

Potential for Phytotoxicity of Mogeton 25 WP
(Quinoclamine) on
Beard Tongue (*Penstemon X mexicali* 'Red Rocks')

By

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Project: Interregional Research Project #4
Project Number 24054A – August 24, 2005

Donors/Supporters:
Hines Horticulture, Vacaville, CA

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PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

Investigator (Name, Address, Phone#, e-mail, etc)	Dr. Heiner Lieth Department of Plant Sciences University of California One Shields Ave. Davis, CA 95616 Ph 530-752-7198 FAX 530-752-1819 Email: jhlieth@ucdavis.edu				
Location of Trial	UC Davis				
TRIAL TYPE: (field, container, greenhouse, etc)	Greenhouse containers				
Chemical - Common Name	Quinoclamine				
- Formulation	Wettable Powder 25%				
- Batch Number					
- Product	Mogeton				
- EPA Registration Number	CAS number 2797-51-5				
- Manufacture	Crompton				
USE INFORMATION					
- Plant Common Name	Beard Tongue				
- Plant Scientific Name	<i>Penstemon X mexicali</i> 'Red Rocks'				
- Pest (s) / Pathogen(s) / Weed(s)	Liverworts				
Soil Type or Type of Potting Mix:	% Sand	% Silt	% Clay	% OM	pH
UC Mix	35			65	6.5
Enter each DATE for:	Seeding:	Emergence:		Transplanting: 5/27/2005	
Enter each SPACING for:	Plant or Pot: 6 inches		Row: 6 inches		
Enter each SIZE for:	Pot: 6-inch		Plot: 45 feet ²		
Experimental Design:	Randomized Complete Block				
Number of Reps:	3 blocks X 3reps/block = 9 replicates total for each treatment				

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

APPLICATION PARAMETERS¹

Type of Application: (aerial, ground, foliar, drench, ppi, chemigation, broadcast, directed, etc)	Foliar spray
Number of Applications:	2, four weeks apart
Application Type:	Over the top
Nozzle Type/Size:	Manual spray bottles
Nozzle Pressure:	
Delivery Rate:	
Calibration Date(s):	

APPLICATION SUMMARY

APPLICATION DATE	RATES (a.i./100 gallons water) (Be sure to provide units)	Brief Description of Growth Stage (Dormant, New Growth Present, Bud, etc)
6/02/2005	0, 2, 4, 8 oz./gal	Vegetative, 5 days post-transplant
6/29/2005	0, 2, 4, 8 oz./gal	Vegetative, 4 weeks post-transplant

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

The plants were watered daily during the 12-week experiment with half-strength Hoagland's solution using a drip irrigation system delivering 1 gallon per hour.

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

OTHER PESTICIDES, FERTILIZER, LIME AND ADJUVANTS USED:

PRODUCT	AMOUNT	DATE
Pylon	6 mL/4 gal	6/17/2005
Marathon II	4 oz/4 gal	6/17/2005

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

Materials and Methods

Plant Material and Culture. Cuttings of *Penstemon X mexicali* 'Red Rocks' were propagated from stock plants at the Environmental Horticulture Department on September 19, 2004. These were transplanted into 6-inch pots containing UC Mix on May 27, 2005, cut back to 6 inches (15 cm) and maintained in a greenhouse under natural day length for 5 days until the experiment began on June 2, 2005. For the experiment, the plants were transferred to a greenhouse under natural day length with day/night temperatures of 77°/67°F (25°/19°C) (Figure 1). The plants were watered daily during the 12-week experiment with half-strength Hoagland's solution using a drip irrigation system delivering 1 gallon per hour. Applications of pesticides as part of a normal pest management program were made as needed (see above).

Experimental Procedure. Thirty-six plants were randomly chosen and individually tagged for treatment with 0 (Control), 2 (1X), 4 (2X), or 8 (4X) oz./gal Mogeton with 9 replicates per treatment. These dosages were prescribed in IR4 Ornamental Protocol 05-004 dated 5/05 (Appendix A). The plants received the first foliar spray application on June 2, 2005 and the second application 4 weeks later on June 29, 2005. The plants were arranged in a randomized complete block design with 3 blocks and 3 treatment replicates per block. Phytotoxicity ratings and plant height and width measurements were taken at week 0, 1, 2, 4, 8, and 12. Visual phytotoxicity evaluations were based on a numerical rating scale ranging from 0 (no injury) to 10 (complete kill) (Table 1). Plant height (cm) was measured from the container soil surface to the top of the canopy.

Plant width (cm) was measured twice along perpendicular lines at the widest part of the plant, resulting in W_1 and W_2 . 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 Mogeton. The calculation was made as $H*W_1*W_2$, where H is the height and W_1 and W_2 are two width measurements. The usefulness of this index is based on the fact that many of the models for such a volume calculation are of the form $a*H*W_1*W_2$. 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. The data were analyzed using Proc GLM of the Statistical Analysis System (SAS). The phytotoxicity and change in mean value from the starting plant height, width and volume index were analyzed for significant differences using t-tests.

Results

Phytotoxicity index readings were generally low (less than 1) in all treatments at all times (Table 2, Figure 2, Appendix B). Only on week 4 did we observe slightly elevated levels of the phytotoxicity index. At weeks 2, 4 and 8, the levels in the 8 oz/gal (4X) treatment were significantly higher than the control, but it should be noted that the average values were around 1 or lower, indicating that the damage level even at the highest rate of application was very small. Because the plants were watered with a drip irrigation system, the orange Mogeton spray residue persisted (Figure 3).

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

Both the height and width changed a substantial amount over the 12 weeks of the trial (Table 3, Figures 2 and 4, Appendix B). The height increase was significantly smaller in the 4 (2X) and 8 oz/gal (4X) treatments than in the control or 2 oz/gal (1X) treatment. The widths of the plants were significantly affected by all Mogeton treatments. While the width increase in the control averaged 10.4 cm, the width increase in the 1X treatment was 5.8 cm.

Discussion

Although there were no foliar symptoms attributable to Mogeton, there was a substantial reduction in the amount of plant growth at all rates of application of the material. The conclusion is that Mogeton should not be used on this crop.

Alternatively, growers may find that penstemon typically grows a bit too tall in containers so that the height reduction without foliar damage may well be a good thing.

Growers should be advised that when they apply Mogeton over the top of plants, the orange residue on the foliage will need to be washed off prior to sale. This is likely to be an issue only with plants that do not receive overhead irrigation or rain.

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:

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

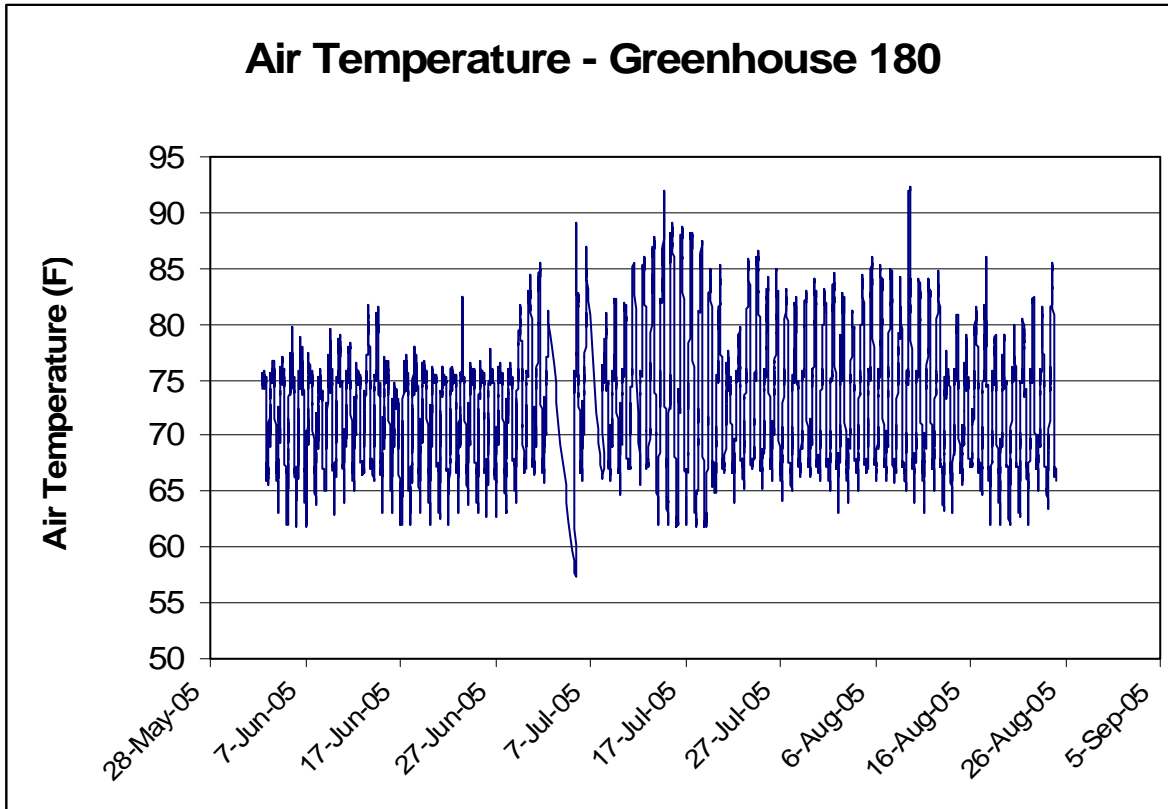


Figure 1. Greenhouse air temperatures during the experiment to evaluate the phytotoxicity of Mogeton on *Penstemon X mexicali* 'Red Rocks'.

Table 1. 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. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

Table 2. Phytotoxicity ratings over 12 weeks for *Penstemon X mexicali* 'Red Rocks' treated with 0 (Control), 2 (1X), 4 (2X), or 8 (4X) oz./gallon Mogeton, applied at weeks 0 and 4. Different letters within a column indicate significant differences between treatments (P < 0.05). "Yes"/"No" refer to significant treatment effects at the 5% level. Means ± SE (n = 9)

Treatment (oz/gal)	Week 1 no	Week 2 no	Week 4 yes	Week 8 no	Week 12 no
0	0.00 ± 0.00 a	0.44 ± 0.18 ab	0.11 ± 0.11 a	0.00 ± 0.00 a	0.22 ± 0.15 a
2	0.44 ± 0.29 a	0.22 ± 0.15 ab	0.89 ± 0.20 bc	0.00 ± 0.00 a	0.33 ± 0.17 a
4	0.22 ± 0.22 a	0.00 ± 0.00 a	0.44 ± 0.18 ab	0.22 ± 0.15 ab	0.11 ± 0.11 a
8	0.67 ± 0.33 a	0.67 ± 0.24 b	1.11 ± 0.26 c	0.44 ± 0.24 b	0.44 ± 0.24 a

Table 3. Plant height, width and volume changes over 12 weeks for *Penstemon X mexicali* 'Red Rocks' treated with 0 (Control), 2 (1X), 4 (2X), or 8 (4X) oz./gallon Mogeton, applied at weeks 0 and 4. Different letters within a column indicate significant differences between treatments (P < 0.05). "Yes"/"No" refer to significant treatment effects at the 5% level. Means ± SE (n = 9)

Treatment (oz/gal)	Height Increase after 12 weeks	yes	Width Increase after 12 weeks:	yes	Relative Volume Index Increase after 12 weeks	yes
0	36.17 ± 1.22	a	10.44 ± 1.86	a	25771.2 ± 4896.50	a
2	33.89 ± 1.72	a	5.89 ± 1.15	b	16530.7 ± 1808.98	b
4	29.11 ± 1.30	b	5.47 ± 0.57	b	12741.3 ± 1167.56	bc
8	25.06 ± 1.21	b	2.42 ± 0.76	c	7551.08 ± 1129.99	c

PR.NO.	24870
:	
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

Species: Penstemon -- Material: Mogeton

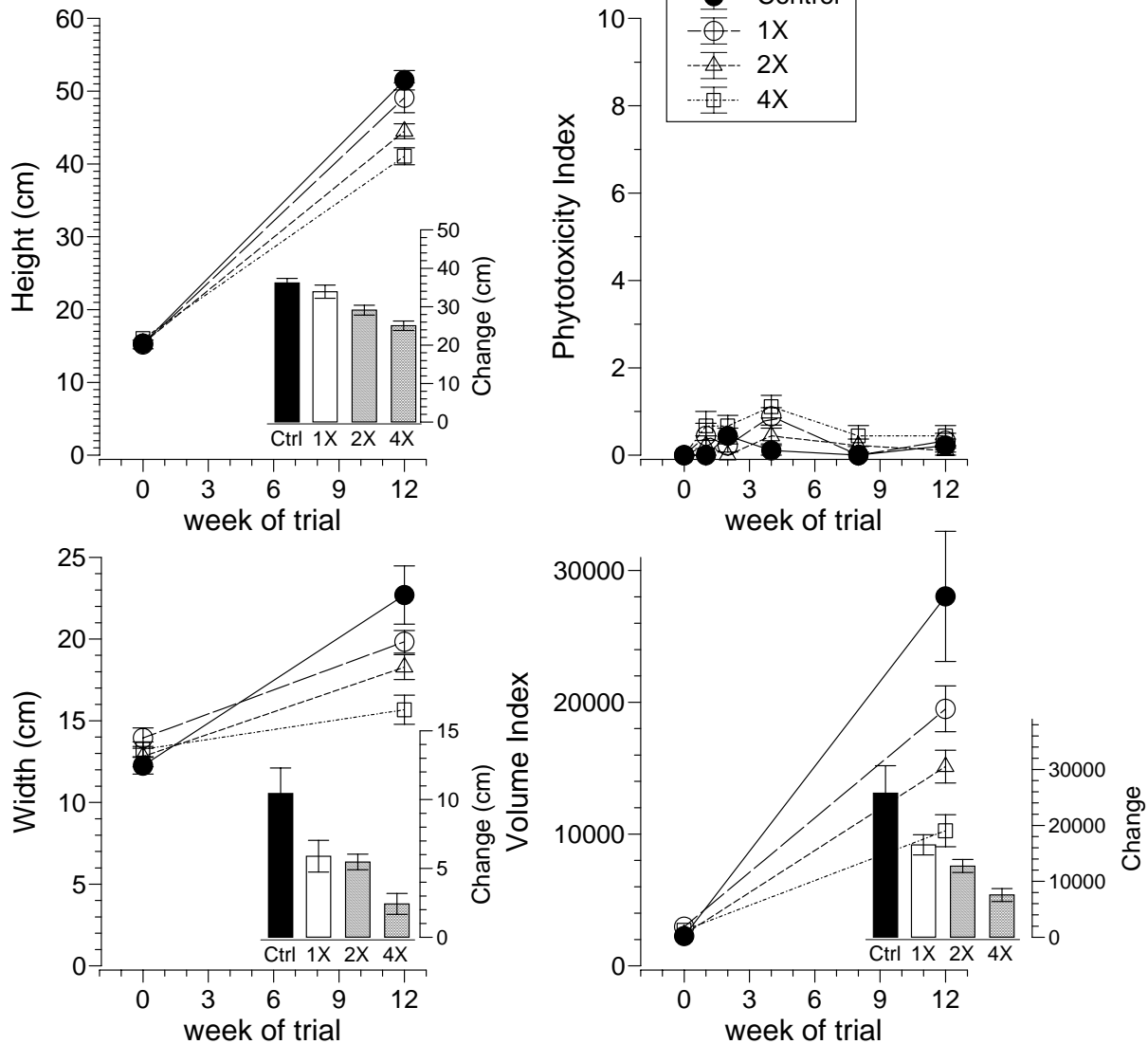


Figure 2. Summary of results over 12 weeks for *Penstemon X mexicali* 'Red Rocks' treated with 0 (Control), 2 (1X), 4 (2X), or 8 (4X) oz./gallon Mogeton, applied at weeks 0 and 4. Both means and cumulative changes over time are plotted for phytotoxicity index, plant height, plant width and plant volume index. Histograms show changes over the 12-week trial period. SE bars shown. (n = 9)

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM



Figure 3. Because the *Penstemon X mexicali* 'Red Rocks' plants were watered with a drip irrigation system, the orange Mogeton spray residue persisted.

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM



Block A



Block B



Block C

CONTROL

1X

2X

4X

Figure 4. *Penstemon X mexicali* 'Red Rocks' plants 12 weeks after treatment with 0 (Control), 2 (1X), 4 (2X), or 8 (4X) oz./gallon Mogeton, applied at weeks 0 and 4.

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

APPENDIX A

Phytotoxicity to herbaceous perennial plants with applications of Mogeton 25WP

Ornamental Protocol Number: 05-004

REVISED DATE: 05/05

Objective: Determine phytotoxicity of Mogeton 25WP to perennial plants commonly grown in greenhouse and/or nurseries.

Experimental Design:

Plot Size: Must be adequate to reflect actual use conditions.

Replicates: Minimum of 3 replications (preferably 4) with 3 pots per replicate

Application Instructions: Two applications made approximately 4 weeks apart. Plant materials must be established in containers and have broken dormancy prior to first application. Use 2 qts of final spray solution per 100 sq ft or about 218 gal per acre. Applications should be made over the top of the plants using application equipment consistent with conventional commercial equipment. Please see table below for instructions for post-application irrigation.

Plant Materials: See attached list of plant materials. Plants must be growing in containers and not field grown.

Evaluations: Record phytotoxicity on a scale of 0 to 10 (0 = No phytotoxicity; 10 = Complete kill) at 1, 2, 4, 8, and 12 weeks after initial application. If appropriate, also include ratings for chlorosis, defoliation, stunting or other growth effects on a scale of 0 to 10 (0 = No effect; 10 = Complete plant affected). If any phytotoxicity is observed in treated plants, take pictures comparing treated and untreated plant material.

Recordkeeping: Keep detailed records of weather conditions including temperature and precipitation, soil-type or soil-less media, application equipment, application volume per acre, irrigation, liner size, plant height & width, and plant growth stage at application and data collection dates.

Treatments:

Product	Rate	Post-Application Irrigation Instructions
Mogeton 25WP (quinoclamine)	2.0 oz/gal 4.0 oz/gal 8.0 oz/gal	Do not overhead water for 24 h after application.
Untreated	--	--

For labels, materials, and any required adjuvants contact:

Mogetan - Crompton, Kevin Donovan, 203-393-2163 x 2028, kevin.donovan@cromptoncorp.com

Reports:

Report must include a brief summary paragraph of results, a summary table with appropriate statistical analyses, a section on experimental design and materials and methods, with raw data and recordkeeping information as listed above included as appendices. If pictures were taken, please include them.

An electronic report is preferred but not required. If the report is provided electronically, the basic report can be sent in MS Word or WordPerfect, the recordkeeping information as pdf or other electronic documents, and the raw data in MS Excel or other suitable program such as ARM.

Please direct questions to: Cristi Palmer, IR-4 HQ, Rutgers University, 681 US Hwy 1 S, North Brunswick, NJ 08902-3390, Phone 732-932-9575 x629, palmer@aesop.rutgers.edu

OR

Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-488, E-mail: evvea@comcast.net.

PR.NO. :	24870
TRIAL:	1
DATE:	8/24/2005

IR-4 ORNAMENTAL DATA REPORTING FORM

APPENDIX B

Phytotoxicity Report Form			Phytotoxicity at week						Plant Size at week 0			Plant Size at week 12		
Treatment	Block	Rep	0	1	2	4	8	12	Height (cm)	Width1 (cm)	Width 2 (cm)	Height (cm)	Width1 (cm)	Width 2 (cm)
			Control	A	1	0	0	1	0	0	0	16.5	10	12
Control	A	2	0	0	0	0	0	0	16	13.5	13	57	32	29
Control	A	3	0	0	0	0	0	1	16.5	14.5	9	52	30	25
Control	B	1	0	0	0	0	0	0	14.5	15	15	52.5	22	19
Control	B	2	0	0	1	1	0	0	14.5	10	13	47	21	18.5
Control	B	3	0	0	1	0	0	0	16.5	14.5	9	46	22	21
Control	C	1	0	0	1	0	0	0	13	13	10.5	49	18	16
Control	C	2	0	0	0	0	0	0	14.5	13.5	7	49	18	17.5
Control	C	3	0	0	0	0	0	1	16	17	11	56	21	17.5
Mean			0.0	0.0	0.4	0.1	0.0	0.2	15.3	13.4	11.1	51.5	24.6	20.8
1X	A	1	0	2	1	1	0	0	16.5	17	9.5	52.5	25	21
1X	A	2	0	0	0	1	0	1	16.5	11	12	49	25	21
1X	A	3	0	0	0	1	0	0	16	16	17	46	19	20
1X	B	1	0	2	1	2	0	0	17	15	15	53.5	17	17
1X	B	2	0	0	0	0	0	1	16	15.5	14	59	20	20
1X	B	3	0	0	0	1	0	0	12	13	11	40	19	18.5
1X	C	1	0	0	0	0	0	0	13	16	17	49	19.5	16.5
1X	C	2	0	0	0	1	0	0	14	15	12	40.5	20.5	17
1X	C	3	0	0	0	1	0	1	16	14	11	52.5	23	18
Mean			0.0	0.4	0.2	0.9	0.0	0.3	15.2	14.7	13.2	49.1	20.9	18.8
2X	A	1	0	0	0	0	1	0	14	17	12	44	17	20
2X	A	2	0	0	0	1	0	0	14	19	9	49	20	20
2X	A	3	0	0	0	0	0	0	16.5	16	7	42	21	20
2X	B	1	0	0	0	0	0	1	16	20.5	10	44	20.5	19
2X	B	2	0	0	0	1	0	0	18	11	11.5	45.5	15.5	19.5
2X	B	3	0	0	0	1	0	0	14.5	15	9	49.5	17.5	19.5
2X	C	1	0	2	0	0	1	0	16.5	10	9	40	13	12.5
2X	C	2	0	0	0	0	0	0	15	15	11	42.5	18.5	18
2X	C	3	0	0	0	1	0	0	14	15	13.5	44	19.5	18
Mean			0.0	0.2	0.0	0.4	0.2	0.1	15.4	15.4	10.2	44.5	18.1	18.5
4X	A	1	0	0	0	0	0	1	17	13	10	42	19	18
4X	A	2	0	2	1	1	1	0	15	19	9.5	36	18	19
4X	A	3	0	2	2	2	2	0	16	11	16	44.5	14	15
4X	B	1	0	0	0	0	0	0	18	17	7.5	36.5	14	11
4X	B	2	0	0	0	1	1	0	15	15	13	42	19	14.5
4X	B	3	0	0	0	1	0	0	16	16.5	14	44.5	21	17.5
4X	C	1	0	0	1	1	0	2	15.5	16	12	38	17	12
4X	C	2	0	2	1	2	0	0	16.5	11	11	45	13	11
4X	C	3	0	0	1	2	0	1	15	15	12	41	16	13
Mean			0.0	0.7	0.7	1.1	0.4	0.4	16.0	14.8	11.7	41.1	16.8	14.6