

US EPA ARCHIVE DOCUMENT

9-8-94

DP Barcode : D205890
PC Code No : 038901
EEB Out : / /

To: Kathryn Davis
Product Manager 52
Special Review and Reregistration Division (7508W)

From: Anthony F. Maciorowski, Chief
Ecological Effects Branch/EFED (7507C)

Attached, please find the EEB review of...

Reg./File # : 038901
Chemical Name : Endothall
Type Product : herbicide
Product Name :
Company Name :
Purpose : Review fish ELS study.

Action Code: 606
Reviewer: Dennis McLane

Date Due: 10/24/94

EEB Guideline/MRID Summary Table: The review in this package contains an evaluation of the following:

NO	D NO	N NO	D NO	N NO	NO	T
71-1 (A)		72-2 (A)		72-7 (A)		
71-1 (B)		72-2 (B)		72-7 (B)		
71-2 (A)		72-3 (A)		122-1 (A)		
71-2 (B)		72-3 (B)		122-1 (B)		
71-3		72-3 (C)		122-2		
71-4 (A)		72-3 (D)		123-1 (A)		
71-4 (B)		72-3 (E)		123-1 (B)		
71-5 (A)		72-3 (F)		123-2		
71-5 (B)		72-4 (A)	43295401 y	124-1		
72-1 (A)		72-4 (B)		124-2		
72-1 (B)		72-5		141-1		
72-1 (C)		72-6		141-2		
72-1 (D)				141-5		

Y=Acceptable (Study satisfied Guideline)/Concur
P=Partial (Study partially fulfilled Guideline but additional information is needed)
S=Supplemental (Study provided useful information but Guideline was not satisfied)
N=Unacceptable (Study was rejected)/Nonconcur

DP BARCODE: D205890

REREG CASE # 2245

CASE: 818815
SUBMISSION: S470549

DATA PACKAGE RECORD
BEAN SHEET

DATE: 07/26/94
Page 1 of 1

*** CASE/SUBMISSION INFORMATION ***

CASE TYPE: REREGISTRATION ACTION: 606 GENERIC DATA
CHEMICALS: 038901 Endothall

ID#: 038901-

COMPANY:

PRODUCT MANAGER: 52 KATHRYN DAVIS 703-308-8156 ROOM: CS1 3F3
PM TEAM REVIEWER: SHANAZ BACCHUS 703-308-8065 ROOM: CS1 3RD FL
RECEIVED DATE: 07/08/94 DUE OUT DATE: 10/06/94

*** DATA PACKAGE INFORMATION ***

DP BARCODE: 205890 EXPEDITE: N DATE SENT: 07/26/94 DATE RET.: / /
CHEMICAL: 038901 Endothall
DP TYPE: 999 Miscellaneous Data Package

ASSIGNED TO	CSF:	DATE IN	DATE OUT	ADMIN DUE DATE: 10/24/94
DIV : EFED		7/28/94	/ /	NEGOT DATE: / /
BRAN: EEB		07/28/94	/ /	PROJ DATE: / /
SECT:		/ /	/ /	
REVR :		/ /	/ /	
CONTR:		/ /	/ /	

*** DATA REVIEW INSTRUCTIONS ***

Please review 43295401 to determine whether GDLN# 72-4(a) data requirements are satisfied.

If you have any questions please contact Shan Bacchus at 308-8065.

*** DATA PACKAGE EVALUATION ***

No evaluation is written for this data package

*** ADDITIONAL DATA PACKAGES FOR THIS SUBMISSION ***

DP BC	BRANCH/SECTION	DATE OUT	DUE BACK	INS	CSF	LABEL
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E 100

DATA EVALUATION RECORD
FISH EARLY LIFE-STAGE TEST
GUIDELINE 72-4(A)

1. CHEMICAL: Endothall Shaughnessey #: 038901
2. TEST MATERIAL: Endothall monohydrate Technical Purity: 91.21%
3. CITATION:

Author: Bettencourt, M. J.
Title: Endothall Technical (Acid) -
The Toxicity to Fathead Minnow
Pimephales promelas During an
Early Life-Stage Exposure.
Date: June 10, 1994
Laboratory Report #: 93-1-4567
Any Other Study #: 12442.0692.6149.120
Sponsor: Elf Atochem North America
Laboratory: Springborn Laboratories, Inc.
MRID No.: 43295401

4. REVIEWED BY:

Dennis J. McLane
Section 1
Ecological Effects Branch (7507C)
U.S.E.P.A.

Signature: 

Date: 9-8-94

5. APPROVED BY:

Les W. Touart
Section Head
Ecological Effects Branch (7507C)
U.S.E.P.A.

Signature: 

Date: 9-8-94

6. CONCLUSIONS: This study is fulfills the guideline requirements for an early life-stage study with freshwater fish. Two parameters were affected: total length and wet weight. Both were reduced at the measured concentration of 2.6 mg a.i./L. Hence, the NOEL is 1.3 mg a.i./L and the LOEL is 2.6 mg a.i./L. This would place endothall in the moderately toxic category.

7. ADEQUACY OF THE STUDY:

A. Classification: CORE

B. Rationale: Fulfills the guideline requirements.

C. Reparability: N/A

8. MAJOR GUIDELINE DEVIATIONS:

None

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9. MATERIALS AND METHODS:A. Biological System:

Guideline Criteria	Reported Information
Species: An estuarine fish species, preferably a silversides species or sheepshead minnow (<u>Cyprinodon variegatus</u>).	Fathead Minnow <i>Pimephales promelas</i>
Source	Springborn Laboratories
Age at beginning of test: Embryos 2 to 24 hours old.	Embryos \leq 24 hours old at test initiation.
Replicates: Minimum of 20 embryos per replicate cup, 4 replicates per concentration, Minimum of 30 fish per treatment for post-hatch exposure.	40 embryos per replicate cup, 2 reps. per concentration. yes
Post Hatch: % of embryos that produce live fry must be \geq 50% in each control; % hatch in any control embryo cup must be no more than 1.6 times that in another control cup.	Per cent hatch ranged from 71.6-75% in controls, based on count of viable embryos on day 5 of exposure.
Feeding: Fish should be fed at least twice daily. Fish should not be fed for at least 24 hr prior to termination on day 32.	Fish were fed live brine shrimp nauplii three times daily and twice on weekends. Fish not fed 24 hours prior to termination on day 32.
Counts: At a minimum, live fish should be counted 11, 18, 25, and 32 days after hatching.	Larval survival was estimated at least twice weekly. Per cent survival was determined at test termination (30 days post-hatch).
Controls: Avg. survival at end of test must be \geq 80%. Survival in any control chamber must not be $<$ 70%.	Avg. survival in controls $>$ 80%.

Guideline Criteria	Reported Information
Controls: Negative control and carrier control (when applicable) are required.	Test included negative as solvent was not needed.

Comments:

B. Physical System:

Guideline Criteria	Reported Information
<p>Test Water:</p> <p>1) well or spring provided the source is not polluted;</p> <p>2) Water should be sterilized with ultraviolet irradiation and tested for contaminants;</p> <p>3) Hardness of 40 to 48 mg/L as CaCO₃ and pH of 7.2 to 7.6 is recommended;</p> <p>4) Reconstituted water can be used see ASTM.</p>	<p>1) Untreated well water and aerated;</p> <p>2) Not reported</p> <p>3) 24-28 mg/L and pH 7.0-7.2;</p> <p>4) N/A</p>
<p>Test Temperature: Depends upon test species; should not deviate by more than 2°C from appropriate temperature. For fathead minnow 25°C.</p>	<p>Temperature range of 23°C to 24°C for duration of test.</p>
<p>Photoperiod: Recommend 16L/8D.</p>	<p>16L/8D.</p>
<p>Dosing Apparatus: Intermittent flow proportional diluters or continuous flow serial diluters should be used. A minimum of 5 toxicant concentrations with a dilution factor not greater than 0.5 and controls should be used.</p>	<p>Intermittent flow proportional diluter. Six toxicant concentrations with dilution factor = 0.5, plus control</p>

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Guideline Criteria	Reported Information
<p>Toxicant Mixing: 1) Mixing chamber is recommended but not required; 2) Aeration should not be used for mixing; 3) It must be demonstrated that the test solution is completely mixed before intro. into the test system; 4) Flow splitting accuracy must be within 10%.</p>	<p>1) Mixing chamber positioned over magnetic stirrer; 2) aeration not reported; 3) see Table 2a 4) 52% of the six concentrations measured show in Table 2b exceeded 10% (see attached figure 1)</p>
<p>Test Vessels: All glass or glass with stainless steel frame.</p>	<p>All glass and silicone sealant.</p>
<p>Embryo Cups: 120 ml glass jars with bottoms replaced with 40 mesh stainless steel or nylon screen.</p>	<p>Glass jars (5 cm O.D., 8 cm high) with 40-mesh Nitex screen bottoms.</p>
<p>Flow Rate: Flow rates to larval cups should provide 90% replacement in 8-12 hours. Flow rate must maintain DO at above 75% of saturation and maintain the toxicant level.</p>	<p>90% replacement time of approx. 8 hours. DO maintained at > 86% saturation.</p>
<p>Aeration: Dilution water should be aerated to insure DO concentration at or near 100% saturation. Test tanks and embryo cups should not be aerated.</p>	<p>Dilution water aerated at 100% saturation Test tanks and embryo cups were not aerate.</p>

Comments: Using the criteria of 10% difference between A and B replicates as indication of variability in the concentration, EEB analyzed Table 2b. Between 12 and 26 mg a.i./L 34 measurements differed over 10%. Two from Day 26 to Day 35 and 5 from Day 1 to Day 12. The higher the concentration the more accurate were the concentrations. (see EEB's figure 1 and Graph 1).

C. Chemical System:

Guideline Criteria	Reported Information
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<p>Concentrations: Minimum of 5 concentrations and a control, all replicated, plus solvent control if appropriate.</p> <ul style="list-style-type: none"> - Toxicant conc. must be measured in one tank at each toxicant level every week. - One concentration must adversely affect a life stage and one concentration must not affect any life stage. 	<ul style="list-style-type: none"> - Six concentrations plus control, all replicated twice. - Toxicant conc. measured in all tanks on test days 0, 5, 12, 15, 19, 26, 27, and 35. <p>Dunnett's analysis confirmed differences in weight at two concentrations and at three concentrations for length.</p>
<p>Other Variables:</p> <ol style="list-style-type: none"> 1) DO must be measured at each conc. at least once a week; 2) Monthly pH range < 0.8 pH units. 	<p>DO and pH were measured daily in each aquarium. pH was within acceptable limits for 3.7, 1.9 and 0.94 concentrations, only. The other concentrations and pH differences were 30 mg/L-1.1, 15 mg/L-1.1, 7.5 mg/L-1.2, control-0.9, respectively.</p>
<p>Solvents: Should not exceed 0.1 ml/L in a flow-through system. Following solvents are acceptable: dimethylformamide, triethylene glycol, methanol, acetone, ethanol.</p>	<p>N/A</p>

Comments: No adverse effects noted at any concentration.

10. REPORTED RESULTS:

Guideline Criteria	Reported Information
<p>Data Endpoints must include:</p> <ul style="list-style-type: none"> - Number of embryos hatched; - Time to hatch; - Mortality of embryos, larvae, and juveniles; - Measurement of growth; - Incidence of pathological or histological effects; - Observations of other effects or clinical signs. 	<p>Number of embryos hatched; Not reported Mortality of embryos and larvae; Measurement of growth; Not reported Not reported</p>
<p>Raw data included? (Y/N)</p>	<p>Y</p>

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Effects Data:

Toxicant Conc. (µg/L)		Per cent Hatch		Time to Hatch		Survival (35 days)		Total Length (mm)		Wet weight (gm)	
Nom.	Meas.	A	B	A	B	A	B	A	B	A	B
Ctrl		72	75			83	85	33.0	33.3	.331	.310
0.94	0.88		75			83	75	32.1	32.5	.299	.317
1.9	1.3	77	73			90	88	32.9	32.5	.323	.294
3.7	2.6	75	68			90	93	32.1	31.4	.293	.265
7.5	6.1	75	78			85	88	32.6	32.6	.319	.323
15	13	75	82			78	75	31.7	32.1	.302	.301
30	27	80	77			85	85	30.2	30.3	.277	.249

Time to hatch was not measured.

Toxicity Observations: No adverse effects reported.

Statistical Results:

Statistical Method: Dunnett's

NOEL:13 mg a.i./L LEL: 27 mg a.i./L

Most sensitive endpoint: total length and wet weight

Comments: "Average larval lengths at these treatment levels (i.e., <13 mg a.i./L) ranged from 31.9 mm to 32.7 mm which represented ≤3.9% difference from the length of the control organisms. The average length of organisms exposed to these lower exposure levels established no concentration-effect response. Although statistical differences were indicated at the 13 and 2.6 mg a.i./L treatment levels, these minimal (i.e. ≤3.9%) differences were considered within the range of natural variability for this species and did not indicate a difference of biological significance which is considered an adverse repose to toxicity of the test material. Based on these data and the expectations of natural variability for growth (organism length) of this species, 13 mg a.i./L Engothall technical is considered an accurate estimation of the NOEC for this study."

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"The wet weight of organisms exposed to the remaining lower treatments were statistically similar to the performance of the control organism."

11. Reviewer's Statistical Results:

Statistical Method: Dunnett's

NOEL: 1.3 ppm LEL: 2.6

Most sensitive endpoint: total length and wet weight

Comments: Both length and width show differences from the control at 27 and 2.6 mg a.i./L concentrations. In addition, length shows a difference between the 13 mg a.i./L level and the control. Neither weight or length showed differences between the control and the 6.1 mg a.i./L dose. (see attached SAS printouts) EEB believes that the 6.1 mg a.i./L level is an anomaly. Therefore the NOEL is 1.3 mg a.i./L and the LOEL is 2.6 mg a.i./L.

12. COMPLETION OF ONE-LINER FOR STUDY:

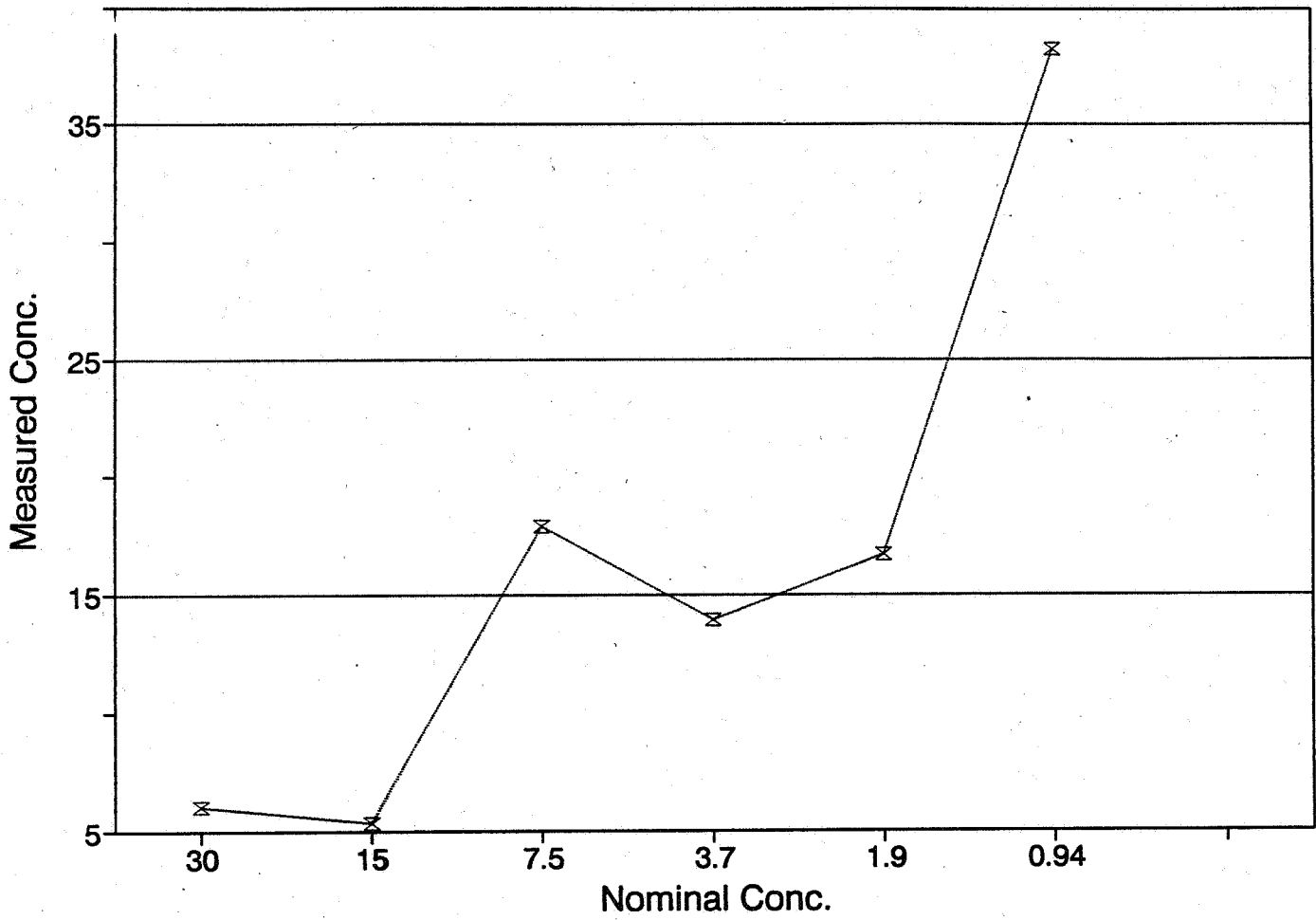
Figure 1
 Fish Early life Study
 Percent Difference Between Measured Concentrations of Endothall

Nominal Conc.	Day 0	1	5	12	15	19	26	27	35	Stat*	Means	
30	28		28	29	29	28	20	26	28	3	27.00	
	28		27	26	25	25	19	25	28		25.38	
	0.00%		3.57%	10.34%	13.79%	10.71%	5.00%	3.85%	0.00%		6.02%	
15	14	14	14	12	14	12	9.5	13	13	2	12.83	
	14	14	14	11	13	12	8.3	11	12		12.14	
	0.00%		0.00%	8.33%	7.14%	0.00%	12.63%	15.38%	7.69%		5.37%	
7.5	7.7		7.9	4	6.9	7.2	4.1	5.6	6.2	5	6.20	
	7.4		7.4	2.3	5.5	6.2	3.7	3.4	4.8		5.09	
	3.90%		6.33%	42.50%	20.29%	13.89%	9.76%	39.29%	22.58%		17.94%	
3.7	3.3		3.4	1.8	2.8	3	1.7	2.4	2.4	5	2.60	
	3		3.3	1.4	2.5	2.1	1.5	2.2	1.9		2.24	
	9.09%		2.94%	22.22%	10.71%	30.00%	11.76%	8.33%	20.83%		13.94%	
1.9	1.5	**	1.5	1.5	1.7	1.3	0.96	1.3	1.4	5	1.40	
	1.5		1.3	1.4	1.3	1.1	0.68	0.71	1.3		1.16	
	0.00%		13.33%	6.67%	23.53%	15.38%	29.17%	45.38%	7.14%		16.76%	
0.94	0.61	**	0.67	0.55	2.4	2.2	0.62	1.6	0.58	0.65	6	1.10
	0.42		0.62	0.47	0.39	1.4	0.57	1.3	0.54	0.39		0.68
	31.15%		14.55%	83.75%	36.36%	8.06%	18.75%	6.90%	40.00%	38.26%		

* The number of times the 10% difference was exceeded for a given concentration.

** The difference between the two replicates exceeds the 10% allowed by the guidelines.

EEB Table 1. Endothall Percentage
Difference Between Replicate A & B



OBS	TRT	RESP
1	a	35
2	a	33
3	a	33
4	a	34
5	a	34
6	a	34
7	a	33
8	a	31
9	a	32
10	a	33
11	a	34
12	a	37
13	a	34
14	a	30
15	a	33
16	a	32
17	a	34
18	a	30
19	a	30
20	a	33
21	a	33
22	a	34
23	a	30
24	a	33
25	a	33
26	a	32
27	a	36
28	a	33
29	a	29
30	a	34
31	a	35
32	a	33
33	a	35
34	a	36
35	a	35
36	a	33
37	a	31
38	a	33
39	a	33
40	a	35
41	a	34
42	a	35
43	a	33
44	a	33
45	a	36
46	a	32
47	a	34
48	a	33
49	a	30
50	a	34
51	a	36
52	a	33
53	a	33
54	a	32
55	a	34
56	a	34
57	a	33
58	a	35
59	a	35
60	a	33
61	a	33
62	a	33
63	a	34

OBS	TRT	RESP
64	a	30
65	a	34
66	a	32
67	a	31
68	b	27
69	b	31
70	b	34
71	b	33
72	b	33
73	b	26
74	b	31
75	b	24
76	b	30
77	b	37
78	b	14
79	b	31
80	b	33
81	b	36
82	b	37
83	b	32
84	b	35
85	b	33
86	b	31
87	b	34
88	b	35
89	b	36
90	b	32
91	b	34
92	b	33
93	b	33
94	b	35
95	b	34
96	b	36
97	b	33
98	b	34
99	b	36
100	b	27
101	b	35
102	b	36
103	b	37
104	b	29
105	b	32
106	b	29
107	b	31
108	b	29
109	b	31
110	b	36
111	b	33
112	b	34
113	b	33
114	b	27
115	b	38
116	b	36
117	b	33
118	b	31
119	b	34
120	b	17
121	b	34
122	b	34
123	b	33
124	b	34
125	b	33
126	b	30

P

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OBS	TRT	RESP
127	b	32
128	b	35
129	b	35
130	b	34
131	b	31
132	b	34
133	c	32
134	c	35
135	c	32
136	c	34
137	c	31
138	c	33
139	c	35
140	c	31
141	c	33
142	c	27
143	c	32
144	c	35
145	c	33
146	c	33
147	c	31
148	c	33
149	c	30
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151	c	34
152	c	37
153	c	35
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164	c	31
165	c	36
166	c	33
167	c	33
168	c	31
169	c	32
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172	c	37
173	c	34
174	c	36
175	c	31
176	c	34
177	c	35
178	c	38
179	c	31
180	c	33
181	c	35
182	c	34
183	c	32
184	c	34
185	c	34
186	c	33
187	c	31
188	c	33
189	c	23

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OBS	TRT	RESP
190	c	30
191	c	31
192	c	32
193	c	31
194	c	29
195	c	27
196	c	36
197	c	32
198	c	30
199	c	34
200	c	34
201	c	32
202	c	33
203	d	32
204	d	30
205	d	32
206	d	32
207	d	31
208	d	34
209	d	36
210	d	34
211	d	33
212	d	31
213	d	32
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220	d	33
221	d	33
222	d	31
223	d	31
224	d	32
225	d	38
226	d	36
227	d	31
228	d	33
229	d	22
230	d	39
231	d	37
232	d	31
233	d	26
234	d	31
235	d	33
236	d	31
237	d	28
238	d	33
239	d	31
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241	d	31
242	d	31
243	d	28
244	d	32
245	d	30
246	d	31
247	d	31
248	d	31
249	d	33
250	d	33
251	d	34
252	d	30

13

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 253 d 30
 254 d 30
 255 d 30
 256 d 30
 257 d 29
 258 d 35
 259 d 28
 260 d 28

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OBS	TRT	RESP
261	d	31
262	d	31
263	d	34
264	d	33
265	d	31
266	d	31
267	d	35
268	d	32
269	d	31
270	d	32
271	d	33
272	d	33
273	d	34
274	d	30
275	d	34
276	e	37
277	e	33
278	e	31
279	e	34
280	e	34
281	e	32
282	e	32
283	e	34
284	e	34
285	e	33
286	e	34
287	e	33
288	e	33
289	e	36
290	e	34
291	e	31
292	e	32
293	e	33
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301	e	35
302	e	20
303	e	31
304	e	34
305	e	35
306	e	33
307	e	33
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309	e	31
310	e	35
311	e	34
312	e	32
313	e	29
314	e	32
315	e	34

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 316 e 34
 317 e 30
 318 e 32
 319 e 31
 320 e 32
 321 e 35
 322 e 34
 323 e 35
 324 e 33
 325 e 30

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OBS	TRT	RESP
326	e	30
327	e	33
328	e	32
329	e	29
330	e	29
331	e	31
332	e	28
333	e	39
334	e	34
335	e	39
336	e	27
337	e	36
338	e	32
339	e	33
340	e	34
341	e	34
342	e	30
343	e	35
344	e	34
345	e	34
346	e	34
347	e	32
348	e	33
349	e	34
350	e	33
351	e	30
352	e	33
353	e	34
354	e	30
355	e	32
356	e	32
357	e	36
358	e	31
359	e	25
360	e	31
361	e	32
362	e	31
363	e	33
364	e	31
365	e	28
366	e	22
367	e	32
368	e	31
369	e	33
370	e	32
371	e	34
372	e	32
373	e	34
374	e	31
375	e	33
376	e	36
377	e	31
378	e	31

4

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 379 F 32
 380 F 32
 381 F 35
 382 F 33
 383 F 35
 384 F 33
 385 F 29
 386 F 30
 387 F 30
 388 F 34
 389 F 31
 390 F 31

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OBS	TRT	RESP
391	F	32
392	F	31
393	F	32
394	F	31
395	F	28
396	F	33
397	F	31
398	F	35
399	F	32
400	F	32
401	F	32
402	F	34
403	F	35
404	F	31
405	F	31
406	F	28
407	F	32
408	F	30
409	F	35
410	F	25
411	F	32
412	F	35
413	F	31
414	F	34
415	F	31
416	F	31
417	F	31
418	F	29
419	F	25
420	F	31
421	F	27
422	F	35
423	F	32
424	F	34
425	F	19
426	F	29
427	F	30
428	F	34
429	F	30
430	F	31
431	F	32
432	F	34
433	F	34
434	F	36
435	F	15
436	F	22
437	F	29
438	F	30
439	F	35
440	F	32
441	F	32

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 442 G 28
 443 G 29
 444 G 29
 445 G 31
 446 G 31
 447 G 30
 448 G 34
 449 G 28
 450 G 26
 451 G 32
 452 G 31
 453 G 32
 454 G 25
 455 G 31

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OBS	TRT	RESP
456	G	32
457	G	28
458	G	31
459	G	30
460	G	31
461	G	29
462	G	30
463	G	29
464	G	31
465	G	34
466	G	29
467	G	36
468	G	26
469	G	32
470	G	31
471	G	32
472	G	26
473	G	31

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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 = 473

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General Linear Models Procedure

Dependent Variable: RESSP

Source	DF	Sum of Squares	F Value	Pr > F
Model	6	368.09185343	7.52	0.0001
Error	466	3803.03711063		
Corrected Total	472	4171.12896406		

Source	DF	Type I SS	F Value	Pr > F
TRT	6	368.09185343	7.52	0.0001
Source	DF	Type III SS	F Value	Pr > F
TRT	6	368.09185343	7.52	0.0001

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General Linear Models Procedure

Dunnett's T tests for variable: RESP

NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.

Alpha= 0.05 Confidence= 0.95 df= 466 MSE= 8.161024
 Critical Value of Dunnett's T= 2.576

Comparisons significant at the 0.05 level are indicated by '***'.

TRT Comparison	Simultaneous		
	Lower Confidence Limit	Difference Between Means	Upper Confidence Limit
c - a	-1.679	-0.421	0.836
e - a	-1.832	-0.570	0.692
b - a	-2.138	-0.856	0.425
f - a	-2.581	-1.279	0.023
d - a	-2.642	-1.397	-0.152
g - a	-4.181	-2.914	-1.647

Dunnett H

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General Linear Models Procedure

Dunnett's One-tailed T tests for variable: RESP

NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.

Alpha= 0.05 Confidence= 0.95 df= 466 MSE= 8.161024
 Critical Value of Dunnett's T= 2.298

Comparisons significant at the 0.05 level are indicated by '***'.

TRT Comparison	Simultaneous		
	Lower Confidence Limit	Difference Between Means	Upper Confidence Limit
c - a	-1.543	-0.421	0.701
e - a	-1.696	-0.570	0.556
b - a	-2.000	-0.856	0.287
f - a	-2.441	-1.279	-0.117

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Dunnett HL

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General Linear Models Procedure

Dunnett's One-tailed T tests for variable: RRESP

NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.

Alpha= 0.05 Confidence= 0.95 df= 466 MSE= 8.161024
 Critical Value of Dunnett's T= 2.298

Comparisons significant at the 0.05 level are indicated by '***'.

TRT Comparison	Simultaneous		
	Lower Confidence Limit	Difference Between Means	Upper Confidence Limit
c - a	-1.543	-0.421	0.701
e - a	-1.696	-0.570	0.556
b - a	-2.000	-0.856	0.287
f - a	-2.441	-1.279	-0.117
d - a	-2.508	-1.397	-0.286
g - a	-4.044	-2.914	-1.784

Dunnett HU

```
option ls=66 ps=70; DATA;
INFIL 'c:\fatwt.dat';
INPUT TRT $ RESP @@;
RUN;
PROC PRINT;
RUN;
PROC GIM;
CLASSES TRT;
MODEL RESP=TRT;
RUN;
MEAN TRT/DUNNETT ('a');
MEAN TRT/DUNNETTL ('a');
MEAN TRT/DUNNETTU ('a'); RUN;
```

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OBS	TRT	RESP
1	a	394.5
2	a	303.6
3	a	314.2
4	a	323.9
5	a	330.0
6	a	425.1
7	a	302.3
8	a	286.8
9	a	317.1
10	a	383.5
11	a	392.2
12	a	381.6
13	a	334.0
14	a	256.8
15	a	428.5
16	a	262.6
17	a	347.0
18	a	261.9
19	a	263.5
20	a	319.4
21	a	277.1
22	a	386.9
23	a	242.3
24	a	299.1
25	a	421.5
26	a	325.3
27	a	213.4
28	a	330.9
29	a	371.1
30	a	326.4
31	a	456.1
32	a	428.8
33	a	378.1
34	a	305.9
35	a	242.3
36	a	293.1
37	a	288.0
38	a	288.0
39	a	387.6
40	a	387.9
41	a	314.0
42	a	326.4
43	a	316.6
44	a	472.8
45	a	255.4
46	a	317.9
47	a	279.5
48	a	196.2
49	a	352.4
50	a	388.4
51	a	265.4
52	a	310.0
53	a	219.7
54	a	257.9
55	a	282.7
56	a	330.5
57	a	363.8
58	a	358.7
59	a	285.0
60	a	331.4
61	a	299.4
62	a	362.1
63	a	210.0

OBS	TRT	RESP
66	a	198.9
67	b	255.9
68	b	258.3
69	b	341.7
70	b	327.1
71	b	310.1
72	b	160.8
73	b	253.3
74	b	114.9
75	b	230.1
76	b	406.2
77	b	19.9
78	b	258.4
79	b	323.8
80	b	433.8
81	b	478.6
82	b	311.8
83	b	407.1
84	b	326.5
85	b	285.3
86	b	362.6
87	b	346.1
88	b	337.5
89	b	317.7
90	b	322.0
91	b	298.8
92	b	292.0
93	b	384.2
94	b	331.7
95	b	380.3
96	b	270.0
97	b	310.8
98	b	230.4
99	b	175.0
100	b	338.9
101	b	416.6
102	b	492.6
103	b	260.8
104	b	300.3
105	b	201.4
106	b	269.9
107	b	227.9
108	b	283.2
109	b	433.3
110	b	317.1
111	b	384.6
112	b	342.5
113	b	204.2
114	b	490.3
115	b	388.7
116	b	318.8
117	b	252.6
118	b	308.7
119	b	43.5
120	b	327.4
121	b	318.5
122	b	355.9
123	b	384.3
124	b	313.7
125	b	209.0
126	b	306.6

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OBS	TRT	RESP
127	b	373.4
128	b	350.3
129	b	309.5
130	b	271.8
131	b	349.1
132	c	315.8
133	c	410.4
134	c	261.4
135	c	376.5
136	c	258.6
137	c	357.8
138	c	348.7
139	c	247.3
140	c	312.2
141	c	170.7
142	c	300.8
143	c	405.3
144	c	350.9
145	c	376.2
146	c	278.9
147	c	349.1
148	c	260.3
149	c	297.0
150	c	304.1
151	c	407.8
152	c	338.5
153	c	310.5
154	c	322.2
155	c	290.9
156	c	346.6
157	c	254.8
158	c	367.0
159	c	401.3
160	c	374.1
161	c	379.0
162	c	336.7
163	c	256.7
164	c	411.2
165	c	319.7
166	c	314.6
167	c	223.1
168	c	309.5
169	c	226.4
170	c	426.7
171	c	480.5
172	c	371.5
173	c	401.1
174	c	270.0
175	c	303.9
176	c	349.4
177	c	268.3
178	c	258.2
179	c	292.0
180	c	335.4
181	c	339.5
182	c	249.4
183	c	289.5
184	c	364.3
185	c	305.6
186	c	288.1
187	c	248.2
188	c	296.1
189	c	206.1

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OBS	TRT	RESP
190	c	246.1
191	c	238.2
192	c	274.4
193	c	281.6
194	c	188.0
195	c	138.7
196	c	380.5
197	c	301.1
198	c	239.8
199	c	300.1
200	c	317.8
201	c	274.4
202	c	239.4
203	d	281.5
204	d	225.0
205	d	287.8
206	d	288.9
207	d	270.6
208	d	348.5
209	d	439.2
210	d	297.0
211	d	325.8
212	d	251.5
213	d	400.9
214	d	259.5
215	d	265.1
216	d	254.6
217	d	416.6
218	d	270.7
219	d	152.3
220	d	312.7
221	d	288.7
222	d	216.3
223	d	278.7
224	d	306.2
225	d	460.7
226	d	378.2
227	d	256.0
228	d	359.6
229	d	103.4
230	d	475.4
231	d	452.4
232	d	242.7
233	d	196.3
234	d	228.8
235	d	233.7
236	d	234.1
237	d	178.8
238	d	304.6
239	d	273.2
240	d	270.4
241	d	272.7
242	d	243.4
243	d	165.0
244	d	304.0
245	d	264.7
246	d	241.3
247	d	274.7
248	d	240.3
249	d	314.5
250	d	310.4
251	d	419.6
252	d	214.2

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 253 d 199.3
 254 d 217.7
 255 d 222.1
 256 d 251.0
 257 d 188.7
 258 d 415.0
 259 d 169.3
 260 d 161.2

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OBS	TRT	RESP
261	d	256.6
262	d	210.1
263	d	346.4
264	d	308.1
265	d	241.8
266	d	249.3
267	d	338.9
268	d	257.2
269	d	229.8
270	d	302.4
271	d	306.3
272	d	292.2
273	d	305.4
274	d	177.4
275	d	327.3
276	e	509.3
277	e	286.0
278	e	215.3
279	e	341.2
280	e	386.7
281	e	279.3
282	e	290.3
283	e	388.6
284	e	405.9
285	e	311.9
286	e	342.6
287	e	331.3
288	e	340.5
289	e	475.7
290	e	344.7
291	e	253.8
292	e	287.1
293	e	304.3
294	e	300.2
295	e	333.8
296	e	377.4
297	e	309.5
298	e	241.6
299	e	216.0
300	e	231.0
301	e	404.5
302	e	111.6
303	e	256.2
304	e	363.7
305	e	393.2
306	e	322.2
307	e	282.3
308	e	354.5
309	e	237.2
310	e	410.5
311	e	391.7
312	e	286.1
313	e	208.1
314	e	312.7
315	e	326.3

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 316 e 353.6
 317 e 220.1
 318 e 297.7
 319 e 278.4
 320 e 301.7
 321 e 400.5
 322 e 360.8
 323 e 444.2
 324 e 307.4
 325 e 219.9

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OBS	TRT	RESP
326	e	275.1
327	e	319.8
328	e	287.3
329	e	197.3
330	e	215.3
331	e	238.0
332	e	198.4
333	e	541.4
334	e	358.7
335	e	575.3
336	e	158.9
337	e	462.4
338	e	280.9
339	e	333.5
340	e	366.1
341	e	346.4
342	e	238.2
343	e	411.2
344	e	369.0
345	f	384.8
346	f	390.8
347	f	265.8
348	f	373.4
349	f	358.4
350	f	337.4
351	f	245.4
352	f	347.2
353	f	337.0
354	f	273.2
355	f	281.4
356	f	223.1
357	f	468.3
358	f	262.9
359	f	136.2
360	f	252.5
361	f	243.2
362	f	306.3
363	f	329.4
364	f	285.7
365	f	224.6
366	f	109.6
367	f	316.2
368	f	318.1
369	f	366.8
370	f	299.1
371	f	357.0
372	f	292.9
373	f	390.4
374	f	265.1
375	f	305.9
376	f	463.5
377	f	226.4
378	f	293.7

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379	F	307.5
380	F	299.6
381	F	434.7
382	F	320.8
383	F	296.1
384	F	270.8
385	F	172.2
386	F	197.0
387	F	229.8
388	F	379.1
389	F	266.5
390	F	295.1

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OBS	TRT	RSP
391	F	289.0
392	F	264.3
393	F	273.7
394	F	265.0
395	F	195.2
396	F	357.8
397	F	274.7
398	F	369.9
399	F	358.8
400	F	332.2
401	F	283.7
402	F	282.9
403	F	437.2
404	F	277.1
405	F	328.9
406	G	179.4
407	G	298.5
408	G	237.5
409	G	431.5
410	G	151.6
411	G	271.1
412	G	402.8
413	G	266.7
414	G	363.4
415	G	293.6
416	G	317.9
417	G	256.5
418	G	191.9
419	G	110.0
420	G	257.8
421	G	170.9
422	G	431.9
423	G	240.5
424	G	403.6
425	G	49.5
426	G	173.7
427	G	277.5
428	G	388.5
429	G	313.4
430	G	315.2
431	G	334.5
432	G	359.5
433	G	299.6
434	G	484.9
435	G	36.8
436	G	162.8
437	G	280.7
438	G	326.5
439	G	414.3
440	G	328.1
441	G	325.7

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442	G	172.5
443	G	248.2
444	G	175.9
445	G	286.3
446	G	260.9
447	G	224.3
448	G	422.3
449	G	189.6
450	G	123.5
451	G	331.4
452	G	251.9
453	G	328.1
454	G	115.5
455	G	258.9

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OBS	TRT	RSP
456	G	268.3
457	G	172.9
458	G	237.7
459	G	253.7
460	G	187.6
461	G	195.2
462	G	255.0
463	G	206.8
464	G	262.0
465	G	348.7
466	G	194.3
467	G	417.7
468	G	171.5
469	G	294.5
470	G	309.7
471	G	306.5
472	G	124.5
473	G	228.4

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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 = 473

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General Linear Models Procedure

Dependent Variable: RSP

Source	DF	Sum of Squares	F Value	Pr > F
Model	6	193446.017881	8.81	0.0001
Error	466	2668002.606921		
Corrected Total	472	3060448.624102		

R

Source	DF	Type I SS	F Value	Pr > F
TRT	6	192446.017281	5.21	0.0001
Source	DF	Type III SS	F Value	Pr > F
TRT	6	192446.017281	5.21	0.0001

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General Linear Models Procedure

Dunnett's T tests for variable: RSP

NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.

Alpha= 0.05 Confidence= 0.95 df= 466 MSR= 6154.512
 Critical Value of Dunnett's T= 2.575

Comparisons significant at the 0.05 level are indicated by '***'.

TRT Comparison	Simultaneous Lower Confidence Limit			Simultaneous Upper Confidence Limit		
	Lower Limit	Difference Between Means	Upper Limit	Lower Limit	Difference Between Means	Upper Limit
e - a	-34.08	0.70	35.47	-30.32	0.70	31.72
c - a	-45.48	-10.94	23.59	-41.75	-10.94	19.86
b - a	-47.39	-12.09	23.20	-43.57	-12.09	19.39
f - a	-54.28	-18.41	17.46	-50.41	-18.41	13.59
d - a	-75.79	-41.49	-7.18	-72.09	-41.49	-10.88
g - a	-91.83	-56.93	-22.03	-88.06	-56.93	-25.80

Dunnett

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General Linear Models Procedure

Dunnett's One-tailed T tests for variable: RSP

NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.

Alpha= 0.05 Confidence= 0.95 df= 466 MSE= 6154.512
 Critical Value of Dunnett's T= 2.297

Comparisons significant at the 0.05 level are indicated by '***'.

TRT Comparison	Simultaneous Lower Confidence Limit			Simultaneous Upper Confidence Limit		
	Lower Limit	Difference Between Means	Upper Limit	Lower Limit	Difference Between Means	Upper Limit
e - a	-30.32	0.70	31.72	-30.32	0.70	31.72
c - a	-41.75	-10.94	19.86	-41.75	-10.94	19.86
b - a	-43.57	-12.09	19.39	-43.57	-12.09	19.39
f - a	-50.41	-18.41	13.59	-50.41	-18.41	13.59

Dunnett

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General Linear Models Procedure

Dunnett's One-tailed T tests for variable: RSP

NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.

Alpha= 0.05 Confidence= 0.95 df= 466 MSR= 6154.512
 Critical Value of Dunnett's T= 2.297

Comparisons significant at the 0.05 level are indicated by '***'.

TRT Comparison	Simultaneous Lower Confidence Limit			Simultaneous Upper Confidence Limit		
	Lower Limit	Difference Between Means	Upper Limit	Lower Limit	Difference Between Means	Upper Limit
e - a	-30.32	0.70	31.72	-30.32	0.70	31.72
c - a	-41.75	-10.94	19.86	-41.75	-10.94	19.86
b - a	-43.57	-12.09	19.39	-43.57	-12.09	19.39
f - a	-50.41	-18.41	13.59	-50.41	-18.41	13.59
d - a	-72.09	-41.49	-10.88	-72.09	-41.49	-10.88
g - a	-88.06	-56.93	-25.80	-88.06	-56.93	-25.80

Dunnett