Potential for Phytotoxicity of Endorse 11.3 DF (Polyoxin D) On St. John's Wort (*Hypericum calycinum*)

By

Heiner Lieth, Director
Linda Dodge
Ron Lane
Jackie Fortunko

Project: Interregional Research Project #4
Project Number 22592A – November 12, 2004

Acknowledgements: Ahmet Gulcu

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

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

PR.NO. :	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

Investigator (Name, Address, Phone#, e-mail, etc)	Dr. Heiner Lieth Department of Plant Sciences, Mailstop 6 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	Polyoxin D
- Formulation	DF, 11.3% a.i./gal
- Batch Number	
- Product	Endorse 11.3 DF
- EPA Registration Number	
- Manufacturer	Cleary
USE INFORMATION **- Plant Common Name**	St. John's Wort
- Plant Scientific Name	*Hypericum calycinum*
- Pest (s)	Bacterial diseases
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: 4/23/04**
Enter each SPACING for:	**Plant or Pot: 6 inches Row: 6 inches**
Enter each SIZE for:	**Pot: 6-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. :	**222592A**
TRIAL:	**1**
DATE:	**11/12/04**

IR-4 ORNAMENTAL DATA REPORTING FORM

APPLICATION PARAMETERS

Type of Application: (aerial, ground, foliar, drench, ppi, chemigation, broadcast, directed, etc)	Foliar spray
Number of Applications:	4, 14 days apart
Application Type:	Manual spray bottle
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)
9/15/04	0, 3.5,7.0,14.0 oz./100 gal	21 weeks post- transplant, actively growing
9/29/04	0, 3.5,7.0,14.0 oz./100 gal	23 weeks post- transplant, actively growing
10/13/04	0, 3.5,7.0,14.0 oz./100 gal	25 weeks post- transplant, actively growing
10/27/04	0, 3.5,7.0,14.0 oz./100 gal	27 weeks post- transplant, actively growing

RAINFALL/IRRIGATION RECORDS:

See Table 1

PR.NO.:	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

OTHER PESTICIDES, FERTILIZER, LIME AND ADJUVANTS USED:

PRODUCT	AMOUNT	DATE
Osmocote 19-6-12	5 grams per 6-inch pot	9/10/04

NARRATIVE SUMMARY OF METHODS AND RESULTS:

Materials and Methods

***Plant Material and Culture*.** Young plants of *Hypericum calycinum* were received from Yoder Bros. on April 12, 2004. These were transplanted to 4-inch pots containing UC Mix on April 23, 2004 and maintained in a greenhouse under natural day length for 4.5 months. The plants were repotted into 6-inch pots containing UC Mix on September 10, 2004 and cut back on September 13, 2004, 2 days before the start of the experiment on September 15, 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 8-week experiment with tap water. Fertilizer in the form of Osmocote (19-6-12) was added at the rate of 5 grams per 6-inch pot on September 10, 2004. Environmental conditions during the 8-week experiment from September 15, 2004 to November 12, 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, 3.5 oz/100 gal (1X), 7.0 oz/100 gal (2X) or 14.0 oz/100 gal (4X) Endorse 11.3 DF (Polyoxin D) with 9 replicates per treatment. These dosages were prescribed in IR4 Ornamental Protocol 640 dated 3/04 (Appendix A). The plants received the first of 4 foliar spray applications of the material on September 15, 2004. The subsequent 3 applications were made at 14-day intervals on September 29, 2004, October 13, 2004 and October 27, 2004. The plants were arranged in a randomized complete block design with 3 blocks and 3 treatment replicates per block. Phytotoxicity ratings and plant height measurements were taken at days 0, 14, 28, 42 and 58 (November 12, 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.

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. :	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

Results

All phytotoxicity index value observation means were below 2 and in all cases, when elevated levels (e.g. week 2) were noted, these were seen in all treatments and were probably due to variations in irrigation or sampling error (Table 3, Figures 1 and 2, appendix B).

During the 8 weeks of the experiment Hypericum grew only a small amount with the height increasing only 2 to 4 cm (Table 3, Figures 1 and 3, Appendix C). The small differences in growth between treatments were generally less than typical measurement error so that even in the instances where statistically significant differences were noted, they could not be attributed to the Polyoxin D.

Discussion

Polyoxin D did not result in foliar phytotoxicity symptoms in Hypericum. It also did not cause any height reduction.

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.:	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

Table 1. Environmental conditions during the phytotoxicity trial of Endorse 11.3 DF on *Hypericum calycinum*. 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)	Max Rel Hum (%)	Min Rel Hum (%)	Dew Pt (°F)	Avg wSpd (MPH)
9/13/2004	0.19	0	524	12.1	86	53.4	78	27	49.6	4.3
9/14/2004	0.35	0	528	7.2	89.3	60.5	65	12	36.1	13.1
9/15/2004	0.28	0	515	8.9	93.6	65.4	51	16	41.6	7.7
9/16/2004	0.22	0	508	11.9	91.5	59.2	68	25	49.2	4.7
9/17/2004	0.23	0	483	11.6	90.7	55.1	74	20	48.4	6.5
9/18/2004	0.15	0	344	8.6	72.7	51.8	69	29	40.6	6.6
9/19/2004	0.1	0	289	10.4	67.3	48.6	88	45	45.6	5.8
9/20/2004	0.19	0	500	8.8	73.9	43.8	94	24	41.3	6.9
9/21/2004	0.25	0	511	6.1	82.6	55.9	41	13	31.8	8.6
9/22/2004	0.17	0	497	8	84.5	47.3	70	18	38.7	2.8
9/23/2004	0.17	0	573	8	88.5	--	59	16	38.7	2.6
9/24/2004	0.18	0	478	8.6	92.8	51.3	57	15	40.8	3.1
9/25/2004	0.18	0	484	9.7	90.5	48.2	69	14	43.9	3.6
9/26/2004	0.18	0	487	8.9	90.8	46.5	75	13	41.5	3.3
9/27/2004	0.17	0	477	11.1	82.5	46.1	77	30	47.2	5.9
9/28/2004	0.15	0	422	12.2	77.4	49	90	41	49.9	5.9
9/29/2004	0.14	0	438	12.4	73.7	49.6	86	47	50.3	6.3
9/30/2004	0.13	0	424	12.5	74.5	48.2	90	48	50.5	5.4
10/1/2004	0.13	0	414	12.5	77.1	49.1	86	44	50.4	3.9
10/2/2004	0.15	0	412	12.3	84.7	49.2	80	33	50.1	3.5
10/3/2004	0.15	0	419	12.5	85.7	50.9	78	32	50.4	3.9
10/4/2004	0.14	0	411	12.9	81.3	49.7	86	40	51.2	4.5
10/5/2004	0.13	0	400	12.4	84.2	46.7	89	34	50.3	3.3
10/6/2004	0.15	0	399	12.3	86.9	50	84	29	50	3.4
10/7/2004	0.14	0	407	13.4	84.9	50.6	85	34	52.4	3.7
10/8/2004	0.16	0	401	13.4	85.3	52.1	86	32	52.3	6.7
10/9/2004	0.22	0	425	8.9	77	55.6	88	14	41.6	10.8
10/10/2004	0.37	0	417	5.6	81.8	62.2	30	13	29.8	19.5
10/11/2004	0.34	0	420	5.4	87.7	59.2	32	11	29.2	14.3
10/12/2004	0.25	0	393	5.8	91.7	53.5	38	12	30.7	7.9
10/13/2004	0.17	0	339	8	94.2	54.4	48	15	38.7	4.6
10/14/2004	0.07	0	183	10	77.5	51.1	70	35	44.5	2.1
10/15/2004	0.11	0	276	10	83.1	47.3	73	26	44.7	4
10/16/2004	0.13	0	338	11.8	70.7	48.7	80	48	49	7.1
10/17/2004	0.08	0.05	180	13.2	68.9	50.3	86	59	52	9.3
10/18/2004	0.06	0	202	10.7	64.7	45.3	92	48	46.4	5.1
10/19/2004	0.02	0.95	89	12.4	58.2	50.9	91	77	50.2	10.8
10/20/2004	0.06	0.1	241	10.8	62.2	47.4	91	55	46.5	4.2
10/21/2004	0.07	0	292	10.7	66.6	41.5	92	52	46.4	4.2
10/22/2004	0.06	0	250	11.9	65.4	44.5	95	59	49.1	3.4
10/23/2004	0.01	0.13	52	13.2	56.9	53.5	94	82	52	5.9
10/24/2004	0.09	0	301	11.4	66.3	47.3	94	40	47.9	6.1
10/25/2004	0.07	0.14	274	10.5	65.4	42.6	95	52	45.8	4.1
10/26/2004	0.08	0.94	301	10.7	61.1	48.2	94	52	46.2	6.1
10/27/2004	0.08	0.06	329	9.7	60.7	43.7	92	53	43.7	5.1
10/28/2004	0.04	0.01	188	9.8	60.1	41.1	94	60	43.9	3.7
10/29/2004	0.07	0	275	10.5	63.5	44.2	94	49	45.9	3.9
10/30/2004	0.07	0	296	11.2	68	41.4	94	54	47.4	2.4
10/31/2004	0.17	0	319	7.2	65.4	49.7	90	25	36	13.1
11/1/2004	0.14	0	302	6.4	68.5	45.5	77	25	33.2	8.3
11/2/2004	0.08	0	276	9.4	69.9	38.9	89	36	42.9	2.8
11/3/2004	0.03	0.06	102	10.9	56.9	47.9	93	62	46.7	6.5
11/4/2004	0.06	0.05	233	9.9	56.3	42.7	93	66	44.2	6.9
11/5/2004	0.07	0.05	286	9.4	67.2	39	92	49	42.8	2.7
11/6/2004	0.07	0.04	289	10	69.4	38.2	96	46	44.6	3.6
11/7/2004	0.06	0.01	259	10.8	62.2	41.3	96	67	46.5	3.6
11/8/2004	0.03	0.15	124	11.2	60.3	44.3	94	67	47.6	3.8
11/9/2004	0.03	0	116	11.7	61.7	52	88	66	48.7	2.6
11/10/2004	0	0.35	68	12.9	56.5	51.2	94	85	51.3	3.1
11/11/2004	0	1.04	48	13.3	56.8	51.5	95	90	52.1	4.1

PR.NO. :	**222592A**
TRIAL:	**1**
DATE:	**11/12/04**

IR-4 ORNAMENTAL DATA REPORTING FORM

11/12/2004	0.07	0.02	258	12.3	65.5	46	95	61	50.1	4.8

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.:	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

Table 3. Summary of results for *Hypericum calycinum* treated with 0, 3.5, 7.0 or 14.0 oz./100 gal Endorse 11.3 DF. Cumulative changes over time are reported for phytotoxicity index and plant height. 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 = 9).

Material: Polyoxin

Phytotoxicity Increase after:

Treatment	2 weeks	no	4 weeks	no	6 weeks	no	8 weeks	no
Control	1.89 ± 0.26	a	-0.11 ± 0.11	a	-0.11 ± 0.11	a	0.56 ± 0.18	a
1x	1.33 ± 0.29	a	0.11 ± 0.20	a	0.33 ± 0.33	a	0.56 ± 0.24	a
2x	1.44 ± 0.29	a	0.00 ± 0.17	a	0.11 ± 0.26	a	0.22 ± 0.22	a
4x	2.00 ± 0.37	a	0.22 ± 0.15	a	0.11 ± 0.26	a	0.67 ± 0.17	a

Height Increase after:

Treatment	2 weeks	at 10%	4 weeks	yes	6 weeks	no	8 weeks	at 10%
Control	-1.56 ± 0.88	a	-0.50 ± 0.94	a	-0.44 ± 1.04	a	1.94 ± 1.10	a
1x	0.61 ± 0.78	b	1.50 ± 0.62	b	0.67 ± 0.57	a	4.00 ± 0.91	a
2x	-0.28 ± 0.40	ab	1.56 ± 0.46	b	0.72 ± 0.62	a	2.94 ± 0.80	a
4x	-0.50 ± 0.74	ab	1.00 ± 0.71	ab	0.83 ± 0.95	a	2.11 ± 0.91	a

PR.NO. :	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

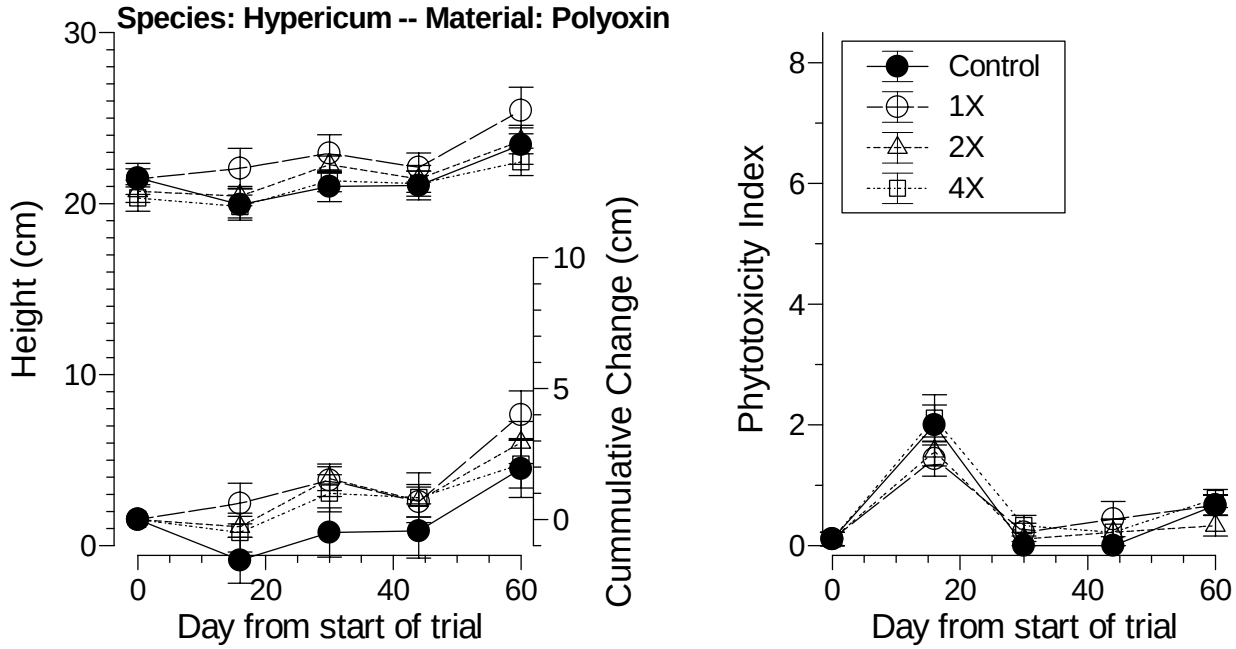

Figure 1. Summary of results for *Hypericum calycinum* treated with 0, 3.5, 7.0 or 14.0 oz./100 gal Endorse 11.3 DF. Mean heights as well as mean cumulative changes in height are shown along with standard errors of the means. For phytotoxicity index, the mean values and standard error bars are shown (n = 9).

PR.NO.:	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

Figure 2. Damage symptoms (leaf tip necrosis) seen on *Hypericum calycinum* plants treated with 0, 3.5, 7.0 or 14.0 oz./100 gal Endorse 11.3 DF.

PR.NO.:	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

Block A

Block B

Block C

Figure 3. *Hypericum calycinum* plants 8 weeks after 4 applications of 0, 3.5, 7.0 or 14.0 oz./100 gal Endorse 11.3 DF. Applications were made at Weeks 0, 2, 4 and 6.

PR.NO. :	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

APPENDIX A

PHYTOTOXICITY PROTOCOL FOR CLEARING POLYOXIN D ON ORNAMENTALS

Date: 03/04
Ornamental Protocol Number: 640
General label directions: Refer to Product Label
Research program:
Site (species, variety, etc.) - As Attached
Pest(s) - As Attached
Pesticide (common name and trade name) - Polyoxin D (ENDORSE 11.3 DF)
For label, material & if needed spray oil surfactant contact:
Cleary, Rick Fletcher 1-800-524-1662, (908) 329-8399, FAX# 908-274-0894; e-mail: rick.fletcher@clearychemical.com

Formulation- Use only EPA registered product
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:	DRENCH	FOLIAR SPRAY
Dosages - 1x	3.5 oz/100 gal.	3.5 oz/100 gal.
2x	7.0 oz/100 gal.	7.0 oz/100 gal.
4x	14.0 oz/100 gal.	14.0 oz/100 gal.

Volume - 100 gal - 400 gal.
Timing - (Interval) 14 day
Number Applications: 3 - 5

Reports:
Method of application: (treatments are to be applied using application equipment consistent with conventional commercial equipment).
Report completely on experimental design and method of application.
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.
If appropriate also include a rating for: Chlorosis. Percent of Defoliation (0-10 scale) and stunting (0-10). Indicate if marketable or not.

Please direct questions to: IR-4 Project, 681 US Highway #1 South, North Brunswick, NJ (732) 932-9575 x 629, FAX# 732-932-8481.

PR.NO.:	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

APPENDIX B: PHYTOTOXICITY REPORT FORM: Visual Rating

Hypericum- phyto trial with Polyoxin D								
				9/13/2004	9/29/2004	10/13/2004	10/27/2004	11/12/2004
	Rate			Phyto	Phyto	Phyto	Phyto	Phyto
Treatment	oz./100gal	Block	Rep	Rating	Rating	Rating	Rating	Rating
Control	0	A	1	0	1	0	0	0
Control	0	A	2	0	2	0	0	1
Control	0	A	3	0	3	0	0	1
Control	0	B	1	0	1	0	0	1
Control	0	B	2	1	4	0	0	1
Control	0	B	3	0	2	0	0	0
Control	0	C	1	0	1	0	0	0
Control	0	C	2	0	2	0	0	1
Control	0	C	3	0	2	0	0	1
1x	3.5	A	1	0	1	0	0	1
1x	3.5	A	2	0	3	1	2	1
1x	3.5	A	3	0	2	0	0	0
1x	3.5	B	1	0	1	0	0	1
1x	3.5	B	2	0	1	0	0	1
1x	3.5	B	3	1	2	0	0	0
1x	3.5	C	1	0	2	1	0	1
1x	3.5	C	2	0	1	0	2	1
1x	3.5	C	3	0	0	0	0	0
2x	7	A	1	1	1	0	0	0
2x	7	A	2	0	1	1	0	1
2x	7	A	3	0	3	0	0	0
2x	7	B	1	0	2	0	2	1
2x	7	B	2	0	1	0	0	0
2x	7	B	3	0	1	0	0	1
2x	7	C	1	0	1	0	0	0
2x	7	C	2	0	2	0	0	0
2x	7	C	3	0	2	0	0	0
4x	14	A	1	1	3	1	0	1
4x	14	A	2	0	3	0	0	1
4x	14	A	3	0	0	0	0	1
4x	14	B	1	0	2	1	0	1
4x	14	B	2	0	3	1	0	1
4x	14	B	3	0	3	0	0	1
4x	14	C	1	0	1	0	0	0
4x	14	C	2	0	3	0	0	1
4x	14	C	3	0	1	0	2	0

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

PR.NO.:	222592A
TRIAL:	1
DATE:	11/12/04

IR-4 ORNAMENTAL DATA REPORTING FORM

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

Hypericum- phyto trial with Polyoxin D								
				9/13/2004	9/29/2004	10/13/2004	10/27/2004	11/12/2004
	Rate			Plant	Plant	Plant	Plant	Plant
Treatment	oz./100gal	Block	Rep	Height (cm)	Height (cm)	Height (cm)	Height (cm)	Height (cm)
Control	0	A	1	22.5	18.5	18	17	20
Control	0	A	2	22	22.5	24	22.5	24
Control	0	A	3	22.5	26	26	25.5	28
Control	0	B	1	20	18.5	20	20	23
Control	0	B	2	22.5	19.5	20.5	21	29
Control	0	B	3	20	17.5	18.5	19.5	22
Control	0	C	1	24	18.5	19.5	19	21
Control	0	C	2	21	20.5	22.5	23	25
Control	0	C	3	19	18	20	22	19
1x	3.5	A	1	23.5	24	26	24	28
1x	3.5	A	2	23	29	27.5	26.5	32
1x	3.5	A	3	19	20.5	21	20	22
1x	3.5	B	1	16	17	19	19	22
1x	3.5	B	2	22	21.5	22	22.5	24
1x	3.5	B	3	21.5	21	23	21	26
1x	3.5	C	1	20	18.5	18	20	19
1x	3.5	C	2	23	24	24	21	27
1x	3.5	C	3	25	23	26	25	29
2x	7	A	1	20	20	21.5	20.5	23
2x	7	A	2	21	20.5	22	21	28
2x	7	A	3	23	22	25.5	27	26
2x	7	B	1	21.5	22	23	21	24
2x	7	B	2	17	19	20	18	22
2x	7	B	3	19	18.5	21.5	21.5	22
2x	7	C	1	23	21.5	22	21	21
2x	7	C	2	22	22.5	22	21	25
2x	7	C	3	20	18	23	22	22
4x	14	A	1	17	18.5	20.5	20.5	20
4x	14	A	2	22.5	24	25	24.5	28
4x	14	A	3	20	19.5	22	21	23
4x	14	B	1	17	18	20	23.5	23
4x	14	B	2	21	17	22	22	23
4x	14	B	3	23	20	21	21	21
4x	14	C	1	20	21	18	18	20
4x	14	C	2	19.5	20.5	21.5	18	22
4x	14	C	3	23	20	22	22	22