

Potential for Phytotoxicity of
Pendulum 2G (Pendimethalin)
On Blue Flax
(*Linum perenne* 'Sapphire')

By

Heiner Lieth, Director
Linda Dodge
Shannon Still
Ron Lane
Jackie Fortunko
Jackie Bergquist

Project: Interregional Research Project #4
Project Number 23767A – June 24, 2004

Acknowledgements: Ahmet Gulcu

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

UC Davis Environmental Horticulture IR4 Center
Department of Environmental Horticulture
University of California
One Shields Ave.
Davis, CA 95616
<http://envhort.ucdavis.edu/ir4>

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

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	Blue Flax
- Plant Scientific Name	<i>Linum perenne</i> 'Sapphire'
- 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 3 reps)
Number of Reps:	9 reps total for each treatment

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

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)
5/13/04	0, 2, 4, 8 lb. a.i./A	6 weeks post- transplant, actively growing
6/12/04	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
Osmocote 19-6-12	3 grams per 4-inch pot	5/12/04

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM

(Please type or print)

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

Materials and Methods

Plant Material and Culture. Young plants of *Linum perenne* ‘Sapphire’ 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 13, 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. Fertilizer in the form of Osmocote (19-6-12) was added at the rate of 3 grams per 4-inch pot on May 12, 2004. Environmental conditions during the 6-week experiment from May 13, 2004 to June 24, 2004 are summarized in Table 1 as data recorded at the nearest CIMIS (California Irrigation Management Information System) station (Davis #6).

Experimental Procedure. Thirty-six 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 9 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 13, 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 12, 2004 using the same method. The plants were arranged in a randomized complete block design with 3 blocks and 3 treatment replicates per block. Phytotoxicity ratings, plant height and plant width measurements were taken at days 0, 7, 14, 30 and 42 (June 24, 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.

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

Results

Phytotoxicity. The phytotoxicity index increased steadily for all plants over the 6 weeks (Table 3, Figure 2, Appendix B). At 2 weeks, all treatments had mean phytotoxicity index values ranging from 1.6 or less while by week 6 the means ranged from 2.9 to 3.6. There were no significant differences between treatments on any of the observation dates. Plant damage symptoms included chlorosis and necrosis of individual leaves, and death of one to several branches per plant (Figure 3).

Plant size. All plants grew over the time of the experiment with height increases from around 3 cm by week 1 to 12.5 to 14.6 cm by week 6 (Table 3, Figures 2 and 4, Appendix C). None of the Pendulum treatments were ever significantly different from the control at any of the four times that measurements were made. Width of all plants increased as well (Table 3, Figure 2, Appendix D). As with the height, mean widths of Pendulum treated plants were also never significantly different from the control. The computed volume index showed the same result as the height and width: no significant differences between treatments (Table 3, Figure 2).

Discussion

Any plant damage evident in the experiment was not due to the herbicide. Instead, this is likely to be due to environmental factors (heat and/or irrigation) during the experiment. There was also no growth inhibition from the herbicide.

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.

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

Table 1. Environmental conditions during the phytotoxicity trial of Pendulum 2G on *Linum perenne* 'Sapphire'. 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

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)



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

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

Table 3. Summary of results for *Linum perenne* 'Sapphire' 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 litters 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 = 9).

Linum

Herbicide: Pendulum

Phytotoxicity Increase after:

Treatment	1 week		2 weeks		4 weeks		6 weeks	
	yes	no	yes	no	yes	no	yes	no
Control	0.11 ± 0.11	ab	1.00 ± 0.41	ab	2.44 ± 0.63	a	3.11 ± 0.96	a
1X	1.00 ± 0.29	c	1.56 ± 0.41	a	2.00 ± 0.00	a	3.56 ± 0.58	a
2X	0.00 ± 0.00	a	0.22 ± 0.22	b	2.00 ± 0.00	a	3.00 ± 0.76	a
4X	0.67 ± 0.29	bc	1.22 ± 0.40	ab	2.22 ± 0.15	a	2.89 ± 0.42	a

Height Increase after:

Treatment	1 week		2 weeks		4 weeks		6 weeks	
	no	yes	no	yes	no	yes	no	yes
Control	3.28 ± 0.50	a	6.72 ± 0.85	a	10.50 ± 1.59	a	12.50 ± 1.84	a
1X	3.67 ± 0.51	a	6.17 ± 1.01	a	10.33 ± 1.42	a	12.67 ± 1.96	a
2X	3.72 ± 0.86	a	6.89 ± 1.38	a	14.33 ± 1.53	a	14.56 ± 1.64	a
4X	3.06 ± 0.69	a	8.28 ± 0.74	a	12.67 ± 1.59	a	13.33 ± 0.99	a

Width Increase after:

Treatment	1 week		2 weeks		4 weeks		6 weeks	
	no	yes	no	yes	no	yes	no	yes
Control	2.56 ± 0.78	a	3.78 ± 1.36	a	6.47 ± 1.38	a	4.72 ± 1.81	a
1X	2.17 ± 0.76	a	4.89 ± 0.87	ab	5.58 ± 1.02	a	6.19 ± 1.45	a
2X	2.56 ± 0.51	a	6.89 ± 0.93	ab	7.72 ± 1.12	a	9.06 ± 1.19	a
4X	3.11 ± 1.09	a	7.25 ± 1.25	b	7.58 ± 1.47	a	7.81 ± 1.47	a

Relative Volume Index Increase after:

Treatment	1 week		2 weeks		4 weeks		6 weeks	
	no	yes	no	yes	no	yes	no	yes
Control	1575 ± 324	a	3439 ± 999	a	6769 ± 1683	a	6166 ± 1725	a
1X	1351 ± 377	a	3369 ± 766	a	4933 ± 906	a	6371 ± 1551	a
2X	1543 ± 311	a	4885 ± 876	a	8530 ± 1459	a	9649 ± 1487	a
4X	1615 ± 434	a	5562 ± 907	a	7764 ± 1585	a	8099 ± 1730	a

PR.NO.:	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

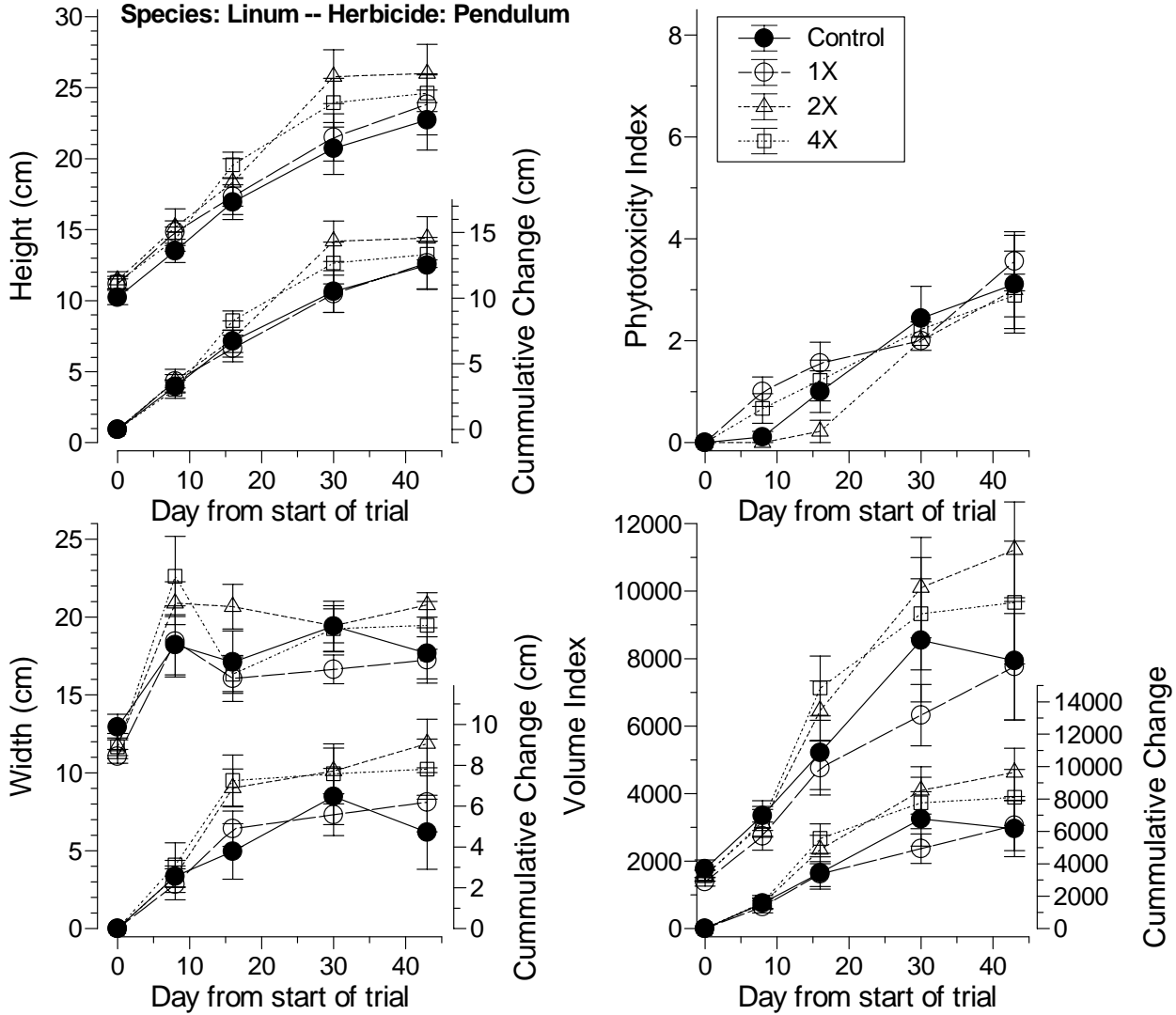


Figure 2. Summary of results for *Linum perenne* ‘Sapphire’ treated with 0, 2, 4 or 8 lb./A Pendulum 2G. Both raw data and cumulative changes over time are plotted for phytotoxicity index, plant height, plant width and volume index. SE bars shown (n = 9).

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

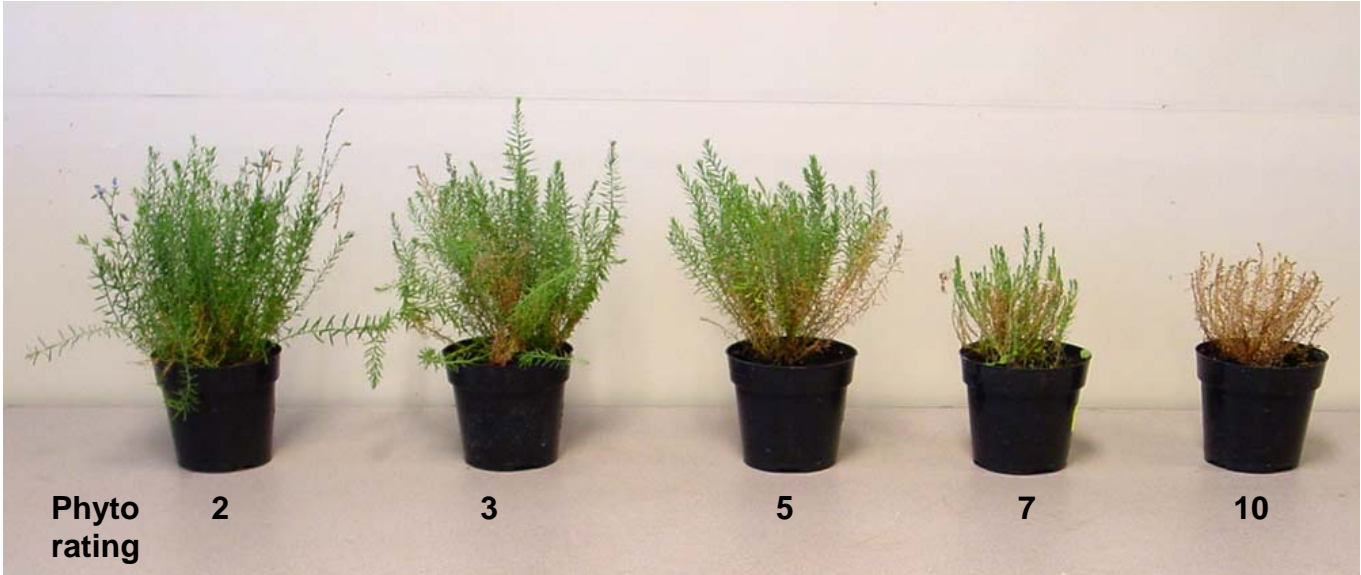
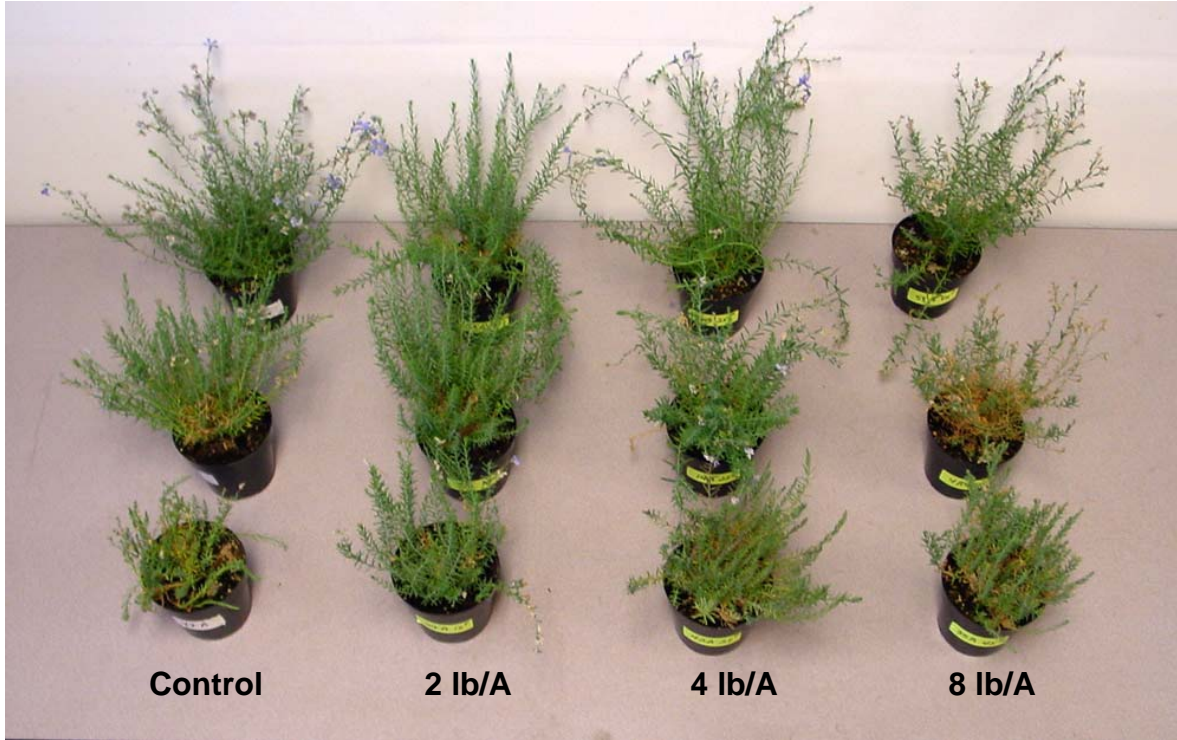


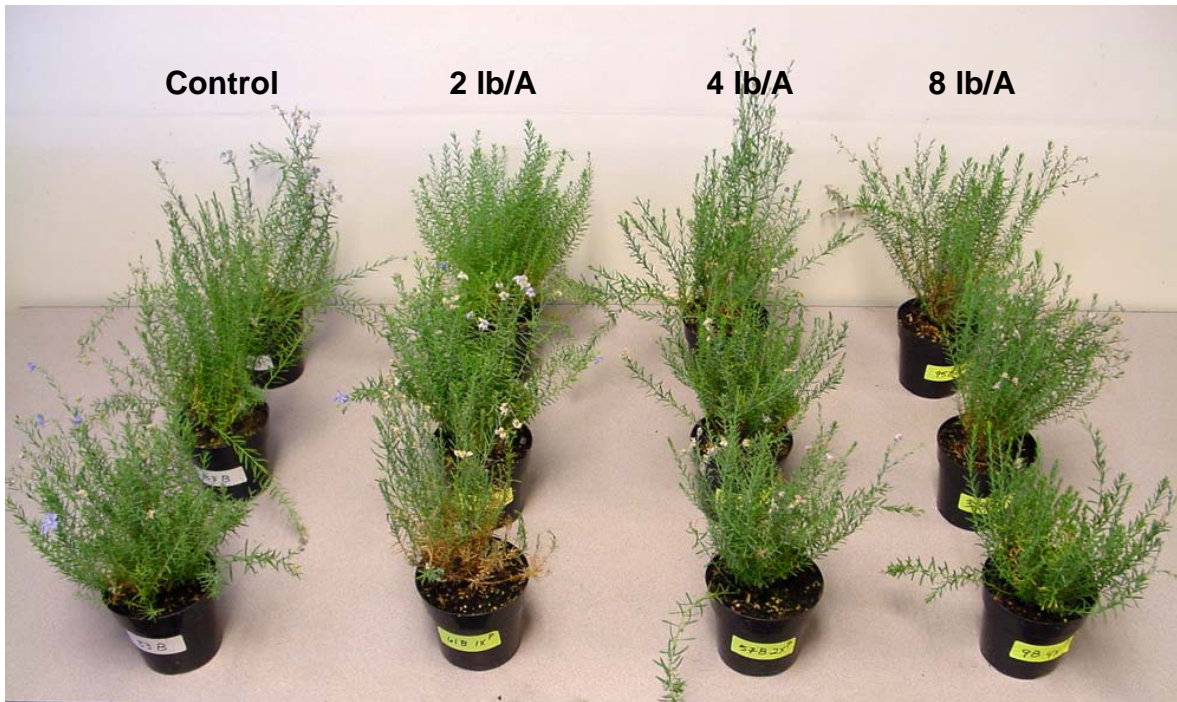
Figure 3. Damage symptoms seen on *Linum perenne* 'Sapphire' plants treated with 0, 2, 4 or 8 lb./A Pendulum 2G on Day 0 and Day 30. At the end of the experiment (Day 42) these plants were given the visual phytotoxicity ratings shown ranging from 2 to 10 (complete kill). See Table 2 for descriptions of symptoms.

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)



Block A

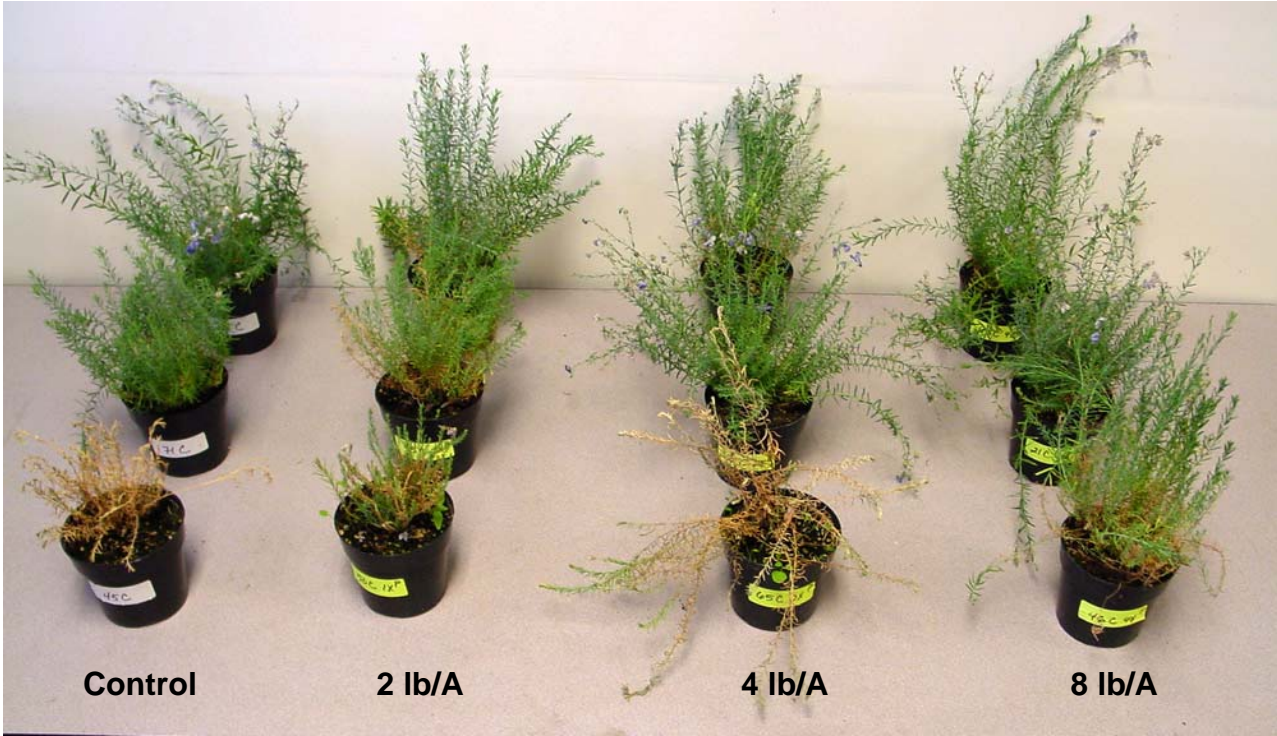


Block B

Figure 4. *Linum perenne* 'Sapphire' plants six weeks after two applications of 0, 2, 4 or 8 lb./A Pendulum 2G. Applications were made on Day 0 and Day 30.

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)



Block

C

Figure 4. *Linum perenne* 'Sapphire' plants six weeks after two applications of 0, 2, 4 or 8 lb./A Pendulum 2G. Applications were made at on Day 0 and Day 30.

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

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: Dr. Robert M. Herrick, IR-4 Project, 681 US Highway #1 South, North Brunswick, NJ
Phone: (732) 932-9575., Ext. 629.**

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

APPENDIX B: PHYTOTOXICITY REPORT FORM: Visual Rating

LINUM Pendulum data								
Treatment	Rate lb ai/A	Block	Rep	Phyto 5/12/2004	Phyto 5/20/2004	Phyto 5/28/2004	Phyto 6/11/2004	Phyto 6/24/2004
Ctrl	0	A	1	0	0	2	3	5
Ctrl	0	A	2	0	0	0	0	0
Ctrl	0	A	3	0	0	2	2	3
Ctrl	0	B	1	0	0	0	2	2
Ctrl	0	B	2	0	0	0	2	2
Ctrl	0	B	3	0	0	0	2	2
Ctrl	0	C	1	0	0	0	2	2
Ctrl	0	C	2	0	1	3	7	10
Ctrl	0	C	3	0	0	2	2	2
Mean				0.00	0.11	1.00	2.44	3.11
Std. Dev.				0.00	0.33	1.22	1.88	2.89
P-1X	2.5	A	1	0	0	2	2	2
P-1X	2.5	A	2	0	1	2	2	3
P-1X	2.5	A	3	0	1	2	2	2
P-1X	2.5	B	1	0	0	0	2	3
P-1X	2.5	B	2	0	0	0	2	2
P-1X	2.5	B	3	0	2	3	2	5
P-1X	2.5	C	1	0	1	0	2	5
P-1X	2.5	C	2	0	2	2	2	3
P-1X	2.5	C	3	0	2	3	2	7
Mean				0.00	1.00	1.56	2.00	3.56
Std. Dev.				0.00	0.87	1.24	0.00	1.74
P-2X	5	A	1	0	0	0	2	3
P-2X	5	A	2	0	0	0	2	2
P-2X	5	A	3	0	0	0	2	2
P-2X	5	B	1	0	0	0	2	2
P-2X	5	B	2	0	0	0	2	2
P-2X	5	B	3	0	0	2	2	2
P-2X	5	C	1	0	0	0	2	2
P-2X	5	C	2	0	0	0	2	9
P-2X	5	C	3	0	0	0	2	3
Mean				0.00	0.00	0.22	2.00	3.00
Std. Dev.				0.00	0.00	0.67	0.00	2.29
P-4X	10	A	1	0	0	2	3	5
P-4X	10	A	2	0	0	0	2	2
P-4X	10	A	3	0	1	2	2	3
P-4X	10	B	1	0	0	0	2	2
P-4X	10	B	2	0	1	2	2	3
P-4X	10	B	3	0	2	3	2	2
P-4X	10	C	1	0	2	2	3	5
P-4X	10	C	2	0	0	0	2	2
P-4X	10	C	3	0	0	0	2	2
Mean				0.00	0.67	1.22	2.22	2.89
Std. Dev.				0.00	0.87	1.20	0.44	1.27

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

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

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

LINUM Pendulum data								
Treatment	Rate	Block	Rep	Height (cm)	Height (cm)	Height (cm)	Height (cm)	Height (cm)
	lb ai/A			5/12/2004	5/20/2004	5/28/2004	6/11/2004	6/24/2004
Ctrl	0	A	1	9.0	11.5	13.0	13.5	14.0
Ctrl	0	A	2	9.5	11.5	15.5	23.5	25.0
Ctrl	0	A	3	10.0	12.5	16.0	21.0	22.5
Ctrl	0	B	1	10.0	13.0	16.0	21.0	24.5
Ctrl	0	B	2	10.0	16.5	19.0	25.0	27.5
Ctrl	0	B	3	12.0	15.0	21.0	227.0	29.0
Ctrl	0	C	1	13.0	18.0	24.0	26.5	30.5
Ctrl	0	C	2	10.5	12.5	13.5	12.0	13.0
Ctrl	0	C	3	8.0	11.0	14.5	17.0	18.5
Mean				10.22	13.50	16.94	42.94	22.72
Std. Dev.				1.50	2.45	3.67	69.20	6.32
P-1X	2.5	A	1	11.5	14.0	17.0	23.5	27.0
P-1X	2.5	A	2	13.0	18.0	20.0	23.5	26.0
P-1X	2.5	A	3	9.5	13.0	13.0	15.5	17.0
P-1X	2.5	B	1	11.0	14.5	19.0	23.5	33.0
P-1X	2.5	B	2	10.5	14.5	17.5	23.5	25.5
P-1X	2.5	B	3	12.0	17.5	19.0	23.5	24.0
P-1X	2.5	C	1	11.0	13.5	15.0	19.0	19.5
P-1X	2.5	C	2	12.0	17.5	24.0	29.0	30.0
P-1X	2.5	C	3	10.0	11.0	11.5	12.5	12.5
Mean				11.17	14.83	17.33	21.50	23.83
Std. Dev.				1.09	2.37	3.80	4.99	6.46
P-2X	5	A	1	9.0	9.5	12.5	16.0	18.5
P-2X	5	A	2	12.0	18.0	16.0	31.5	31.0
P-2X	5	A	3	14.5	21.5	24.0	30.5	31.0
P-2X	5	B	1	12.0	18.0	28.0	33.5	35.5
P-2X	5	B	2	12.5	12.0	15.0	22.5	23.0
P-2X	5	B	3	10.0	12.5	16.0	21.0	21.0
P-2X	5	C	1	9.0	12.0	14.5	23.0	18.0
P-2X	5	C	2	12.0	16.0	21.0	28.0	28.0
P-2X	5	C	3	12.0	17.0	18.0	26.0	28.0
Mean				11.44	15.17	18.33	25.78	26.00
Std. Dev.				1.79	3.86	5.04	5.66	6.15
P-4X	10	A	1	10.5	12.0	19.5	20.0	20.5
P-4X	10	A	2	11.0	13.5	22.0	26.0	26.5
P-4X	10	A	3	10.5	12.0	17.0	15.5	18.5
P-4X	10	B	1	9.5	10.0	13.5	18.0	20.0
P-4X	10	B	2	11.0	17.0	21.5	27.0	27.0
P-4X	10	B	3	11.0	16.0	20.0	26.5	25.5
P-4X	10	C	1	11.5	16.5	20.5	31.0	26.5
P-4X	10	C	2	14.0	15.0	20.5	23.0	29.0
P-4X	10	C	3	12.5	17.0	21.5	28.5	28.0
Mean				11.28	14.33	19.56	23.94	24.61
Std. Dev.				1.30	2.56	2.71	5.17	3.87

PR.NO. :	23767A
TRIAL:	1
DATE:	6/24/04

IR-4 ORNAMENTAL DATA REPORTING FORM
(Please type or print)

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

LINUM Pendulum data								
Treatment	Rate	Block	Rep	Width (cm)	Width (cm)	Width (cm)	Width Avg (cm)	Width Avg (cm)
	lb ai/A			5/12/2004	5/20/2004	5/28/2004	6/11/2004	6/24/2004
Ctrl	0	A	1	11.0	13.0	11.5	12.8	11.0
Ctrl	0	A	2	12.0	18.5	23.5	22.5	25.5
Ctrl	0	A	3	18.0	17.5	16.5	21.0	15.0
Ctrl	0	B	1	13.0	15.5	15.5	20.5	21.0
Ctrl	0	B	2	13.5	14.5	16.0	16.8	13.8
Ctrl	0	B	3	9.5	15.0	16.5	18.0	19.0
Ctrl	0	C	1	15.0	18.5	22.5	29.0	23.3
Ctrl	0	C	2	11.5	11.5	14.0	14.3	13.0
Ctrl	0	C	3	13.0	15.5	14.5	20.0	17.5
Mean				12.94	15.50	16.72	19.42	17.67
Std. Dev.				2.47	2.38	3.89	4.82	4.93
P-1X	2.5	A	1	11.0	15.0	19.0	19.8	22.8
P-1X	2.5	A	2	12.0	17.5	17.5	16.8	22.0
P-1X	2.5	A	3	10.5	13.5	13.5	17.3	15.8
P-1X	2.5	B	1	10.0	12.5	16.5	19.3	19.5
P-1X	2.5	B	2	11.0	13.0	16.0	16.3	16.0
P-1X	2.5	B	3	10.5	13.0	14.0	16.5	11.5
P-1X	2.5	C	1	14.0	11.5	16.0	14.5	15.5
P-1X	2.5	C	2	11.0	13.5	20.0	18.8	21.5
P-1X	2.5	C	3	9.5	9.5	11.0	10.8	10.8
Mean				11.06	13.22	15.94	16.64	17.25
Std. Dev.				1.31	2.21	2.80	2.76	4.45
P-2X	5	A	1	11.0	13.0	16.5	18.3	18.5
P-2X	5	A	2	13.5	17.5	24.0	22.8	21.8
P-2X	5	A	3	9.0	11.5	19.0	14.5	20.3
P-2X	5	B	1	9.5	14.0	19.5	21.0	23.3
P-2X	5	B	2	11.0	14.5	17.5	16.5	19.5
P-2X	5	B	3	13.5	17.5	20.5	15.5	18.0
P-2X	5	C	1	16.0	17.5	22.0	22.5	23.3
P-2X	5	C	2	9.0	9.5	13.0	22.0	24.0
P-2X	5	C	3	13.0	13.5	15.5	22.0	18.5
Mean				11.72	14.28	18.61	19.44	20.78
Std. Dev.				2.43	2.83	3.39	3.28	2.33
P-4X	10	A	1	11.5	22.0	23.0	23.0	18.8
P-4X	10	A	2	11.5	16.0	20.0	17.5	21.5
P-4X	10	A	3	13.0	13.0	14.5	13.8	14.5
P-4X	10	B	1	12.5	14.5	22.5	16.0	14.3
P-4X	10	B	2	11.0	12.5	15.0	20.0	19.5
P-4X	10	B	3	8.0	10.0	14.5	16.3	16.5
P-4X	10	C	1	12.5	16.5	15.5	16.0	18.3
P-4X	10	C	2	11.0	15.0	23.0	23.8	23.0
P-4X	10	C	3	14.0	13.5	22.0	27.0	29.0
Mean				11.67	14.78	18.89	19.25	19.47
Std. Dev.				1.70	3.35	3.92	4.45	4.61