Addendum to DER of 3/11/86 by Tom Armitage

1. Chemical: Permethrin

2. Test Material: Technical permethrin (FMC 33297, 95.7% ai)

3. Study Type: Fish full life cycle (egg to egg)

   Species tested: Fathead minnow
   (Pimephales promelas)

4. Study ID: FMC Corp. Pounce Technical Insecticide. EPA Reg. No. 279-3014. Ecological Effects Data Call-In, Fish Life Cycle Study, Supplementary Information. EPA Acc. No. 263993. (Addendum to EPA Acc. No. 096699).

5. Review By:

   Ann Stavola
   Aquatic Biologist
   Ecological Effects Branch
   Hazard Evaluation Division (TS-769-C)

   Signature: Ann Stavola
   Date: 29 Jan 87

6. Approved By:

   Douglas J. Urban
   Head - Section III
   Ecological Effects Branch
   Hazard Evaluation Division (TS-769-C)

   Signature: Douglas J. Urban
   Date: 1/30/87

7. Conclusions: The MATC of permethrin to fathead minnows is > 0.30 < 0.41 ug/l based on the reduced survivability of first and second generation 30 day old fry. Based on the additional data supplied by FMC to answer EEB's concerns in the DER of 3/11/86. The study is scientifically sound and fulfills the guideline requirement for a fish full life-cycle study.

8. Background: FMC submitted information to address EEB's comments in the DER of 3/11/86 by T. Armitage. EEB had requested data on: raw data on length and weight, justification for the use of DMSO as a solvent; and study parameters including temperature readings, checks of diluter operation, source of eggs and numbers of discarded fish.

9. Reviewer's Discussion

A. Test Procedures: EEB originally stated that the eggs used to initiate the study must come from at least 3 different females. FMC responded that since the average number of eggs per spawn for fathead minnows is 150 to 250 and that the test began with 14 chambers each holding 60 eggs (840 eggs total) more than 3 females were needed to provide the eggs.

FMC submitted sufficient information to show that the temperature of the system was recorded on a regular basis and maintained within an acceptable range of 22°c to 24°c; and the operation of the diluter was checked daily, and the cycles of test solution per 24 hours were recorded.

The EEB review stated the DMSO should not have been the solvent. However, at the time the study was conducted (1976) DMSO was an acceptable solvent. According to EPA guidelines the concentration of an organic solvent in a flow-through system should not exceed 0.1 ml/L (100 ppm). The highest concentration of DMSO in this study was 7.2 mg/l, which is in the acceptable range.

FMC submitted photos to demonstrate that numbers deformed were noted and discarded prior to selecting 15 first generation fish for each spawning chamber. There were two fish with scoliosis at 60 days, one in the solvent control group and one in the group exposed to 0.23 ug/l, measured concentration (0.5 ug/l nominal concentration).

B. Statistics: The most significant deficiency was the failure to include the raw data particularly on lengths and weights of fish so the reported results could be verified. The data for lengths of 30 day first generation (F_0) fish and second generation (F_1) fish and lengths and weights of 60 day and 246 day F_0 fish were analyzed by one-way ANOVA. Percent hatchability and percent survivability of 30 day F_0 and F_1 fish were also analyzed by one-way ANOVA using an arcsine transformation. The comparisons among the means of the treatment groups were done with Duncan's procedure. The results of these several analyses are attached and are self-explanatory.

Although the study authors did not include the growth data from the fish exposed to the highest permethrin concentration, these fish were included in EEB's analyses.

C. Results: EEB's analysis confirms the author's conclusions that effects on growth at 30 days, 60 days and 246 days for the first generation and at 30 days for the second generation were not statistically different. In addition, there was no effect on the percent of the first generation eggs that hatched. However, the survivability of fry that survived to 30 days for both generations was significantly reduced in the groups exposed to 0.41 ug/l, measured concentrations. As stated in our earlier review, the MATC of permethrin to fathead minnows is $> 0.30 \leq 0.41$ ug/l.

D. Adequacy Study

1. Category - Core

2. Rationale - The new informatin submitted by the registrant has successfully answered EEB's concerns in the DER of 3/11/86. The study is now determined to fulfill the Guidelines requirement for a fish full life-cycle study.

Table 1 -- Effects on first generation fathead minnows during the initial 63 days exposure to FMC 33297 (F0)

Nominal concentration (ug/l)	0-35 days: Measured concentration (ug/l)		0-35 days: Mean total length (mm)	0-63 days: Measured concentration (g)		0-63 days: Mean total length (mm)	0-63 days: Mean weight (g)
1.0-1.5	0.41 ± 0.12	A	--	0.55 ± 0.33	A	--	--
		B	--		B	--	--
0.5-0.75	0.14 ± 0.061	A	24	0.23 ± 0.12	A	29	0.23
		B	26		B	32	
0.25-0.38	0.092 ± 0.050	A	24	0.17 ± 0.066	A	29	0.21
		B	24[a]		B	29	
0.13-0.19	<0.032 ± 0.022	A	25	0.83 ± 0.066	A	31	0.23
		B	24[a]		B	30	
0.063-0.094	<0.023 ± 0.023	A	24	<0.043 ± 0.038	A	30	0.27
		B	26		B	30	
	sol. control		23	sol. control	A	28	0.22
			25[a]		B	31	
	control		24	control	A	29	0.21
			27		B	32	

[a] Indicates that average measurements of replicates A and B are significantly (P<0.05) different from controls.

Table 2 -- Total lengths and weights of males and females after 246 days exposure to FMC 33297 (F_0)

Nominal concentration (ug/l)	Mean measured concentration (ug/l)		Total length (mm) male	Total length (mm) female	Wet weight (g) male	Wet weight (g) female
1.0-1.5	0.87 ± 0.42	A	--	--	--	--
		B	--	--	--	--
0.50-0.75	0.36 ± 0.26	A	70	56	5.20	1.87
		B	69	52	4.39	1.51
0.25-0.38	0.25 ± 0.21	A	61	53	3.25	1.58
		B	69	53	4.21	1.64
0.13-0.19	0.17 ± 0.19	A	70	53	5.06	1.66
		B	72	52	5.34	1.69
0.063-0.094	<0.087 ± 0.011	A	69	51	4.92	1.36
		B	71	53	5.09	1.50
solvent control		A	67	53	4.71	1.73
		B	72	54	5.61	1.80
control		A	66	52	4.42	1.60
		B	65	53	4.00	1.62

Table 3 -- Growth of second generation fry of fathead minnow continuously exposed to FMC 33297. (F1)

Nominal concentration (ug/l)	Mean measured concentration (ug/l)		30 day old fry Total length (mm)	30 day old fry Wet weight (g)
1.5	0.91 ± 0.47	A	--	--
		B	--	--
0.75	0.41 ± 0.34	A	25	0.14
		B	23[a]	
0.38	0.30 ± 0.26	A	20	0.08
		B	20[b]	
0.19	0.17 ± 0.15	A	21	0.09
		B	22	
0.094	>0.11 ± 0.12	A	22	0.11
		B	20[b]	
	sol. control	A	23	0.11
		B	21	
	control	A	22	0.10
		B	23	

[a] Indicates that average measurements of replicates A and B are significantly ($P<0.05$) greater than controls.

[b] Indicates that average measurements of replicates A and B are significantly ($P<0.05$) less than controls.

PERCENTAGE HATCH OF EGGS AND SURVIVAL AND GROWTH OF FIRST GENERATION FATHEAD MINNOW (Pimephales promelas) CONTINUOUSLY EXPOSED TO FMC-33297

Mean measured concentration (ug/l) *		Hatch (%)	30 days survival (%)	30 days total length (mm)	60 days survival (%)	60 days total length (mm)	60 days wet weight (g)	Mean meas. Conc (ug/l)
~~0.79~~	A	88	8	25 ± 3	8	32 ± 3	-	0.55 [b]
0.41 [a]	B	92	3	25 (1 fish)	3	36 (1 fish)	-	
~~0.29~~	A	92	93	24 ± 2	93	29 ± 4	0.21	0.23
0.14	B	88	70	26 ± 3	70	32 ± 3	0.25	
~~0.20~~	A	93	73	24 ± 2	73	29 ± 3	0.23	0.17
0.092	B	97	93	24 ± 2	93	29 ± 3	0.19	
~~0.066~~	A	85	70	25 ± 3	68	31 ± 4	0.24	0.83
<0.032	B	93	75	24 ± 2	75	30 ± 2	0.21	
~~0.055~~	A	92	68	24 ± 2	68	30 ± 3	0.25	<0.043
<0.023	B	88	50	26 ± 3	50	30 ± 3	0.28	
Solvent control	A	95	95	23 ± 2	95	28 ± 3	0.20	
	B	77	85	25 ± 4	85	31 ± 4	0.23	
Control	A	97	95	24 ± 2	95	29 ± 2	0.20	
	B	83	63	27 ± 2	63	32 ± 3	0.25	

Note from reviewer: These measured concentrations are not reported as indicated here anywhere else in the data package. For the purpose of consistency the written concentrations will be considered the correct ones.

a- concentrations for 30 days exposure (from Table 1)

b- concentrations for 60 days exposure (from Table 2)

Reproduction from fathead minnows continuously exposed to FMC-33297 for 235 days.

Nominal concentrations (ug/ℓ)		total spawns	total eggs	eggs/spawn	number females	spawns/female	eggs/female	
1.5		(no female survivors)			0			
0.75	A	40	6,966	174	5	8	1393	1975
	B	68	17,892	263	7	10	2556	
0.38	A	36	7,521	209	6	6	1254	1966
	B	63	16,059	255	6	10	2677	
0.19	A	26	3,391	130	3	9	1130	1356
	B	46	9,485	206	6	8	1581	
0.094	A	31	6,533	211	6	5	1089	212
	B	21	4,002	191	3	7	1334	
solvent control	A	54	13,136	243	7	8	1877	1754
	B	38	9,784	257	6	9	1631	
control	A	55	10,166	185	7	8	1452	1749
	B	35	8,179	234	4	6	2045	

Percentage hatch of eggs and percentage survival of fry from fathead minnows continuously exposed to FMC-33297 (F1)

Nominal concentration (ug/ℓ)		Hatch (%) Mean ± S.D.	(N)[a]	30 day fry survival (%) exposed parents	control parents	transferred to control
1.5	A	93±11[b]	(3)	-	0	-
	B	93±9[b]	(3)	-	0	-
0.75	A	86±12	(10)	20	33	~~88c~~ 98
	B	90±10	(10)	28	40	~~55c~~ 58
0.38	A	87±12	(10)	78		
	B	92±6	(10)	88		
0.19	A	91±6	(10)	85		
	B	91±9	(10)	98		
0.094	A	96±4	(10)	60		
	B	88±11	(10)	65		
solvent control	A	93±4	(10)	65		
	B	87±12	(10)	75		
control	A	97±3	(10)	63		
	B	94±6	(10)	78		

[a] number of groups of 50 eggs incubated
[b] eggs spawned in control aquaria
[c] groups with 7-10 days exposure remaining

o/o hatch
To

OBS	TRT	RESPONSE	ARS	EFFECT
1	A	88	1.21705	69.7040
2	A	92	1.28404	73.5405
3	B	92	1.28404	73.5405
4	B	88	1.21705	69.7040
5	C	93	1.30303	74.6283
6	C	97	1.39671	79.9936
7	D	85	1.17310	67.1865
8	D	93	1.30303	74.6283
9	E	92	1.28404	73.5405
10	E	88	1.21705	69.7040
11	F	95	1.34528	77.0480
12	F	77	1.07062	61.3171
13	G	97	1.39671	79.9936
14	G	83	1.14581	65.6235

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	7	A B C D E F G

NUMBER OF OBSERVATIONS IN DATA SET = 14

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: EFFECT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	6	76.50791161	12.75131860	0.31	0.9145	0.208101	8.9381
ERROR	7	291.14027184	41.59146741		ROOT MSE		EFFECT MEAN
CORRECTED TOTAL	13	367.64818345			6.44914470		72.15373723

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	6	76.50791161	0.31	0.9145	6	76.50791161	0.31	0.9145

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: EFFECT

NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE, NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=7 MSE=41.5915

NUMBER OF MEANS	2	3	4	5	6	7
CRITICAL RANGE	15.238	15.8501	16.1791	16.3424	16.4359	16.484

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	77.311	2	C
A			
A	72.809	2	G
A			
A	71.622	2	B
A			
A	71.622	2	A
A			
A	71.622	2	E
A			
A	70.907	2	D
A			
A	69.183	2	F

ug/l - meas. conc
0.092
Control
0.14
0.41
<0.023
<0.032
Solv. Control

30day + 60day

FD

o/o Survivability

SAS 9:01 WEDNESDAY, JANUARY 14, 1987 1

OBS	TRT	RESPONSE	ARS	EFFECT
1	A	8	0.28676	16.4233
2	A	3	0.17408	9.9702
3	B	93	1.30303	74.6283
4	B	70	0.99116	56.7662
5	C	73	1.02440	58.6699
6	C	93	1.30303	74.6283
7	D	70	0.99116	56.7662
8	D	75	1.04720	59.9759
9	E	68	0.96953	55.5277
10	E	50	0.78540	44.9819
11	F	95	1.34528	77.0480
12	F	85	1.17310	67.1865
13	G	95	1.34528	77.0480
14	G	63	0.91691	52.5139

SAS 9:01 WEDNESDAY, JANUARY 14, 1987 2

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	7	A B C D E F G

NUMBER OF OBSERVATIONS IN DATA SET = 14

SAS 9:01 WEDNESDAY, JANUARY 14, 1987 3

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: EFFECT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	6	4829.86347182	804.97724530	7.85	0.0078	0.870577	18.1287
ERROR	7	718.02628742	102.57518392		ROOT MSE		EFFECT MEAN
CORRECTED TOTAL	13	5547.88975924			10.12794075		55.86674046

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	6	4829.86347182	7.85	0.0078	6	4829.86347182	7.85	0.0078

SAS 9:01 WEDNESDAY, JANUARY 14, 1987 4

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: EFFECT

NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE, NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=7 MSE=102.575

NUMBER OF MEANS	2	3	4	5	6	7
CRITICAL RANGE	23.9302	24.8915	25.4081	25.6647	25.8114	25.8869

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

Means Conc (ug/l)

DUNCAN GROUPING	MEAN	N	TRT	
A	72.12	2	F	Solv-control.
A				
A	66.65	2	C	0.092
A				
A	65.70	2	B	0.14
A				
A	64.78	2	G	Control
A				
A	58.37	2	D	0.032
A				
A	50.25	2	E	0.023
B	13.20	2	A	0.41

SAS 9:01 WEDNESDAY, JANUARY 14, 1987 5

VARIABLE N MEAN STANDARD MINIMUM MAXIMUM STD ERROR

30 day To length

NUMBER OF OBSERVATIONS IN DATA SET = 370

GENERAL LINEAR MODELS PROCEDURE

RIABLE: RESPONSE

	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
	6	124.53806608	20.75634435	3.11	0.0055	0.048961	10.5159
	363	2419.08625825	6.66414947		ROOT MSE		RESPONSE MEAN
TAL	369	2543.62432432			2.58150140		24.54864865

DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
6	124.53806608	3.11	0.0055	6	124.53806608	3.11	0.0055

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=363 MSE=6.66415

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=20.0006

NUMBER OF MEANS	2	3	4	5	6	7
CRITICAL RANGE	1.62167	1.70529	1.75909	1.79951	1.83353	1.86133

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	25.3810	63	G control
A			
A	25.0000	4	A 0.41
A			
A	24.9839	62	B 0.14
A			
A	24.9574	47	E 0.023
A			
A	24.2931	58	D 0.032
A			
A	24.0563	71	F Solv. Control
A			
A	23.7692	65	C 0.092

meas. conc ug/l

N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TRT=A								
4	25.00000000	3.16227766	22.00000000	29.00000000	1.58113883	100.00000000	10.00000000	12.649
TRT=B								
62	24.98387097	2.68872531	18.00000000	31.00000000	0.34146846	1549.0000000	7.22924379	10.762
TRT=C								
65	23.76923077	2.11961989	18.00000000	28.00000000	0.26290649	1545.0000000	4.49278846	8.917
TRT=D								
58	24.29310345	2.54095313	19.00000000	30.00000000	0.33364349	1409.0000000	6.45644283	10.460
TRT=E								
47	24.95744681	2.52773697	20.00000000	30.00000000	0.36870838	1173.0000000	6.38945421	10.128

353	G	32
354	G	31
355	G	31
356	G	32
357	G	34
358	G	31
359	G	34
360	G	35
361	G	31
362	G	32
363	G	33
364	G	31
365	G	32
366	G	32

Length
60 day Fo

1 SAS 9:01 FRIDAY, JANUARY 9, 1987 8

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	7	A B C D E F G

NUMBER OF OBSERVATIONS IN DATA SET = 366

1 SAS 9:01 FRIDAY, JANUARY 9, 1987 9

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	6	131.84069983	21.97344997	2.03	0.0609	0.032821	10.9706
ERROR	359	3885.09099416	10.82198049		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	365	4016.93169399			3.28967787		29.98633880

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	6	131.84069983	2.03	0.0609	6	131.84069983	2.03	0.0609

1 SAS 9:01 FRIDAY, JANUARY 9, 1987 10

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE

NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE, NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=359 MSE=10.822

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=19.9336

NUMBER OF MEANS	2	3	4	5	6	7
CRITICAL RANGE	2.07001	2.17674	2.24542	2.29702	2.34044	2.37593

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	33.250	4	A 0.55
B	30.517	60	B 0.23
B			
B	30.250	56	D 0.83
B			
B	30.210	62	G Control
B			
B	30.191	47	E 0.043
B			
B	29.676	71	F Solventcontrol
B			
B	29.061	66	C 0.17

1 SAS 9:01 FRIDAY, JANUARY 9, 1987 10

Weight
60 day FO

1	A	0.21
2	A	0.25
3	B	0.23
4	B	0.19
5	C	0.24
6	C	0.21
7	D	0.25
8	D	0.28
9	E	0.20
10	E	0.23
11	F	0.20
12	F	0.25

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

NUMBER OF OBSERVATIONS IN DATA SET = 12

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	5	0.00376667	0.00075333	1.08	0.4568	0.472803	11.5872
ERROR	6	0.00420000	0.00070000		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	11	0.00796667			0.02645751		0.22833333

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	5	0.00376667	1.08	0.4568	5	0.00376667	1.08	0.4568

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=6 MSE=7.0E-04

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	0.0647401	0.0671006	0.0681958	0.0687505	0.0690044

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	0.26500	2	D ca 043
A			
A	0.23000	2	A 0.23
A			
A	0.22500	2	C 0.83
A			
A	0.22500	2	F ~~Sol~~ Control
A			
A	0.21500	2	E Solu Control
A			
A	0.21000	2	B 0.17

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.

TRT=A

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	5	46.16691191	9.23338238	1.45	0.2198	0.111216	4.7742
ERROR	58	368.94246309	6.36107695		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	63	415.10937500			2.52211755		52.82812500

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	5	46.16691191	1.45	0.2198	5	46.16691191	1.45	0.2198

246 day
To
female
length

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=58 MSE=6.36108

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=10.4641

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	2.20853	2.32219	2.39719	2.45034	2.49466

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT	Mean Conc ug/l
A	53.750	12	A	0.36
A				
A	53.692	13	E	Solv. control
A				
B A	52.800	10	B	0.25
B A				
B A	52.556	9	C	0.17
B A				
B A	52.364	11	F	Control
B				
B	51.222	9	D	0.09

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TRT=A									
RESPONSE	12	53.75000000	2.70100991	49.00000000	58.00000000	0.77971440	645.00000000	7.29545455	5.025
TRT=B									
RESPONSE	10	52.80000000	1.93218357	51.00000000	56.00000000	0.61101009	528.00000000	3.73333333	3.659
TRT=C									
RESPONSE	9	52.55555556	2.55495162	50.00000000	56.00000000	0.85165054	473.00000000	6.52777778	4.861
TRT=D									
RESPONSE	9	51.22222222	3.70060055	45.00000000	57.00000000	1.23353352	461.00000000	13.69444444	7.225
TRT=E									
RESPONSE	13	53.69230769	2.21301511	51.00000000	58.00000000	0.61377996	698.00000000	4.89743590	4.122
TRT=F									
RESPONSE	11	52.36363636	1.85864075	50.00000000	56.00000000	0.56040127	576.00000000	3.45454545	3.549

246 day
F0
males-length

27	E	67
28	E	70
29	F	68
30	F	69
31	F	64
32	F	76
33	F	69
34	F	70
35	G	75
36	G	64
37	G	60
38	G	64
39	G	65
40	G	66

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	7	A B C D E F G

NUMBER OF OBSERVATIONS IN DATA SET = 40

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	6	413.84285714	68.97380952	3.44	0.0095	0.384648	6.4494
ERROR	33	662.05714286	20.06233766		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	39	1075.90000000			4.47910010		69.45000000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	6	413.84285714	3.44	0.0095	6	413.84285714	3.44	0.0095

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE, NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=33 MSE=20.0623

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=5.55766

NUMBER OF MEANS	2	3	4	5	6	7
CRITICAL RANGE	5.46471	5.744	5.93396	6.05712	6.15796	6.23858

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT	
A	77.000	4	A	0.87
B	71.000	6	D	<0.087 0.17
B				
B	70.143	7	E	~~Solv Control~~ <0.087
B				
B	69.333	6	F	control-solv.
B				
B	69.333	6	B	0.36
B				
B	65.667	6	G	~~0.~~ control
B				
B	65.400	5	C	0.25

Fo:

246 day
Females-weight

OBS	TRT	RESPONSE
53	E	1.73
54	F	1.89

OBS	TRT	RESPONSE
55	F	1.78
56	F	1.40
57	F	1.63
58	F	1.52
59	F	1.54
60	F	1.43
61	F	1.60
62	F	1.36
63	F	1.81
64	F	1.71

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

NUMBER OF OBSERVATIONS IN DATA SET = 64

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	5	0.72391605	0.14478321	2.11	0.0766	0.154087	16.0545
ERROR	58	3.97416989	0.06852017		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	63	4.69808594			0.26176358		1.63046875

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	5	0.72391605	2.11	0.0766	5	0.72391605	2.11	0.0766

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE

NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=58 MSE=.0685202

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=10.4641

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	0.229217	0.241014	0.248797	0.254314	0.258913

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

Meas conc ug/l

DUNCAN GROUPING	MEAN	N	TRT	
A	1.7615	13	E	Solu Control
A				
A	1.6789	9	C	0.17
A				
A	1.6625	12	A	0.36
A				
B A	1.6070	10	B	0.25
B A				
B A	1.6064	11	F	control
B				
[illegible]	[illegible]	2	D	0.089

246 day
Fo
males-weight

29	F	5.15
30	F	4.73
31	F	4.26
32	F	6.33
33	F	5.14
34	F	5.36
35	G	6.17
36	G	4.00
37	G	3.08
38	G	3.87
39	G	4.18
40	G	3.97

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	7	A B C D E F G

NUMBER OF OBSERVATIONS IN DATA SET = 40

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	6	11.25123714	1.87520619	1.85	0.1191	0.251932	20.9009
ERROR	33	33.40852286	1.01237948		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	39	44.65976000			1.00617070		4.81400000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	6	11.25123714	1.85	0.1191	6	11.25123714	1.85	0.1191

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=33 MSE=1.01238

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=5.55766

NUMBER OF MEANS	2	3	4	5	6	7
CRITICAL RANGE	1.22757	1.29031	1.33299	1.36065	1.3833	1.40141

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT	
A	5.5750	4	A	0.87
A				
B A	5.1983	6	D	0,17
B A				
B A	5.1617	6	F	Solv. Control
B A				
B A	4.9929	7	E	0.087
B A				
B A	4.7950	6	B	0.36
B A				
B A	4.2117	6	G	Control
B				
B	3.8220	5	C	0.25

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CARY, N.C. 27511-8000

% Survivability - 2nd gener. - F1 - 30 day

1 SAS 15:34 WEDNESDAY, JANUARY 14, 1987

OBS	TRT	RESPONSE	ARS	EFFECT
1	A	20	0.46365	26.5544
2	A	28	0.55760	31.9352
3	B	78	1.08259	62.0029
4	B	88	1.21705	69.7040
5	C	85	1.17310	67.1865
6	C	98	1.42890	81.8370
7	D	60	0.88608	50.7481
8	D	65	0.93774	53.7072
9	E	65	0.93774	53.7072
10	E	75	1.04720	59.9759
11	F	63	0.91691	52.5139
12	F	78	1.08259	62.0029

1 SAS 15:34 WEDNESDAY, JANUARY 14, 1987

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

NUMBER OF OBSERVATIONS IN DATA SET = 12

1 SAS 15:34 WEDNESDAY, JANUARY 14, 1987

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: EFFECT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.
MODEL	5	2344.27648348	468.85529670	12.76	0.0038	0.914029	10.82
ERROR	6	220.49615785	36.74935964		ROOT MSE		EFFECT ME
CORRECTED TOTAL	11	2564.77264133			6.06212501		55.989590

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR >
TRT	5	2344.27648348	12.76	0.0038	5	2344.27648348	12.76	0.0

1 SAS 15:34 WEDNESDAY, JANUARY 14, 1987

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: EFFECT
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=6 MSE=36.7494

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	14.8337	15.3745	15.6255	15.7526	15.8107

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT	Means - Conc (mg/l)
A	74.512	2	C	0.17
A				
B A	65.853	2	B	0.30
B				
B	57.258	2	F	Cont.
B				
B	56.842	2	E	Solv. cont.
B				
B	52.228	2	D	0.11
C	29.245	2	A	Solvent 0.41

1 SAS 15:34 WEDNESDAY, JANUARY 14, 1987

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

. Length 3 day F1

NUMBER OF OBSERVATIONS IN DATA SET = 319

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQ
MODEL	5	411.75011949	82.35002390	8.76	0.0001	0.12
ERROR	313	2944.06806233	9.40596825		ROOT MSE	
CORRECTED TOTAL	318	3355.81818182			3.06691510	

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F
TRT	5	411.75011949	8.76	0.0001	5	411.75011949	

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE

NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE, NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=313 MSE=9.40597

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=42.8204

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	1.31671	1.3846	1.42828	1.4611	1.48872

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

Mean Conc

DUNCAN GROUPING	MEAN	N	TRT	
A	24.0000	18	A	0.41 ug/l
B	22.4107	56	F	Control
B				
C B	21.9643	56	E	Solvent Control
C B				
C B	21.4247	73	C	0.17
C				
C D	20.6600	50	D	3.11
D				
D	19.7121	66	B	0.30 ug/l

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARI
TRT=A								
RESPONSE	18	24.00000000	1.84709629	20.00000000	27.00000000	0.43536477	432.00000000	3.4117
TRT=B								
TRT=F								
RESPONSE	2	97.85000000	2.47487373	96.10000000	99.60000000	1.75000000	195.70000000	6.1250

? 1 221/1

1

F1
30 day-weight

OBS	TRT	RESPONSE
1	A	163.1
2	A	109.3
3	B	77.8
4	B	76.1
5	C	91.2
6	C	88.3
7	D	86.2
8	D	72.4
9	E	112.4
10	E	99.0
11	F	96.1
12	F	99.6

1

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

NUMBER OF OBSERVATIONS IN DATA SET = 12

1

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESPONSE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	5	4757.12750000	951.42550000	3.47	0.0808	0.743171	16.9556
ERROR	6	1643.99500000	273.99916667		ROOT MSE		RESPONSE MEAN
CORRECTED TOTAL	11	6401.12250000			16.55292019		97.62500000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
TRT	5	4757.12750000	3.47	0.0808	5	4757.12750000	3.47	0.0808

1

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESPONSE
NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=6 MSE=273.999

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	40.5041	41.9809	42.6661	43.0132	43.172

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING		MEAN	N	TRT	meas. conc ug/L
	A	136.20	2	A	0.41
	A				
B	A	105.70	2	E	Solvent Control
B	A				
B	A	97.85	2	F	Control
B					
B		89.75	2	C	0.17
B					
B		79.30	2	D	0.11
B					
B		76.95	2	B	0.30

1

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.