

Potential for Phytotoxicity of  
Pennant Magnum 7.62 EC (S-Metolachlor)  
On Blue Flax  
(*Linum perenne* 'Sapphire')

By

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Project: Interregional Research Project #4  
Project Number 23841A – June 24, 2004

Acknowledgements: Ahmet Gulcu

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| TRIAL:      | 1       |
| DATE:       | 6/24/04 |

**IR-4 ORNAMENTAL DATA REPORTING FORM**  
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|   |  |
|---|--|
| <b>Investigator</b> (Name, Address, Phone#, e-mail, etc)  | Dr. Heiner Lieth<br>Department of Plant Sciences<br>University of California<br>One Shields Ave.<br>Davis, CA 95616<br>Ph 530-752-7198<br>FAX 530-752-1819<br>Email: jhlieth@ucdavis.edu |
| <b>Location of Trial</b>                                  | University of California, Davis CA   |
| <b>TRIAL TYPE:</b><br>(field, container, greenhouse, etc) | Field Container  |
| <b>Chemical - Common Name</b>                             | S-Metolachlor  |
| - Formulation   | EC, 7.62 lb. a.i./gal  |
| - Batch Number  |  |
| - Product   | Pennant Magnum 7.62 EC   |
| - EPA Registration Number                                 | 100-950  |
| - Manufacture   | Syngenta   |
| <b>USE INFORMATION</b>                                    |  |
| - Plant Common Name                                       | Blue Flax  |
| - Plant Scientific Name                                   | <i>Linum perenne</i> 'Sapphire'  |
| - Pest (s)  | Weeds  |
| <b>Soil Type or Type of Potting Mix:</b>                  | <b>UC Mix</b><br>a)%Sand: 30 b)%Silt: c)%Clay: d)%OM: 70 e)%pH: 6.5  |
| Enter each <b>DATE</b> for:                               | <b>Seedling: Emergence: Transplanting: 3/29/04</b>   |
| Enter each <b>SPACING</b> for:                            | <b>Plant or Pot: 6 inches Row: 6 inches</b>  |
| Enter each <b>SIZE</b> for:                               | <b>Pot: 4-inch Plot: 50 sq ft</b>  |
| <b>Experimental Design:</b>                               | Randomized complete block (3 blocks X 3 reps)  |
| <b>Number of Reps:</b>                                    | 9 reps total for each treatment  |

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**APPLICATION PARAMETERS**

|   |                     |
|---|---------------------|
| <b>Type of Application:</b><br>(aerial, ground, foliar, drench, ppi, chemigation, broadcast, directed, etc) | Foliar spray        |
| <b>Number of Applications:</b>  | 2, 30 days apart    |
| <b>Application Type:</b>  | Manual spray bottle |
| <b>Nozzle Type/Size:</b>  |                     |
| <b>Nozzle Pressure:</b>   |                     |
| <b>Delivery Rate:</b>   |                     |
| <b>Calibration Date(s):</b>   |                     |

**APPLICATION SUMMARY**

| <b>APPLICATION DATE</b> | <b>RATES (a.i./A)</b><br>(Be sure to provide units) | <b>Brief Description of Growth Stage</b><br>(Dormant, New Growth Present, Bud, etc) |
|-------------------------|---|---|
| 5/13/04                 | 0, 2.1, 4.2, 8.4 lb. a.i./A                         | 6 weeks post- transplant, actively growing  |
| 6/12/04                 | 0, 2.1, 4.2, 8.4 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:**

| <b>PRODUCT</b>   | <b>AMOUNT</b>          | <b>DATE</b> |
|------------------|------------------------|-------------|
| Osmocote 19-6-12 | 3 grams per 4-inch pot | 5/12/04     |

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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 *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, 2.1 lb/A (1X), 4.2 lb/A (2X) or 8.4 lb/A (4X) Pennant Magnum 7.62 EC (s-Metolachlor) 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 foliar spray applications of the material on May 13, 2004. 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.

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**Results**

**Phytotoxicity.** The phytotoxicity index increased steadily for all plants over the 6 weeks (Table 3, Figure 1, 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 2.2 to 3.2. 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 2).

**Plant size.** All plants grew over the time of the experiment with height increases from around 3 cm by week 1 to 11.3 to 14.6 cm by week 6 (Table 3, Figures 1 and 3, Appendix C). None of the Pennant Magnum 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 1 and Appendix D). As with the height, mean widths of Pennant Magnum 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 1).

**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.**

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**Table 1. Environmental conditions during the phytotoxicity trial of Pennant Magnum 7.62 EC 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               |

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**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 *Linum perenne* 'Sapphire' treated with 0, 2.1, 4.2 or 8.4 lb./A Pennant Magnum 7.62 EC. 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: Pennant**

Phytotoxicity Increase after:

| Treatment | 1 week      | no | 2 weeks     | no | 4 weeks     | no | 6 weeks     | no |
|-----------|-------------|----|-------------|----|-------------|----|-------------|----|
| Control   | 0.11 ± 0.11 | a  | 1.00 ± 0.41 | a  | 2.44 ± 0.63 | a  | 3.11 ± 0.96 | a  |
| 1X        | 0.44 ± 0.29 | a  | 1.00 ± 0.41 | a  | 2.00 ± 0.00 | a  | 2.22 ± 0.15 | a  |
| 2X        | 0.44 ± 0.29 | a  | 1.56 ± 0.29 | a  | 2.11 ± 0.11 | a  | 2.67 ± 0.33 | a  |
| 4X        | 0.56 ± 0.29 | a  | 1.44 ± 0.38 | a  | 2.56 ± 0.56 | a  | 3.22 ± 0.86 | a  |

Height Increase after:

| Treatment | 1 week      | no | 2 weeks     | no | 4 weeks      | no | 6 weeks      | no |
|-----------|-------------|----|-------------|----|--------------|----|--------------|----|
| Control   | 3.28 ± 0.50 | a  | 6.72 ± 0.85 | a  | 10.50 ± 1.59 | a  | 12.50 ± 1.84 | a  |
| 1X        | 2.89 ± 0.37 | a  | 8.17 ± 0.77 | a  | 13.28 ± 1.02 | a  | 14.61 ± 0.73 | a  |
| 2X        | 3.67 ± 0.65 | a  | 7.89 ± 0.75 | a  | 12.67 ± 0.82 | a  | 12.67 ± 0.86 | a  |
| 4X        | 2.72 ± 1.14 | a  | 7.61 ± 1.11 | a  | 10.72 ± 1.47 | a  | 11.33 ± 1.70 | a  |

Width Increase after:

| Treatment | 1 week      | no | 2 weeks     | no | 4 weeks     | no | 6 weeks     | no |
|-----------|-------------|----|-------------|----|-------------|----|-------------|----|
| Control   | 2.56 ± 0.78 | a  | 3.78 ± 1.36 | a  | 6.47 ± 1.38 | a  | 4.72 ± 1.81 | a  |
| 1X        | 2.83 ± 1.01 | a  | 5.72 ± 0.95 | a  | 7.97 ± 1.07 | a  | 8.31 ± 1.32 | a  |
| 2X        | 1.22 ± 0.55 | a  | 4.89 ± 1.19 | a  | 6.44 ± 1.48 | a  | 6.00 ± 1.60 | a  |
| 4X        | 2.06 ± 0.81 | a  | 5.22 ± 1.47 | a  | 4.19 ± 1.17 | a  | 5.08 ± 1.36 | a  |

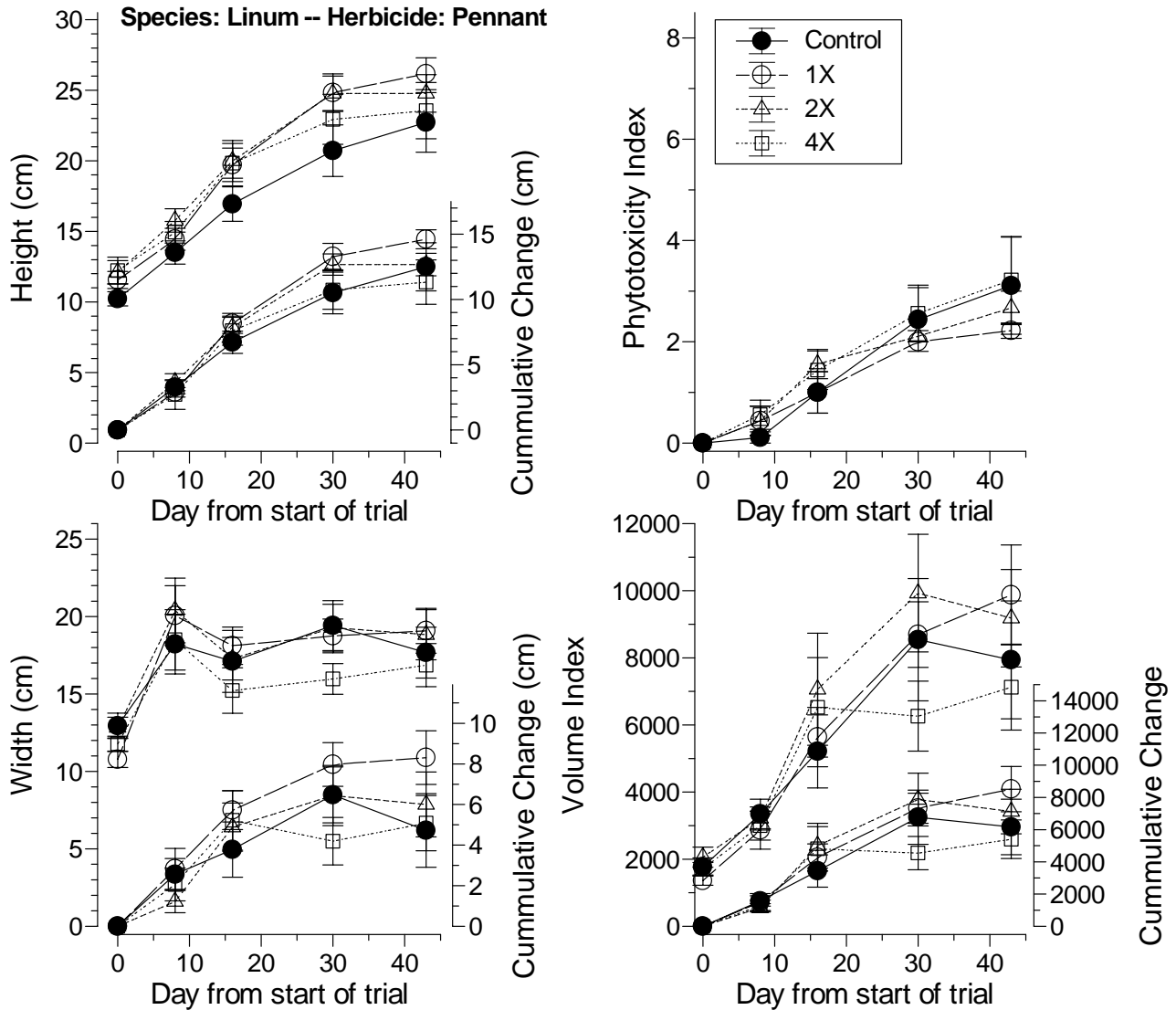
Relative Volume Index Increase

after:

| Treatment | 1 week     | no | 2 weeks     | no | 4 weeks     | no | 6 weeks     | no |
|-----------|------------|----|-------------|----|-------------|----|-------------|----|
| Control   | 1575 ± 324 | a  | 3439 ± 999  | a  | 6769 ± 1683 | a  | 6166 ± 1725 | a  |
| 1X        | 1506 ± 529 | a  | 4279 ± 841  | a  | 7336 ± 932  | a  | 8516 ± 1407 | a  |
| 2X        | 1154 ± 258 | a  | 5005 ± 1398 | a  | 7870 ± 1636 | a  | 7124 ± 1383 | a  |
| 4X        | 1283 ± 341 | a  | 4807 ± 1377 | a  | 4543 ± 1035 | a  | 5407 ± 1198 | a  |

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**Figure 1. Summary of results for *Linum perenne* 'Sapphire' treated with 0, 2.1, 4.2 or 8.4 lb./A Pennant Magnum 7.62 EC. 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).**

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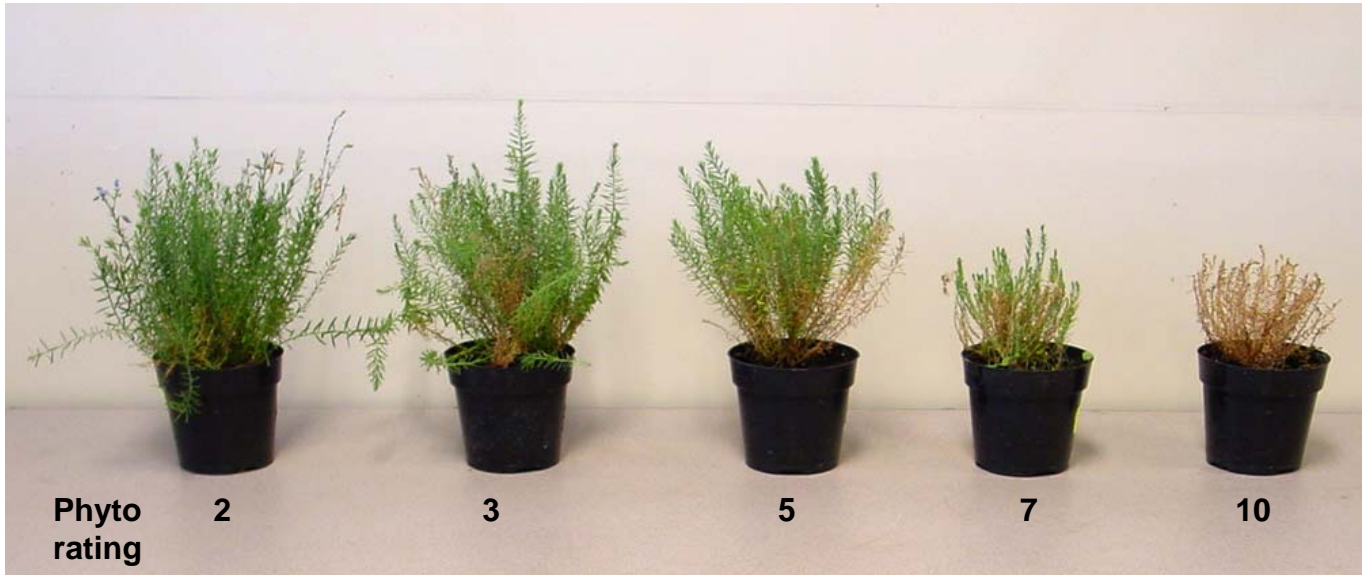
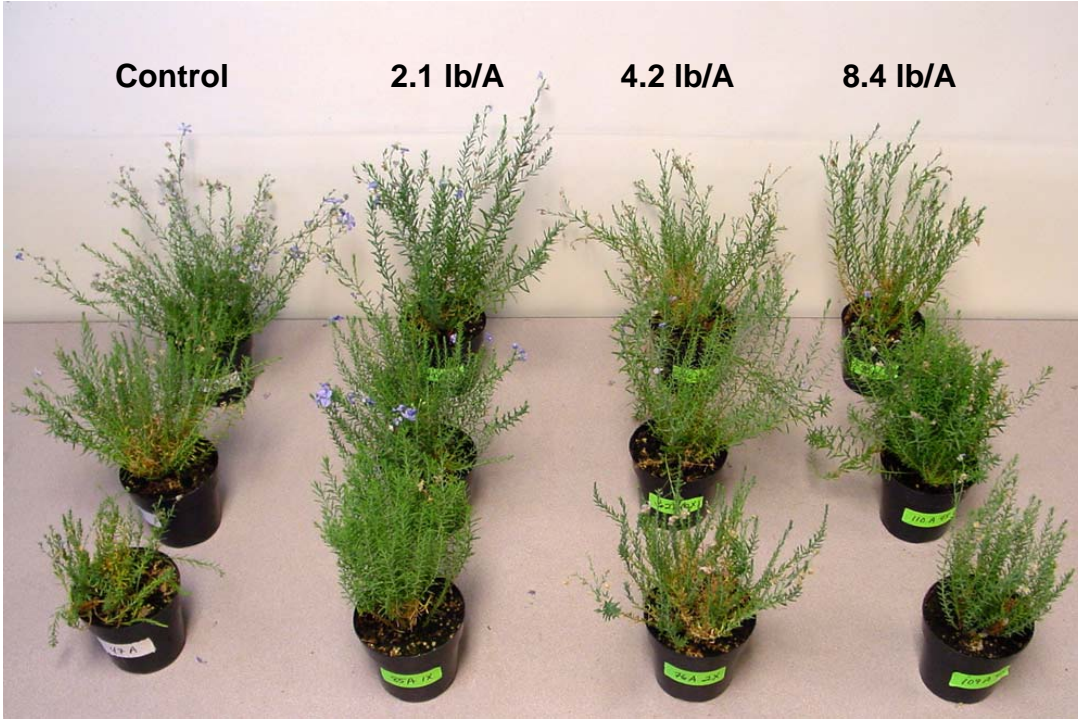


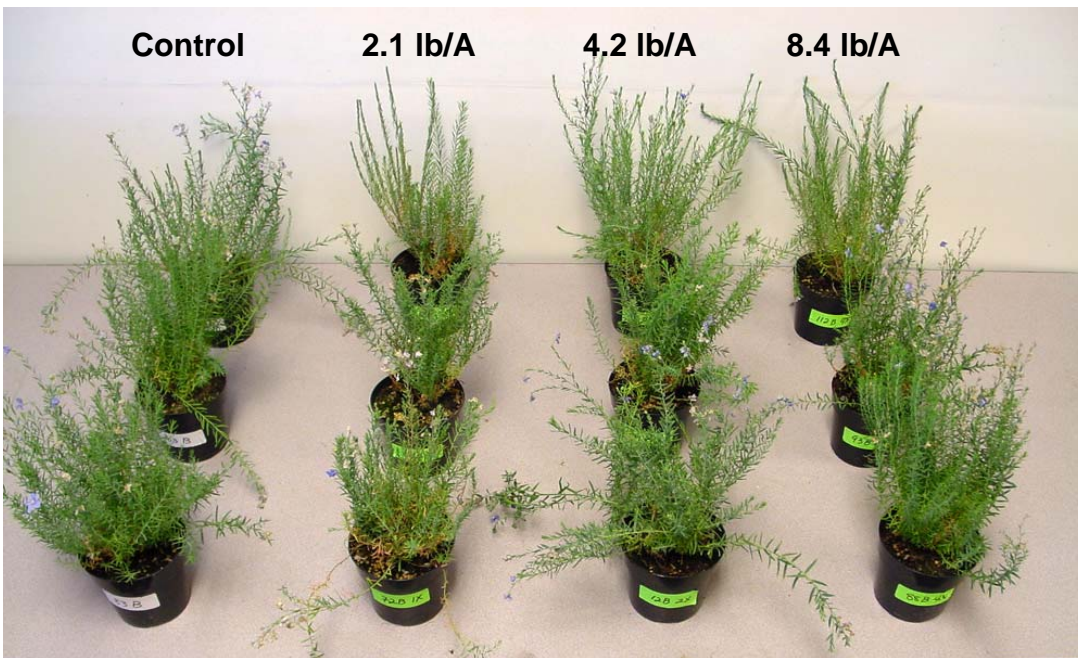
Figure 2. Damage symptoms seen on *Linum perenne* 'Sapphire' plants treated with 0, 2.1, 4.2 or 8.4 lb./A Pennant Magnum 7.62 EC on Day 0 and Day 30. At the end of the experiment (Day 42) these plants were given the visual phytotoxicity ratings shown ranging from 2 to 10 (complete kill). See Table 2 for descriptions of symptoms.

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**Block A**



**Block B**

**Figure 3. *Linum perenne* 'Sapphire' plants six weeks after two applications of 0, 2.1, 4.2 or 8.4 lb./A Pennant Magnum 7.62 EC. Applications were made on Day 0 and Day 30.**

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



Figure 3. *Linum perenne* 'Sapphire' plants six weeks after two applications of 0, 2.1, 4.2 or 8.4 lb./A Pennant Magnum 7.62 EC. Applications were made on Day 0 and Day 30.

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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](mailto:kalmowk@basf-corp.com) (Pendulum)

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

Syngenta, Dave Ross, 336-632-6411, [david.ross@syngenta.com](mailto: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: **PENNANT MAGNUM 7.62 EC      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 (s-Metolachlor), 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 2<sup>nd</sup> 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.**

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

**APPENDIX B: PHYTOTOXICITY REPORT FORM: Visual Rating**

| LINUM Pennant Magnum data |         |       |     |           |           |           |           |           |
|---------------------------|---------|-------|-----|-----------|-----------|-----------|-----------|-----------|
| Treatment                 | Rate    | Block | Rep | Phyto     | Phyto     | Phyto     | Phyto     | Phyto     |
|                           | lb ai/A |       |     | 5/12/2004 | 5/20/2004 | 5/28/2004 | 6/11/2004 | 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         | 0.11      | 1.00      | 2.44      | 3.11      |
| Std. Dev.                 |         |       |     | 0         | 0.33      | 1.22      | 1.88      | 2.89      |
|                           |         |       |     |           |           |           |           |           |
| PM-1X                     | 2.5     | A     | 1   | 0         | 0         | 0         | 2         | 2         |
| PM-1X                     | 2.5     | A     | 2   | 0         | 0         | 0         | 2         | 2         |
| PM-1X                     | 2.5     | A     | 3   | 0         | 0         | 2         | 2         | 2         |
| PM-1X                     | 2.5     | B     | 1   | 0         | 2         | 3         | 2         | 3         |
| PM-1X                     | 2.5     | B     | 2   | 0         | 2         | 2         | 2         | 2         |
| PM-1X                     | 2.5     | B     | 3   | 0         | 0         | 0         | 2         | 3         |
| PM-1X                     | 2.5     | C     | 1   | 0         | 0         | 0         | 2         | 2         |
| PM-1X                     | 2.5     | C     | 2   | 0         | 0         | 2         | 2         | 2         |
| PM-1X                     | 2.5     | C     | 3   | 0         | 0         | 0         | 2         | 2         |
|                           |         |       |     | 0.00      | 0.44      | 1.00      | 2.00      | 2.22      |
|                           |         |       |     | 0.00      | 0.88      | 1.22      | 0.00      | 0.44      |
|                           |         |       |     |           |           |           |           |           |
| PM-2X                     | 5       | A     | 1   | 0         | 0         | 2         | 3         | 3         |
| PM-2X                     | 5       | A     | 2   | 0         | 0         | 0         | 2         | 3         |
| PM-2X                     | 5       | A     | 3   | 0         | 0         | 2         | 2         | 3         |
| PM-2X                     | 5       | B     | 1   | 0         | 0         | 2         | 2         | 2         |
| PM-2X                     | 5       | B     | 2   | 0         | 0         | 0         | 2         | 2         |
| PM-2X                     | 5       | B     | 3   | 0         | 2         | 2         | 2         | 2         |
| PM-2X                     | 5       | C     | 1   | 0         | 0         | 2         | 2         | 2         |
| PM-2X                     | 5       | C     | 2   | 0         | 0         | 2         | 2         | 2         |
| PM-2X                     | 5       | C     | 3   | 0         | 2         | 2         | 2         | 5         |
|                           |         |       |     | 0.00      | 0.44      | 1.56      | 2.11      | 2.67      |
|                           |         |       |     | 0.00      | 0.88      | 0.88      | 0.33      | 1.00      |
|                           |         |       |     |           |           |           |           |           |
| PM-4X                     | 10      | A     | 1   | 0         | 0         | 2         | 2         | 2         |
| PM-4X                     | 10      | A     | 2   | 0         | 0         | 0         | 2         | 2         |
| PM-4X                     | 10      | A     | 3   | 0         | 0         | 2         | 2         | 3         |
| PM-4X                     | 10      | B     | 1   | 0         | 1         | 0         | 2         | 2         |
| PM-4X                     | 10      | B     | 2   | 0         | 0         | 2         | 2         | 2         |
| PM-4X                     | 10      | B     | 3   | 0         | 2         | 2         | 2         | 2         |
| PM-4X                     | 10      | C     | 1   | 0         | 0         | 2         | 2         | 3         |
| PM-4X                     | 10      | C     | 2   | 0         | 0         | 0         | 2         | 3         |
| PM-4X                     | 10      | C     | 3   | 0         | 2         | 3         | 7         | 10        |
|                           |         |       |     | 0.00      | 0.56      | 1.44      | 2.56      | 3.22      |
|                           |         |       |     | 0.00      | 0.88      | 1.13      | 1.67      | 2.59      |

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

|             |         |
|-------------|---------|
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| 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 Pennant Magnum 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        |
|                           |         |       |     |             |             |             |             |             |
| PM-1X                     | 2.5     | A     | 1   | 10.5        | 12.0        | 19.5        | 22.0        | 25.5        |
| PM-1X                     | 2.5     | A     | 2   | 15.0        | 17.5        | 22.0        | 29.5        | 31.0        |
| PM-1X                     | 2.5     | A     | 3   | 10.0        | 11.5        | 15.0        | 17.0        | 20.5        |
| PM-1X                     | 2.5     | B     | 1   | 12.5        | 14.5        | 22.0        | 30.5        | 31.0        |
| PM-1X                     | 2.5     | B     | 2   | 10.5        | 13.5        | 18.0        | 25.5        | 23.5        |
| PM-1X                     | 2.5     | B     | 3   | 9.5         | 12.5        | 15.5        | 24.0        | 24.5        |
| PM-1X                     | 2.5     | C     | 1   | 11.5        | 15.5        | 19.5        | 26.0        | 25.5        |
| PM-1X                     | 2.5     | C     | 2   | 13.5        | 18.0        | 26.5        | 25.0        | 27.5        |
| PM-1X                     | 2.5     | C     | 3   | 11.0        | 15.0        | 19.5        | 24.0        | 26.5        |
|                           |         |       |     | 11.56       | 14.44       | 19.72       | 24.83       | 26.17       |
|                           |         |       |     | 1.79        | 2.31        | 3.53        | 3.98        | 3.38        |
|                           |         |       |     |             |             |             |             |             |
| PM-2X                     | 5       | A     | 1   | 11.0        | 14.0        | 17.0        | 22.0        | 26.0        |
| PM-2X                     | 5       | A     | 2   | 13.0        | 17.0        | 26.0        | 29.5        | 25.5        |
| PM-2X                     | 5       | A     | 3   | 15.5        | 15.5        | 22.0        | 25.0        | 26.0        |
| PM-2X                     | 5       | B     | 1   | 15.0        | 18.0        | 23.5        | 29.0        | 30.0        |
| PM-2X                     | 5       | B     | 2   | 8.5         | 12.5        | 15.5        | 21.5        | 20.0        |
| PM-2X                     | 5       | B     | 3   | 14.0        | 18.0        | 21.0        | 26.5        | 27.0        |
| PM-2X                     | 5       | C     | 1   | 12.0        | 19.0        | 21.0        | 28.0        | 29.0        |
| PM-2X                     | 5       | C     | 2   | 10.5        | 16.0        | 19.0        | 22.0        | 20.5        |
| PM-2X                     | 5       | C     | 3   | 9.5         | 12.0        | 15.0        | 19.5        | 19.0        |
|                           |         |       |     | 12.11       | 15.78       | 20.00       | 24.78       | 24.78       |
|                           |         |       |     | 2.45        | 2.50        | 3.70        | 3.67        | 4.00        |
|                           |         |       |     |             |             |             |             |             |
| PM-4X                     | 10      | A     | 1   | 10.5        | 13.5        | 19.5        | 21.0        | 21.5        |
| PM-4X                     | 10      | A     | 2   | 11.0        | 15.0        | 18.5        | 20.0        | 20.0        |
| PM-4X                     | 10      | A     | 3   | 18.5        | 15.5        | 29.5        | 29.5        | 30.0        |
| PM-4X                     | 10      | B     | 1   | 10.0        | 13.0        | 18.5        | 24.5        | 24.0        |
| PM-4X                     | 10      | B     | 2   | 13.0        | 16.0        | 19.5        | 24.0        | 25.5        |
| PM-4X                     | 10      | B     | 3   | 14.0        | 15.5        | 20.5        | 26.5        | 28.0        |
| PM-4X                     | 10      | C     | 1   | 11.5        | 18.0        | 21.0        | 26.0        | 27.0        |
| PM-4X                     | 10      | C     | 2   | 9.0         | 17.5        | 21.0        | 24.0        | 26.0        |
| PM-4X                     | 10      | C     | 3   | 10.0        | 10.5        | 10.5        | 11.0        | 10.0        |
|                           |         |       |     | 11.94       | 14.94       | 19.83       | 22.94       | 23.56       |
|                           |         |       |     | 2.91        | 2.32        | 4.84        | 5.30        | 5.96        |

|             |         |
|-------------|---------|
| PR.NO.<br>: | 23841A  |
| 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 Pennant Magnum data |                 |       |     |                         |                         |                         |                             |                             |
|---------------------------|-----------------|-------|-----|-------------------------|-------------------------|-------------------------|-----------------------------|-----------------------------|
| Treatment                 | Rate<br>lb ai/A | Block | Rep | Width (cm)<br>5/12/2004 | Width (cm)<br>5/20/2004 | Width (cm)<br>5/28/2004 | Width Avg (cm)<br>6/11/2004 | Width Avg (cm)<br>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                        |
|                           |                 |       |     |                         |                         |                         |                             |                             |
| PM-1X                     | 2.5             | A     | 1   | 10.0                    | 14.0                    | 16.0                    | 21.0                        | 23.0                        |
| PM-1X                     | 2.5             | A     | 2   | 10.0                    | 10.5                    | 16.0                    | 18.3                        | 19.3                        |
| PM-1X                     | 2.5             | A     | 3   | 8.5                     | 9.5                     | 12.5                    | 14.0                        | 16.0                        |
| PM-1X                     | 2.5             | B     | 1   | 11.0                    | 12.0                    | 13.5                    | 16.0                        | 14.3                        |
| PM-1X                     | 2.5             | B     | 2   | 10.0                    | 12.5                    | 16.5                    | 19.0                        | 15.5                        |
| PM-1X                     | 2.5             | B     | 3   | 12.0                    | 14.5                    | 15.5                    | 16.5                        | 14.0                        |
| PM-1X                     | 2.5             | C     | 1   | 13.5                    | 12.5                    | 16.5                    | 18.0                        | 25.3                        |
| PM-1X                     | 2.5             | C     | 2   | 9.5                     | 16.0                    | 18.5                    | 21.0                        | 20.5                        |
| PM-1X                     | 2.5             | C     | 3   | 12.5                    | 21.0                    | 23.5                    | 25.0                        | 24.0                        |
|                           |                 |       |     | 10.78                   | 13.61                   | 16.50                   | 18.75                       | 19.08                       |
|                           |                 |       |     | 1.60                    | 3.41                    | 3.15                    | 3.26                        | 4.35                        |
|                           |                 |       |     |                         |                         |                         |                             |                             |
| PM-2X                     | 5               | A     | 1   | 13.0                    | 15.5                    | 17.5                    | 18.3                        | 15.5                        |
| PM-2X                     | 5               | A     | 2   | 18.0                    | 16.0                    | 26.5                    | 21.0                        | 22.0                        |
| PM-2X                     | 5               | A     | 3   | 12.0                    | 14.0                    | 21.5                    | 22.5                        | 20.5                        |
| PM-2X                     | 5               | B     | 1   | 12.5                    | 15.5                    | 17.0                    | 22.0                        | 19.8                        |
| PM-2X                     | 5               | B     | 2   | 11.5                    | 12.0                    | 17.0                    | 21.0                        | 26.5                        |
| PM-2X                     | 5               | B     | 3   | 11.5                    | 12.5                    | 12.5                    | 14.5                        | 13.0                        |
| PM-2X                     | 5               | C     | 1   | 13.0                    | 15.0                    | 21.5                    | 26.3                        | 23.5                        |
| PM-2X                     | 5               | C     | 2   | 12.0                    | 14.5                    | 15.0                    | 16.5                        | 17.8                        |
| PM-2X                     | 5               | C     | 3   | 12.0                    | 11.5                    | 11.0                    | 11.5                        | 11.5                        |
|                           |                 |       |     | 12.83                   | 14.06                   | 17.72                   | 19.28                       | 18.89                       |
|                           |                 |       |     | 2.02                    | 1.67                    | 4.83                    | 4.53                        | 4.93                        |
|                           |                 |       |     |                         |                         |                         |                             |                             |
| PM-4X                     | 10              | A     | 1   | 10.0                    | 9.0                     | 11.0                    | 13.8                        | 11.5                        |
| PM-4X                     | 10              | A     | 2   | 10.0                    | 15.0                    | 16.5                    | 14.5                        | 20.0                        |
| PM-4X                     | 10              | A     | 3   | 12.0                    | 18.0                    | 23.5                    | 17.8                        | 17.0                        |
| PM-4X                     | 10              | B     | 1   | 14.0                    | 13.5                    | 12.5                    | 16.0                        | 17.3                        |
| PM-4X                     | 10              | B     | 2   | 13.0                    | 17.0                    | 20.0                    | 13.8                        | 24.0                        |
| PM-4X                     | 10              | B     | 3   | 12.0                    | 13.0                    | 19.0                    | 17.5                        | 19.5                        |
| PM-4X                     | 10              | C     | 1   | 12.5                    | 14.0                    | 19.0                    | 16.0                        | 15.5                        |
| PM-4X                     | 10              | C     | 2   | 10.5                    | 12.5                    | 19.5                    | 22.3                        | 16.5                        |
| PM-4X                     | 10              | C     | 3   | 12.5                    | 12.5                    | 12.0                    | 12.3                        | 10.5                        |
|                           |                 |       |     | 11.83                   | 13.83                   | 17.00                   | 15.97                       | 16.86                       |
|                           |                 |       |     | 1.39                    | 2.66                    | 4.29                    | 2.98                        | 4.17                        |