

Potential for Phytotoxicity of
Endorse 11.3 DF (Polyoxin D)
On Vervain
(*Verbena canadensis* 'Homestead Purple')

By

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Project: Interregional Research Project #4
Project Number 22911A – November 3, 2004

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TRIAL:	1
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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)	Greenhouse
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	Vervain
- Plant Scientific Name	<i>Verbena canadensis</i> 'Homestead Purple'
- 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: 5/25/04
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

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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)
9/8/04	0, 3.5,7.0,14.0 oz./100 gal	15 weeks post- transplant, actively growing
9/22/04	0, 3.5,7.0,14.0 oz./100 gal	17 weeks post- transplant, actively growing
10/6/04	0, 3.5,7.0,14.0 oz./100 gal	19 weeks post- transplant, actively growing
10/20/04	0, 3.5,7.0,14.0 oz./100 gal	21 weeks post- transplant, actively growing

RAINFALL/IRRIGATION RECORDS

See Table 1

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OTHER PESTICIDES, FERTILIZER, LIME AND ADJUVANTS USED:

PRODUCT	AMOUNT	DATE
Flagship	47 g/12,000 sq. ft.	9/04
Talstar	0.64 oz.	10/04
Pedestal	0.32 oz.	10/04
Azatin	1.0 oz.	10/04
Avid	0.32 oz.	10/04
Flagship	46 g	10/04

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

Materials and Methods

Plant Material and Culture. Young plants of *Verbena canadensis* 'Homestead Purple' were received from Yoder Bros. on May 24, 2004. These were transplanted to 4-inch pots containing UC Mix on May 25, 2004 and maintained in a greenhouse under natural day length for 4 months during which time the plants were repotted into 6-inch pots containing UC Mix. The plants were cut back on September 6, 2004, 2 days before the experiment began on September 8, 2004. During the 8-week experiment, the plants were maintained in a greenhouse under natural day length and day/night temperatures of 78°/65° F (26°/18° C) (Figure 1). The plants were watered as needed (at least once daily) during the 8-week experiment with half-strength Hoagland's solution. Pesticides were applied as part of a normal pest management program (see above).

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 8, 2004. The subsequent 3 applications were made at 14-day intervals on September 22, October 6 and October 20, 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 56 (November 3, 2004). Visual phytotoxicity evaluations were based on a numerical rating scale ranging from 0 (no injury) to 10 (complete kill) (Table 1). Plant width (cm) was measured twice with measurements made in perpendicular planes.

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 index value observations were generally 2 or lower, representing only slight foliar blemishes (Table 2, Figures 2 and 3, Appendix B). While the differences between mean phytotoxicity index values were significant at week 2 and 4, the levels were so small that they do not represent economic damage. At week 6 the phytotoxicity index of the control was slightly higher than that of the polyoxin-treated plants. At week 8 no significant differences in the increase in phytotoxicity were found between treatments.

During the 8 weeks of the experiment Verbena spread laterally significantly with the width increasing by 135 to 155 cm in the 4 treatments (Table 2, Figures 2 and 4, Appendix C). At week 2 and 4 there appeared to be some significant impact of the polyoxin D on the width increase. At 2 weeks the plants in the control grew in diameter by 29 cm while the width increases in the 1x, 2x, and 4x treatments grew by only 24.2, 23.8, and 20 cm. The significant difference in growth between the control and the polyoxin D treatments persisted at week 4, but by week 6 the plants were all the same. At week 8 the plants treated with polyoxin D typically had matched or exceeded the width growth of the control.

Discussion

Polyoxin D did not result in foliar phytotoxicity symptoms in Verbena. It did, however show slight suppression of growth during the first month after application. It should be noted that this crop grows quite rapidly (mostly laterally) and growers are likely to appreciate the slight reduction in growth. Even so, for the 1X treatment, this slight effect was no longer present by week 4. In fact, after week 4 the plants treated with polyoxin D were able to catch up and even exceed the growth of the untreated plants. In general the negative effect of the 1x treatment was very small so that it is not a concern for growers.

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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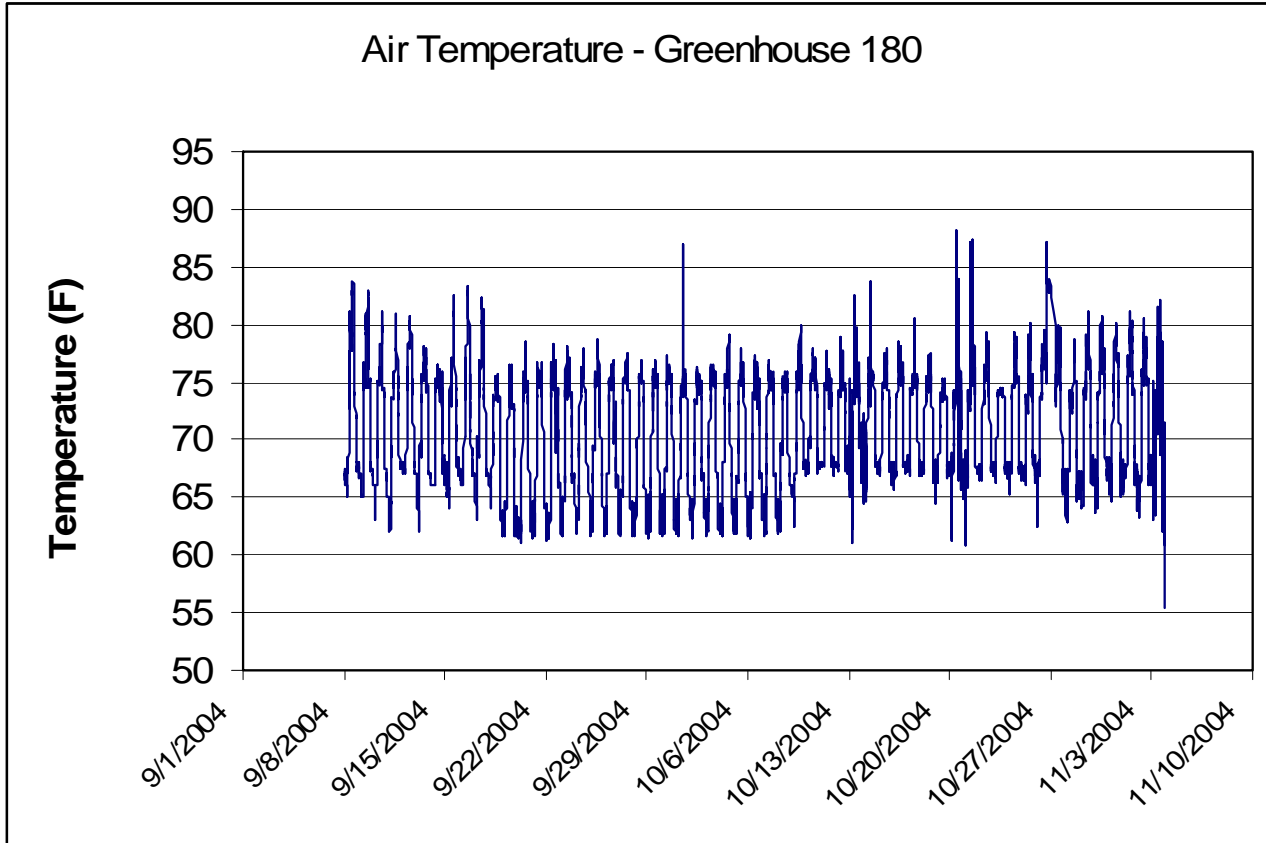


Figure 1. Greenhouse temperatures during the phytotoxicity trial of Endorse 11.3 DF on *Verbena canadensis* 'Homestead Purple'.

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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

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Table 2. Summary of results for *Verbena canadensis* 'Homestead Purple' 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 width. 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	yes	4 weeks	yes	6 weeks	yes	8 weeks	no
Control	0.00 ± 0.00	a	0.00 ± 0.00	a	2.33 ± 0.24	a	1.78 ± 0.22	a
1x	-0.56 ± 0.18	b	-0.56 ± 0.18	b	1.56 ± 0.24	ab	1.67 ± 0.17	a
2x	-0.67 ± 0.17	b	-0.67 ± 0.17	b	1.11 ± 0.26	b	1.56 ± 0.24	a
4x	-0.89 ± 0.11	b	-0.89 ± 0.11	b	1.11 ± 0.35	b	1.67 ± 0.24	a

Width Increase after:

Treatment	2 weeks	yes	4 weeks	yes	6 weeks	no	8 weeks	yes
Control	29.33 ± 1.96	a	74.72 ± 1.94	a	83.56 ± 2.67	a	135.6 ± 5.40	a
1x	24.22 ± 1.15	b	72.06 ± 2.78	ab	81.83 ± 2.34	a	155.1 ± 3.11	b
2x	23.78 ± 1.04	b	64.72 ± 1.92	b	87.83 ± 2.14	a	152.0 ± 4.72	b
4x	20.22 ± 2.03	b	69.78 ± 3.67	ab	85.61 ± 3.10	a	148.9 ± 6.96	ab

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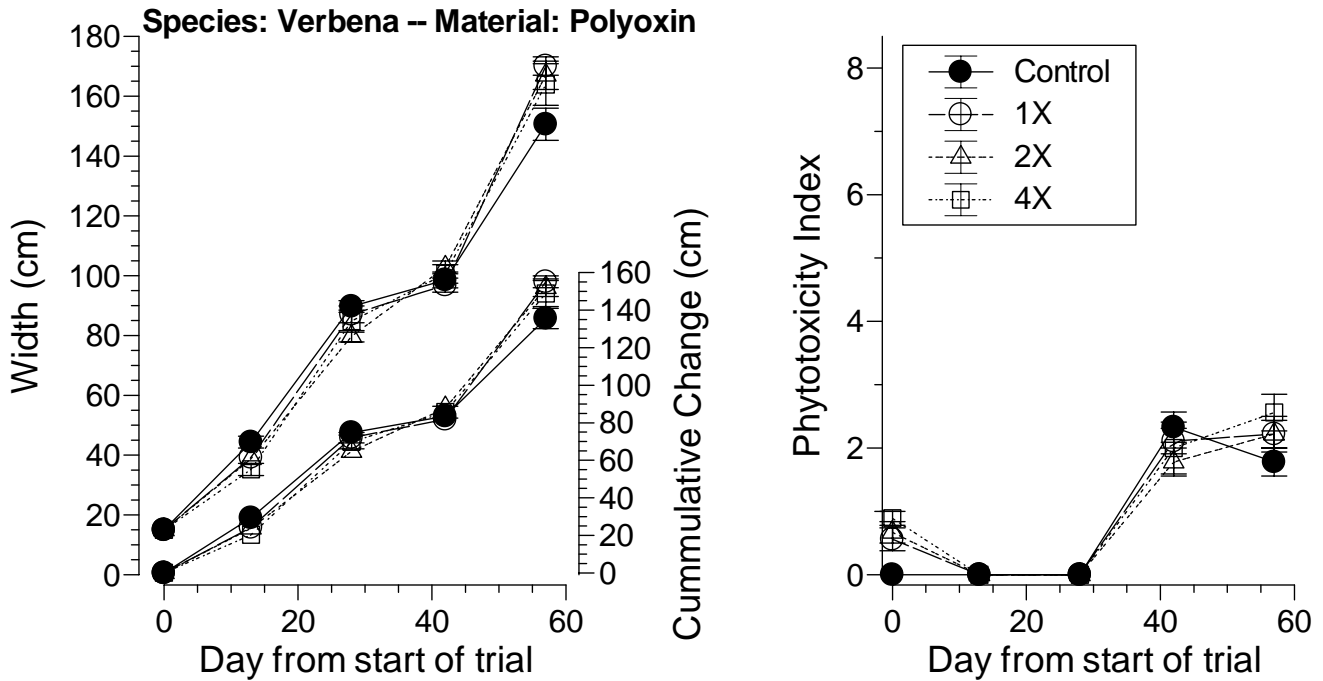


Figure 2. Summary of results for *Verbena canadensis* 'Homestead Purple' treated with 0, 3.5, 7.0 or 14.0 oz./100 gal Endorse 11.3 DF. Mean widths as well as mean cumulative changes in width are shown along with standard errors of the means. For phytotoxicity index, the mean values and standard error bars are shown (n = 9).

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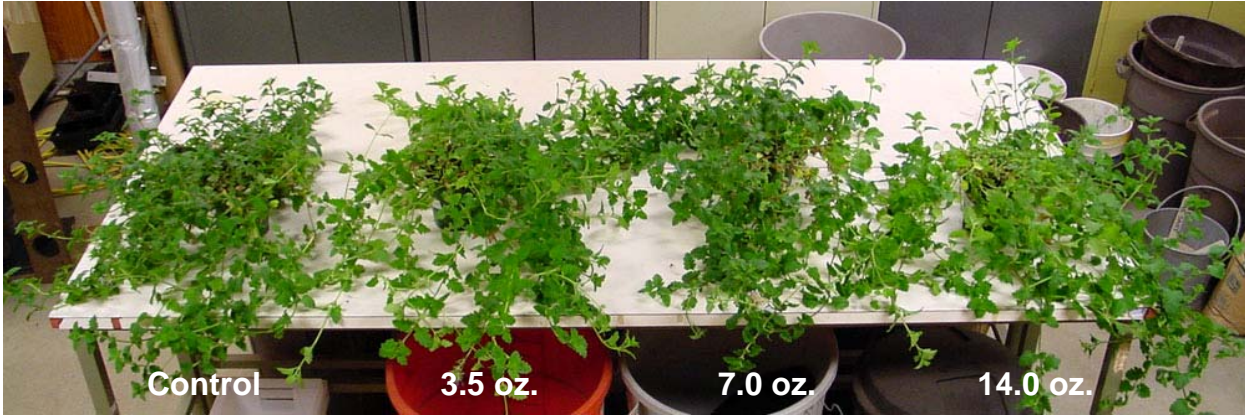
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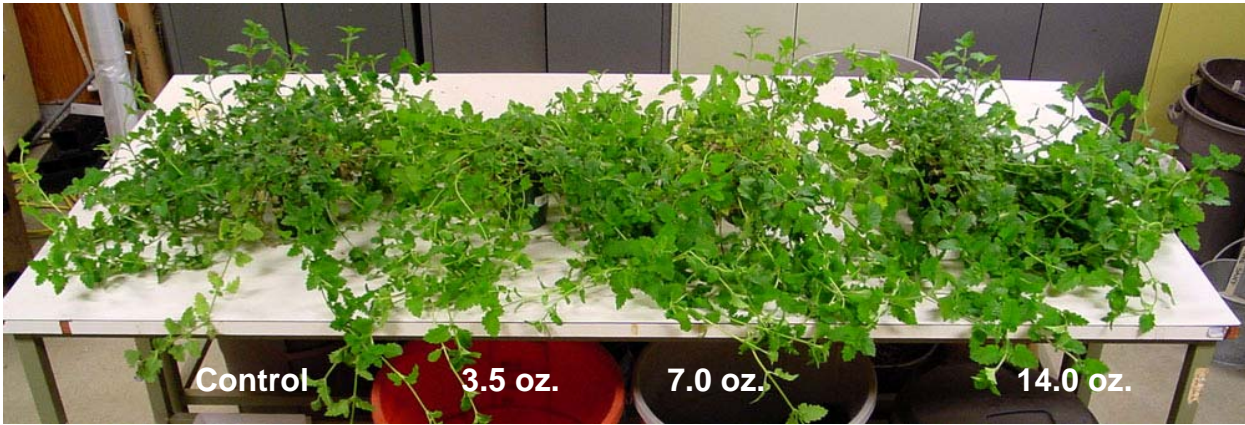
Figure 3. Damage symptoms seen on *Verbena canadensis* 'Homestead Purple' plants treated with 0, 3.5, 7.0 or 14.0 oz./100 gal Endorse 11.3 DF. Symptoms included chlorosis and necrosis of older leaves.

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Block A



Block B



Block C

Figure 4. Representative plants of *Verbena canadensis* 'Homestead Purple' 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.

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APPENDIX B: PHYTOTOXICITY REPORT FORM: Visual Rating

Verbena- phyto trial with Polyoxin D				9/8/2004	9/21/2004	10/6/2004	10/20/2004	11/4/2004
Treatment	Rate oz./100gal	Block	Rep	Phyto Rating	Phyto Rating	Phyto Rating	Phyto Rating	Phyto Rating
Control	0	A	1	0	0	0	2	1
Control	0	A	2	0	0	0	2	2
Control	0	A	3	0	0	0	3	2
Control	0	B	1	0	0	0	2	2
Control	0	B	2	0	0	0	3	2
Control	0	B	3	0	0	0	1	1
Control	0	C	1	0	0	0	2	1
Control	0	C	2	0	0	0	3	3
Control	0	C	3	0	0	0	3	2
1x	3.5	A	1	0	0	0	3	2
1x	3.5	A	2	0	0	0	2	1
1x	3.5	A	3	1	0	0	2	2
1x	3.5	B	1	0	0	0	1	2
1x	3.5	B	2	1	0	0	2	2
1x	3.5	B	3	1	0	0	3	3
1x	3.5	C	1	1	0	0	2	3
1x	3.5	C	2	1	0	0	2	3
1x	3.5	C	3	0	0	0	2	2
2x	7	A	1	1	0	0	1	2
2x	7	A	2	1	0	0	2	2
2x	7	A	3	0	0	0	2	1
2x	7	B	1	0	0	0	1	3
2x	7	B	2	1	0	0	2	3
2x	7	B	3	1	0	0	1	2
2x	7	C	1	1	0	0	3	3
2x	7	C	2	1	0	0	2	3
2x	7	C	3	0	0	0	2	1
4x	14	A	1	1	0	0	4	4
4x	14	A	2	1	0	0	2	2
4x	14	A	3	1	0	0	2	3
4x	14	B	1	1	0	0	1	2
4x	14	B	2	1	0	0	3	3
4x	14	B	3	1	0	0	3	3
4x	14	C	1	1	0	0	2	3
4x	14	C	2	1	0	0	1	2
4x	14	C	3	0	0	0	0	1

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

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

Verbena- phyto trial with Polyoxin D				9/8/04	9/8/04	9/21/04	9/21/04	10/6/04	10/6/04	10/20/04	10/20/04	11/4/04
Trtmt	Rate	Block	Rep	Plant	Plant	Plant	Plant	Plant	Plant	Plant	Plant	Plant
	oz./100gal			Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)	Width (cm)
Cntrl	0	A	1	15	15	41	28	87	91	90	80	120
Cntrl	0	A	2	15	15	48	35	113	85	90	109	150
Cntrl	0	A	3	15	15	48	44.5	98	91	102	79	120
Cntrl	0	B	1	15	15	45	37	105	73	102	88	150
Cntrl	0	B	2	15	15	46	42	94	83	113	102	150
Cntrl	0	B	3	15	15	49	36.5	92	87	109	100	180
Cntrl	0	C	1	15	15	50	47	93	92	98	95	140
Cntrl	0	C	2	15	15	44	45	80	75	120	100	170
Cntrl	0	C	3	15	15	53	59	90	86	100	97	150
1x	3.5	A	1	15	15	41	39	70	89	108	95	175
1x	3.5	A	2	15	15	51	43	86	80	97	98	140
1x	3.5	A	3	15	15	44	32	100	66	95	100	150
1x	3.5	B	1	15	15	45	27	100	90	97	89	190
1x	3.5	B	2	15	15	41.5	37.5	90	87	98	68	180
1x	3.5	B	3	15	15	48	31	94	94	106	90	190
1x	3.5	C	1	15	15	44	37	105	95	100	92	190
1x	3.5	C	2	15	15	35	35	73	74	101	90	165
1x	3.5	C	3	15	15	40	35	90	84	101	118	180
2x	7	A	1	15	15	42	42.5	93	73	107	96	200
2x	7	A	2	15	15	44	34	80	79	110	100	174
2x	7	A	3	15	15	43	35	82	86	100	100	145
2x	7	B	1	15	15	43	41	98	79	102	102	170
2x	7	B	2	15	15	33.5	33.5	72	73	100	92	162
2x	7	B	3	15	15	43	36	80	69	110	100	185
2x	7	C	1	15	15	34	35	90	75	127	108	155
2x	7	C	2	15	15	42.5	33	80	83	92	100	142
2x	7	C	3	15	15	46	37	73	70	105	100	166
4x	14	A	1	15	15	41	38	110	92	97	75	160
4x	14	A	2	15	15	43	38	100	94	109	100	164
4x	14	A	3	15	15	42	39	93	95	112	95	185
4x	14	B	1	15	15	31	23	79	70	96	100	172
4x	14	B	2	15	15	31	32	85	80	96	105	160
4x	14	B	3	15	15	46	42	90	84	120	100	200
4x	14	C	1	15	15	38	31.5	69	80	116	102	170
4x	14	C	2	15	15	31	29	75	63	85	86	130
4x	14	C	3	15	15	30.5	28	87	80	108	109	150