many. This characteristic was not evaluated and probably influenced the width measurements. No significant effects were noted in the plant volume index during the first 30 days (Table 3, Figure 2). No significant Pendulum treatment effects were seen with regard to the volume index.

Discussion

Pendulum caused no phytotoxicity on *Sempervivum tectorum* 'Sunset' at any of the treatment levels during the 6 week period of the trial. There were no significant treatment effects on plant growth during the first 30 days. No negative effect on growth is attributable to Pendulum.

GOOD RESEARCH PRACTICE STATEMENT:

I acknowledge that I have read and followed the IR-4 Research protocol and completed this trial following good agricultural practice, or reported any deviations (note any changes from authorized protocol in narrative).

SIGNATURE (PRINCIPAL INVESTIGATOR) _____

Date Completed:

If submitted, using e-mail, please provide e-mail address and send confirming receipt.

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Table 1. Environmental conditions during the phytotoxicity trial of Pendulum 2G on *Sempervivum tectorum* 'Sunset'. Data recorded at the nearest CIMIS station (Davis #6).

Date	CIMIS ETo (in)	Precip (in)	Sol Rad (Ly/day)	Avg Vap (mBars)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Air Temp (°F)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)	Wnd Run (miles)	Avg Soil Temp (°F)
5/12/2004	0.28	0	669	7.8	81.8	54	66.4	67	19	35	38.1	7.7	186	57.8
5/13/2004	0.24	0	661	10.8	82.9	46.7	65.1	86	17	51	46.7	4.3	103.4	58.4
5/14/2004	0.24	0	630	11.2	85.2	47.4	66.3	87	26	51	47.5	4.3	104.7	58.9
5/15/2004	0.23	0	591	12	82.2	52.3	66.5	79	36	54	49.4	5	120.1	59.3
5/16/2004	0.26	0	650	10.6	81.4	51.1	65.4	79	28	50	46.1	6.7	161.1	59.6
5/17/2004	0.25	0	656	10.8	73.2	50.3	60.5	82	42	60	46.5	9.9	239.4	58.5
5/18/2004	0.22	0	651	10.4	74.8	48	61.6	88	30	55	45.5	4.4	106.9	58.2
5/19/2004	0.24	0	638	11	78.5	46.8	63.9	86	35	54	47	5.6	134.2	58.7
5/20/2004	0.23	--	--	--	--	--	--	--	--	--	--	--	--	--
5/21/2004	0.23	--	--	--	--	--	--	--	--	--	--	--	--	--
5/22/2004	0.23	--	--	--	--	--	--	--	--	--	--	--	--	--
5/23/2004	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--
5/24/2004	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--
5/25/2004	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--
5/26/2004	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--
5/27/2004	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--
5/28/2004	0.24	--	--	--	--	--	--	--	--	--	--	--	--	--
5/29/2004	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--
5/30/2004	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--
5/31/2004	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--
6/1/2004	0.25	0	845	12	91.7	--	81.8	84	21	32	49.3	4.8	115.8	--
6/2/2004	0.27	0	685	13.3	91.7	55.1	72.8	81	24	48	52.2	4.3	103	60.8
6/3/2004	0.24	0	646	12.9	87	52.7	68.3	86	31	55	51.4	5	119.7	61.4
6/4/2004	0.24	0	634	12.8	87.8	50.3	68.3	88	34	54	51	4.5	109	61.6
6/5/2004	0.25	0	665	12.7	88.9	49.9	70.5	73	30	50	50.9	4.1	99	61.9
6/6/2004	0.3	0	682	11.1	90.7	58.2	74.2	72	23	38	47.2	6.1	148.2	62.5
6/7/2004	0.27	0	695	10	81.2	50	66.3	81	21	45	44.4	6.1	148.4	61
6/8/2004	0.23	0	641	9.1	74.9	49	62.3	79	31	48	42.2	4.6	111.6	--
6/9/2004	0.25	0	661	11.3	78.7	46.7	63.5	86	35	56	47.8	6.5	156.1	--
6/10/2004	0.23	0	669	12.6	79.3	51.5	64.6	85	37	61	50.8	5.4	130.8	--
6/11/2004	0.25	0	672	11.8	83.1	50.2	67.3	86	26	52	48.9	4.1	99.5	--
6/12/2004	0.25	0	666	12.4	87.6	52.2	70.1	83	27	49	50.2	4.4	106.2	--
6/13/2004	0.26	0	674	13	89.6	54.3	72.6	76	27	48	51.5	3.8	92.2	60.9
6/14/2004	0.33	0	680	11.9	95.9	58	77.1	78	14	38	49.2	6.6	160.1	61
6/15/2004	0.39	0	681	10.5	97.7	67.7	83.5	49	17	27	45.7	9.5	228.4	--
6/16/2004	0.33	0	873	12.9	94.6	--	80.7	64	22	36	51.4	8.3	200.1	60.9
6/17/2004	0.28	0	759	13.2	81.6	56.3	67.5	75	40	57	51.9	7.4	179.5	60.6
6/18/2004	0.27	0	755	13.3	83.6	52.8	67	84	32	59	52.1	6.6	158.8	60.8
6/19/2004	0.27	0	758	13.8	83.1	52.1	66.9	85	38	61	53.2	5.9	142.6	61.2
6/20/2004	0.27	0	742	13.7	87.2	51.9	68.2	86	33	58	53	5.4	129.3	61.9
6/21/2004	0.28	0	732	14.2	88.3	53.7	70	83	35	57	53.9	5.9	142.2	62.4
6/22/2004	0.27	0	736	13.9	84	55.1	67.7	83	39	60	53.3	7	169.4	62.5
6/23/2004	0.28	0	723	13.2	87.3	53.1	67.9	86	29	57	51.8	6.6	159.5	62.4
6/24/2004	0.28	0	742	12.7	87.4	53.9	69.4	82	30	52	50.8	5.5	133.4	62.5

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Figure 1. Pendulum 2G was broadcast over the top of the plants using a modified shaker made from a quart-sized Mason jar with perforated lid.

Table 2. Numerical plant damage rating scale used for phytotoxicity determinations.

Rating	Description of plant damage
0	No damage
1	No visible damage but unintended (non-permanent) impact
2	Slight leaf/tissue damage (curling leaves, necrosis, etc.)
3	Marginal chlorosis on some leaves (damage on up to 10% of plant)
4	10% – 20% of plant damaged
5	Significant damage to much of plant (30% - 40%)
6	40% – 60% of plant damaged
7	Chlorosis or necrosis on most of plant (60% - 70%)
8	Abscised leaves, branch dieback
9	Tissue severely damaged (80% - 100% of plant)
10	Complete kill

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Table 3. Summary of results for *Sempervivum tectorum* 'Sunset' treated with 0, 2, 4 or 8 lb./A Pendulum 2G. Cumulative changes over time are reported for phytotoxicity index, plant height, plant width and volume index. Different letters within a column indicate significant differences between treatments (P < 0.05). "Yes"/"No" refers to significant treatment effects at the 5% level. Means ± SE (n = 12).

Sempervivum

Herbicide: Pendulum

Phytotoxicity Increase after:

Treatment	1 week	no	2 weeks	no	4 weeks	no	6 weeks	no
0	0.00 ± 0.00	a	0.42 ± 0.42	a	0.42 ± 0.42	a	0.50 ± 0.50	a
1X	0.00 ± 0.00	a	0.25 ± 0.25	a	0.00 ± 0.00	a	0.00 ± 0.00	a
2X	0.00 ± 0.00	a	0.00 ± 0.00	a	0.00 ± 0.00	a	0.00 ± 0.00	a
4X	0.00 ± 0.00	a	0.00 ± 0.00	a	0.00 ± 0.00	a	0.00 ± 0.00	a

Height Increase after:

Treatment	1 week	at 10%	2 weeks	no	4 weeks	no	6 weeks	no
0	-0.63 ± 0.20	a	-0.21 ± 0.36	a	0.33 ± 0.60	a	2.04 ± 0.72	a
1X	-1.17 ± 0.22	b	-1.04 ± 0.29	b	-0.75 ± 0.31	b	0.88 ± 0.33	a
2X	-1.21 ± 0.16	b	-0.58 ± 0.20	ab	-0.75 ± 0.16	b	1.00 ± 0.34	a
4X	-1.21 ± 0.16	b	-0.79 ± 0.16	ab	-0.58 ± 0.23	ab	0.75 ± 0.30	a

Width Increase after:

Treatment	1 week	no	2 weeks	no	4 weeks	no	6 weeks	at 10%
0	2.38 ± 0.25	a	3.63 ± 0.26	a	4.50 ± 0.49	a	1.38 ± 0.75	a
1X	2.17 ± 0.20	a	3.63 ± 0.30	a	4.83 ± 0.39	a	3.21 ± 0.68	b
2X	2.13 ± 0.22	a	3.54 ± 0.37	a	4.35 ± 0.39	a	2.63 ± 0.65	ab
4X	2.08 ± 0.29	a	3.42 ± 0.38	a	3.98 ± 0.52	a	2.85 ± 0.46	b

Relative Volume Index Increase after:

Treatment	1 week	no	2 weeks	no	4 weeks	no	6 weeks	no
0	347 ± 108	a	653 ± 161	a	966 ± 237	a	497 ± 131	a
1X	174 ± 36	a	438 ± 86	a	712 ± 120	a	736 ± 205	a
2X	159 ± 56	a	504 ± 139	a	556 ± 95	a	547 ± 159	a
4X	157 ± 58	a	459 ± 85	a	569 ± 115	a	600 ± 104	a

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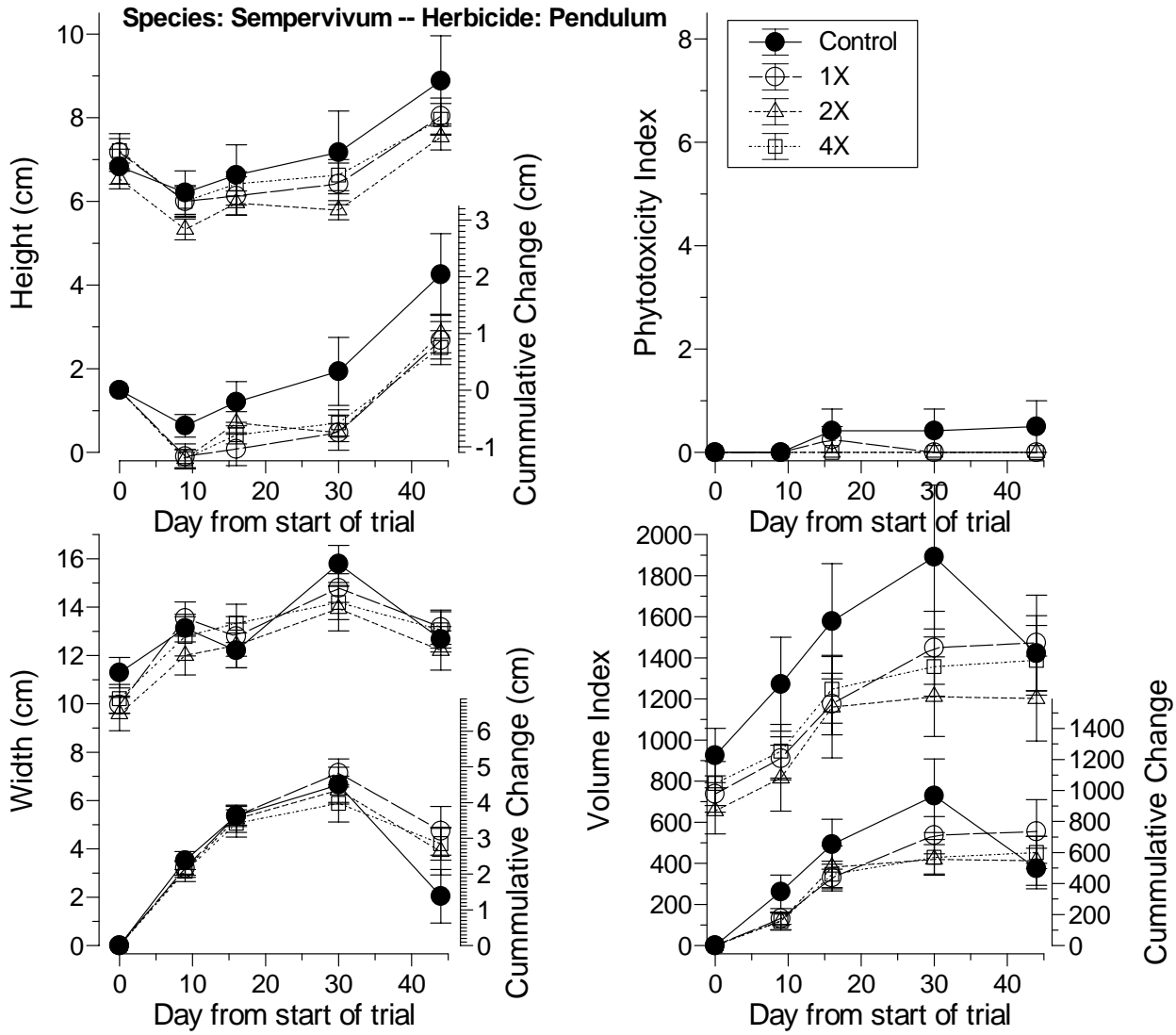
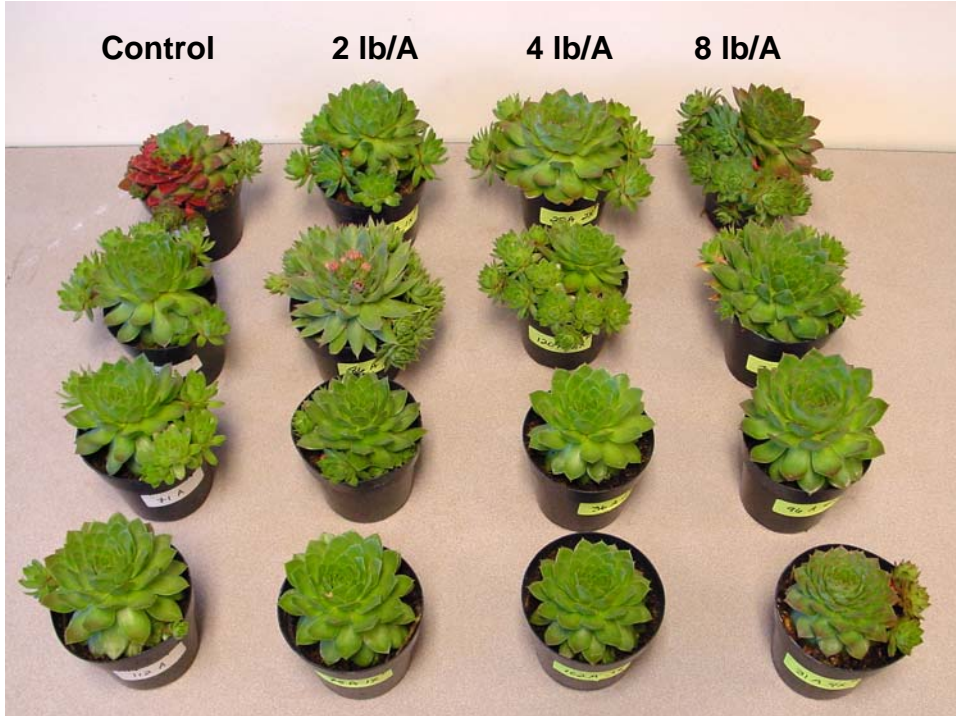


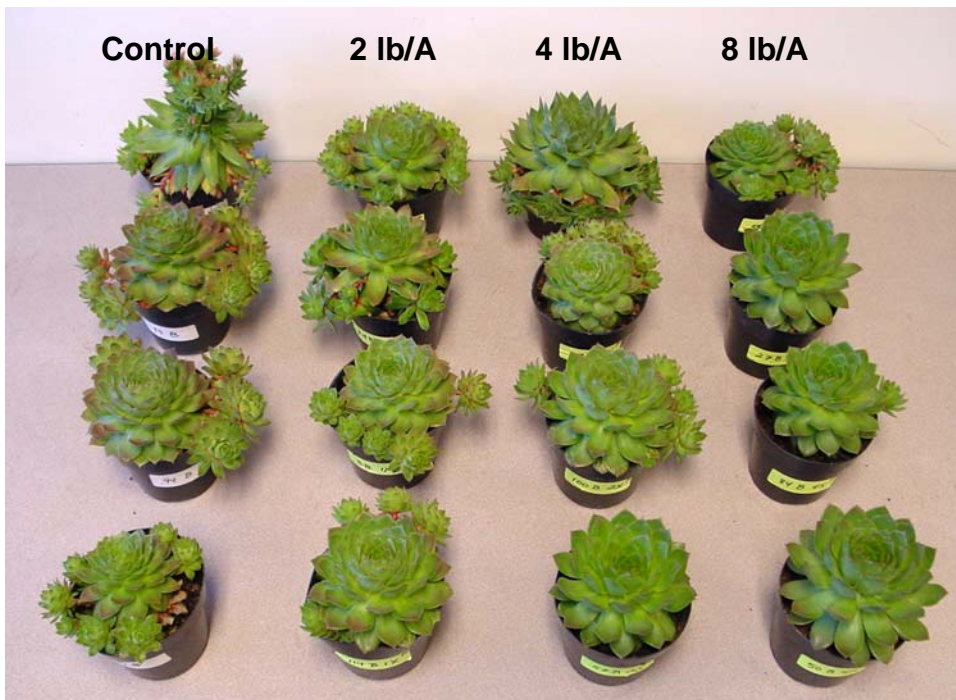
Figure 2. Summary of results for *Sempervivum tectorum* 'Sunset' treated with 0, 2, 4 or 8 lb./A Pendulum 2G. Both means and cumulative changes over time are plotted for phytotoxicity index, plant height, plant width and volume index. SE bars shown (n = 12).

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Block A

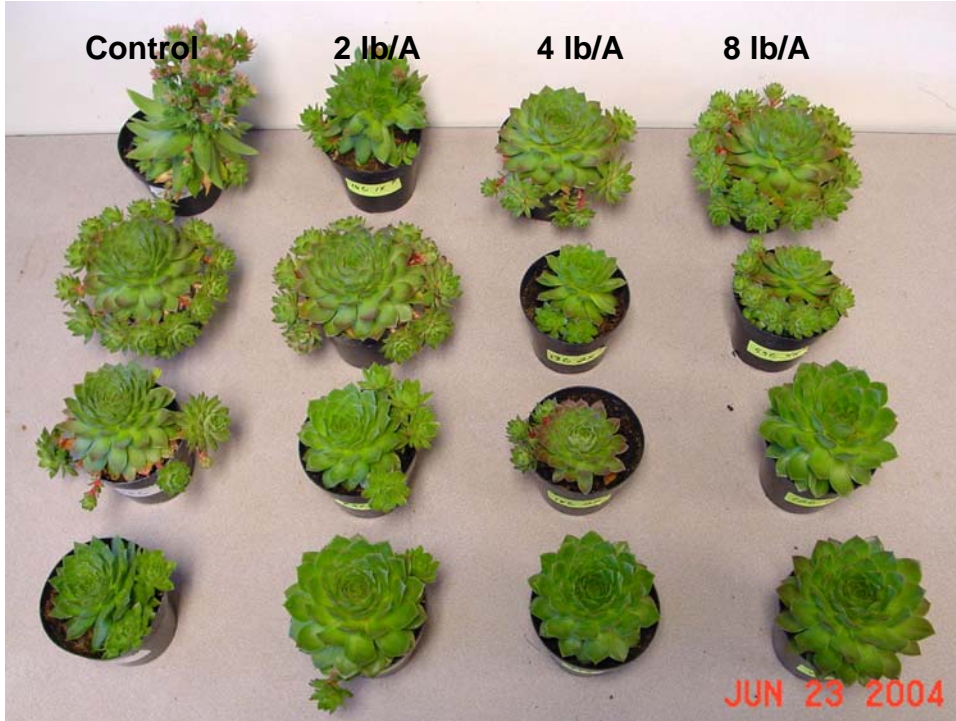


Block B

Figure 3. *Sempervivum tectorum* 'Sunset' plants six weeks after two applications of 0, 2, 4 or 8 lb./A Pendulum 2G. Applications were made at Week 0 and Week 3.

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Block C

Figure 3. *Sempervivum tectorum* 'Sunset' plants six weeks after two applications of 0, 2, 4 or 8 lb./A Pendulum 2G. Applications were made at Week 0 and Week 3.

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APPENDIX A

PHYTOTOXICITY TO HERBACEOUS PERENNIAL PLANTS WITH PRE-EMERGENT APPLICATIONS OF PENDULUM, PENNANT MAGNUM AND SNAPSHOT

Date: 3/04

Ornamental Protocol Number: 001

General label directions: Refer to product labels.

Research program:

Pest(s)/Plants – As attached.

Pesticide (common name and trade name)– Refer to treatment list shown below.

For label, material & if needed spray oil surfactant contact:

BASF, Kathie Kalmowitz, 919-785-9659, email: kalmowk@basf-corp.com (Pendulum)

Dow AgroSciences, Mike Melichar, 317-337-4982, mwmelichar@dow.com (Snapshot)

Syngenta, Dave Ross, 336-632-6411, david.ross@syngenta.com (Pennant Magnum)

Experimental design:

Plot size (must be adequate to reflect actual use condition)

Replicates Minimum of 4 Treatment Units

Controls (untreated controls to be included in all experiments)

Application: **PENDULUM 2G SNAPSHOT 2.5TG PENNANT MAGNUM 7.62EC -OR- PENNANT MAGNUM 7.62EC**

<u>Dosages</u> - 1x	2 lbs.ai/A	2.5 lbs.ai/A	2.5 lbs.ai/A (fine soil)	2.1 lbs.ai/A (medium/course soil)
2x	4 lbs.ai/A	5.0 lbs.ai/A	5.0 lbs.ai/A (fine soil)	4.2 lbs.ai/A (medium/course soil)
4x	8 lbs ai/A	10.0 lbs.ai/A	10.0 lbs.ai/A (fine soil)	8.4 lbs.ai/A (medium/course soil)

Active Ingredient: Pendulum (pendimethalin), Pennant Magnum (s-metolachlor), Snapshot (isoxaben+trifluralin).

Volume - Minimum of 10 gal/A for liquid applications.

Timing - 2 applications, 30 Days Spray Interval. Take initial counts, then efficacy and crop safety at 7, 14, 30 (then 2nd appl.) and 42 DAT.

Reports:

Method of application: (treatments should be made over the top of the plants using application equipment consistent with conventional commercial equipment). Report completely on experimental design and method of application. Report plant size height x width before treatment and throughout the experiment.

Weather – Maintain temperature and precipitation (including irrigation) data.

Soil type – Identify soil type used in experimental area.

Product – When submitting data, include EPA registration number of product used.

Efficacy – Data should include both actual counts and percent control as well as an indication that infestation was light, heavy, etc.

Record all application and evaluation dates.

Phytotoxicity – Record phytotoxicity data at all rates. Use a 0-10 scale. 0 = No Phytotoxicity 10 = complete kill.

Please direct questions data to: IR-4 Project, 681 US Highway #1 South, North Brunswick, NJ

Phone: (732) 932-9575., Ext. 629.

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APPENDIX B: PHYTOTOXICITY REPORT FORM: Visual Rating

SEMPERVIVUM			5/10/2004	5/19/2004	5/26/2004	6/9/2004	6/23/2004
Rate	Block	Rep	Phyto	Phyto	Phyto	Phyto	Phyto
Ctrl	A	1	0	0	0	0	0
Ctrl	A	2	0	0	0	0	0
Ctrl	A	3	0	0	5	5	6
Ctrl	A	4	0	0	0	0	0
Ctrl	B	1	0	0	0	0	0
Ctrl	B	2	0	0	0	0	0
Ctrl	B	3	0	0	0	0	0
Ctrl	B	4	0	0	0	0	0
Ctrl	C	1	0	0	0	0	0
Ctrl	C	2	0	0	0	0	0
Ctrl	C	3	0	0	0	0	0
Ctrl	C	4	0	0	0	0	0
Mean			0.00	0.00	0.42	0.42	0.50
Std. Dev.			0.00	0.00	1.44	1.44	1.73
P-1X	A	1	0	0	3	0	0
P-1X	A	2	0	0	0	0	0
P-1X	A	3	0	0	0	0	0
P-1X	A	4	0	0	0	0	0
P-1X	B	1	0	0	0	0	0
P-1X	B	2	0	0	0	0	0
P-1X	B	3	0	0	0	0	0
P-1X	B	4	0	0	0	0	0
P-1X	C	1	0	0	0	0	0
P-1X	C	2	0	0	0	0	0
P-1X	C	3	0	0	0	0	0
P-1X	C	4	0	0	0	0	0
Mean			0.00	0.00	0.25	0.00	0.00
Std. Dev.			0.00	0.00	0.87	0.00	0.00
P-2X	A	1	0	0	0	0	0
P-2X	A	2	0	0	0	0	0
P-2X	A	3	0	0	0	0	0
P-2X	A	4	0	0	0	0	0
P-2X	B	1	0	0	0	0	0
P-2X	B	2	0	0	0	0	0
P-2X	B	3	0	0	0	0	0
P-2X	B	4	0	0	0	0	0
P-2X	C	1	0	0	0	0	0
P-2X	C	2	0	0	0	0	0
P-2X	C	3	0	0	0	0	0
P-2X	C	4	0	0	0	0	0
Mean			0.00	0.00	0.00	0.00	0.00
Std. Dev.			0.00	0.00	0.00	0.00	0.00
P-4X	A	1	0	0	0	0	0
P-4X	A	2	0	0	0	0	0
P-4X	A	3	0	0	0	0	0
P-4X	A	4	0	0	0	0	0
P-4X	B	1	0	0	0	0	0
P-4X	B	2	0	0	0	0	0
P-4X	B	3	0	0	0	0	0
P-4X	B	4	0	0	0	0	0
P-4X	C	1	0	0	0	0	0
P-4X	C	2	0	0	0	0	0
P-4X	C	3	0	0	0	0	0
P-4X	C	4	0	0	0	0	0
Mean			0.00	0.00	0.00	0.00	0.00
Std. Dev.			0.00	0.00	0.00	0.00	0.00

**NOTE: DEFINE MEASUREMENT OF PHYTOTOXICITY, OR INDEX OF INJURY (0=NO INJURY, 10=COMPLETE KILL)
See Table 2**

PR.NO. :	23773A
TRIAL:	1
DATE:	6/22/04

IR-4 ORNAMENTAL DATA REPORTING FORM

APPENDIX C: PHTOTOXICITY REPORT FORM: Plant Height (cm)

SEMPERVIVUM			5/10/2004	5/19/2004	5/26/2004	6/9/2004	6/23/2004
Rate	Block	Rep	Height (cm)	Height (cm)	Height (cm)	Height (cm)	Height (cm)
Ctrl	A	1	6.5	6.0	6.0	7.0	9.0
Ctrl	A	2	6.5	5.0	5.5	5.5	8.0
Ctrl	A	3	6.0	5.5	6.0	4.5	7.5
Ctrl	A	4	6.0	6.0	7.0	6.5	7.5
Ctrl	B	1	6.5	6.5	6.5	6.5	7.0
Ctrl	B	2	7.0	5.5	6.5	6.0	6.5
Ctrl	B	3	9.5	9.0	10.5	14.0	15.5
Ctrl	B	4	6.0	5.0	5.0	6.0	6.5
Ctrl	C	1	7.0	5.5	5.0	5.5	6.5
Ctrl	C	2	6.0	6.0	5.5	6.0	9.5
Ctrl	C	3	5.0	4.0	3.5	4.0	5.5
Ctrl	C	4	10.0	10.5	12.5	14.5	17.5
Mean			6.83	6.21	6.63	7.17	8.88
Std. Dev.			1.47	1.80	2.49	3.41	3.75
P-1X	A	1	8.0	7.0	7.5	9.0	10.5
P-1X	A	2	7.0	5.0	5.5	6.0	8.0
P-1X	A	3	5.5	5.0	4.0	5.0	7.0
P-1X	A	4	9.0	6.5	6.0	6.5	9.5
P-1X	B	1	6.0	5.5	5.5	5.5	7.0
P-1X	B	2	8.5	7.5	7.5	7.0	8.0
P-1X	B	3	4.5	4.5	4.5	4.5	6.5
P-1X	B	4	6.0	5.0	5.0	5.0	7.5
P-1X	C	1	6.0	5.0	6.0	5.5	7.5
P-1X	C	2	8.0	6.0	6.0	6.5	7.0
P-1X	C	3	8.0	6.0	6.0	6.0	7.0
P-1X	C	4	9.5	9.0	10.0	10.5	11.0
Mean			7.17	6.00	6.13	6.42	8.04
Std. Dev.			1.56	1.31	1.60	1.74	1.48
P-2X	A	1	6.0	5.0	6.0	6.0	9.0
P-2X	A	2	7.0	5.5	6.5	5.5	7.0
P-2X	A	3	5.0	3.5	4.5	4.0	7.5
P-2X	A	4	8.0	6.0	7.0	6.5	9.0
P-2X	B	1	7.0	5.5	6.0	6.5	7.5
P-2X	B	2	6.0	4.5	4.5	5.5	8.0
P-2X	B	3	7.0	7.0	8.0	7.0	8.5
P-2X	B	4	7.0	5.5	5.5	5.5	7.0
P-2X	C	1	5.5	5.0	5.5	5.0	6.5
P-2X	C	2	7.0	6.0	6.0	6.0	8.5
P-2X	C	3	7.0	5.5	6.5	6.5	6.0
P-2X	C	4	6.0	5.0	5.5	5.5	6.0
Mean			6.54	5.33	5.96	5.79	7.54
Std. Dev.			0.84	0.86	0.99	0.81	1.08
P-4X	A	1	7.0	5.5	5.0	6.0	8.0
P-4X	A	2	9.0	9.0	8.0	8.5	9.0
P-4X	A	3	7.5	5.5	7.0	5.5	7.5
P-4X	A	4	7.5	6.0	7.0	7.5	9.5
P-4X	B	1	7.5	6.0	6.5	7.5	9.0
P-4X	B	2	5.0	4.0	4.5	4.5	6.5
P-4X	B	3	8.0	7.0	7.5	7.5	10.0
P-4X	B	4	7.0	6.0	6.5	7.0	8.5
P-4X	C	1	7.0	6.0	6.0	7.0	8.0
P-4X	C	2	6.0	5.0	6.0	5.0	6.0
P-4X	C	3	7.5	5.5	6.0	5.5	6.0
P-4X	C	4	7.5	6.5	7.0	8.0	7.5
Mean			7.21	6.00	6.42	6.63	7.96
Std. Dev.			0.99	1.21	1.00	1.28	1.32

PR.NO. :	23773A
TRIAL:	1
DATE:	6/22/04

IR-4 ORNAMENTAL DATA REPORTING FORM

APPENDIX D: PHTOTOXICITY REPORT FORM: Plant Width (cm)

SEMPERVIVUM			5/10/2004	5/19/2004	5/26/2004	6/9/2004	6/9/2004	6/23/2004	6/23/2004
Rate	Block	Rep	Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)
Ctrl	A	1	9.0	11.5	12.5	14.0	16.5	12.0	12.0
Ctrl	A	2	8.0	9.5	11.5	11.5	15.0	14.5	16.5
Ctrl	A	3	13.0	16.0	15.5	15.0	15.5	15.5	15.5
Ctrl	A	4	9.0	11.5	12.0	12.0	12.0	10.5	11.5
Ctrl	B	1	12.0	13.5	16.5	15.0	20.0	11.0	13.0
Ctrl	B	2	10.0	11.0	13.0	11.5	14.0	12.5	8.0
Ctrl	B	3	13.0	15.5	16.0	16.5	18.0	11.0	12.5
Ctrl	B	4	13.5	16.0	17.5	18.0	21.0	15.0	10.5
Ctrl	C	1	11.5	15.0	17.0	19.0	20.0	15.5	15.0
Ctrl	C	2	14.0	16.5	18.0	14.5	20.5	15.5	10.0
Ctrl	C	3	9.0	10.5	11.5	12.5	12.5	11.5	10.0
Ctrl	C	4	13.5	17.5	18.0	16.5	18.0	13.0	12.0
Mean			11.29	13.67	14.92	14.67	16.92	13.13	12.21
Std. Dev.			2.17	2.74	2.62	2.51	3.15	1.97	2.50
P-1X	A	1	9.0	11.0	12.5	14.0	16.0	16.5	18.5
P-1X	A	2	9.0	11.0	11.0	11.0	11.5	11.0	11.5
P-1X	A	3	9.0	9.5	11.0	12.0	12.0	12.5	12.5
P-1X	A	4	12.0	15.0	16.5	16.5	17.0	17.5	18.5
P-1X	B	1	9.5	12.0	14.0	15.0	15.5	14.5	12.5
P-1X	B	2	10.0	11.5	14.5	15.0	16.0	13.5	12.0
P-1X	B	3	10.5	12.5	15.0	14.0	16.0	12.0	10.0
P-1X	B	4	10.0	12.5	13.0	12.5	15.5	12.0	10.0
P-1X	C	1	8.0	11.0	11.5	14.0	14.0	12.0	12.5
P-1X	C	2	9.5	11.5	12.0	13.5	14.0	13.0	11.5
P-1X	C	3	12.0	14.5	17.0	17.5	20.5	17.0	13.0
P-1X	C	4	11.0	13.5	15.0	15.0	17.0	11.0	11.0
Mean			9.96	12.13	13.58	14.17	15.42	13.54	12.79
Std. Dev.			1.23	1.58	2.07	1.83	2.39	2.31	2.83
P-2X	A	1	8.0	9.0	10.0	10.5	10.5	11.5	11.5
P-2X	A	2	9.0	11.5	13.5	15.0	15.5	14.5	16.5
P-2X	A	3	7.5	9.0	10.0	10.5	10.5	10.0	11.0
P-2X	A	4	12.0	15.0	17.5	14.5	20.0	17.0	20.5
P-2X	B	1	10.0	11.5	14.0	14.0	17.5	13.0	11.5
P-2X	B	2	8.0	9.5	11.0	12.0	12.0	11.0	11.0
P-2X	B	3	15.0	18.0	20.5	19.0	20.5	15.0	13.5
P-2X	B	4	10.5	12.0	13.5	12.5	14.5	9.0	12.0
P-2X	C	1	6.5	9.0	9.0	10.0	11.0	8.0	10.0
P-2X	C	2	9.5	11.5	12.0	12.0	13.0	10.0	11.0
P-2X	C	3	7.5	9.5	10.0	11.5	12.0	10.5	8.5
P-2X	C	4	11.5	15.0	16.5	17.5	18.5	14.5	12.0
Mean			9.58	11.71	13.13	13.25	14.63	12.00	12.42
Std. Dev.			2.40	2.91	3.54	2.84	3.71	2.76	3.20
P-4X	A	1	10.0	12.5	11.5	9.5	12.0	9.0	13.0
P-4X	A	2	11.0	14.0	16.0	16.0	16.0	16.0	18.0
P-4X	A	3	15.0	17.5	18.0	15.5	17.5	17.5	17.5
P-4X	A	4	9.0	11.0	11.5	13.0	14.0	13.0	13.5
P-4X	B	1	10.5	11.5	13.0	13.0	13.0	11.5	11.0
P-4X	B	2	10.5	11.5	13.5	13.0	15.0	9.5	13.5
P-4X	B	3	9.5	11.0	14.0	14.0	14.0	12.0	11.5
P-4X	B	4	8.5	9.0	11.0	12.5	13.5	12.5	10.0
P-4X	C	1	9.5	11.0	12.0	13.5	13.5	12.0	12.0
P-4X	C	2	7.0	10.0	11.5	10.5	13.0	11.0	10.5
P-4X	C	3	12.5	16.5	18.5	19.5	21.0	17.5	17.0
P-4X	C	4	9.5	12.0	13.0	14.0	14.0	12.0	12.5
Mean			10.21	12.29	13.63	13.67	14.71	12.79	13.33
Std. Dev.			2.03	2.53	2.57	2.58	2.46	2.81	2.75