DATA EVALUATION RECORD

1. Chemical: PP321

2. Test Material: PP321, 96.6% w/w Technical Grade

3. Study Type: Fish Early Life Stage Toxicity Test

   Species Tested: Cyprinodon variegatus

4. Study ID: Hill, R.W.; Caunter, J.E.; Cumming, R.I. (1985) PP321: Determination of the Chronic Toxicity to Sheepshead Minnow (Cyprinodon variegatus) Embryos and Larvae. Submitted by ICI Americas, Inc., Prepared by Imperial Chemical Industries, PLC, Brixham Laboratory, Brixham, Devon. EPA Accession No. 073989.

5. Reviewed By: Candy Brassard
   Environmental Protection Specialist
   EEB/HED
   Signature: Candy Brassard
   Date: 10-15-87

6. Approved By: Douglas J. Urban
   Head, Section II
   EEB/HED
   Signature: Douglas J. Urban
   Date: 10/15/87

7. Conclusions:

This study is scientifically sound. However, there are significant data discrepencies, based on lack of raw data, that are outlined in section 14. Specific concerns include: the measured concentrations ranging from only 20 to 64 percent of the nominal; the light intensity and photoperiod varied considerably from the SEP guidelines. Therefore, this study is classified as supplemental.

8. Recommendations:

The raw data are required in order to clarify the data gaps identified in section 14. Repairablity is dependent on the submittal and review of the new information. There are additional concerns for the measured concentrations.

9. Background:

The study was submitted prior to submission of a registration action for Karate on cotton.

10. Discussion of Individual Test: N/A

(1)

11. Materials and Methods:

a. Test Animals - Sheepshead minnow embryos were obtained from broodstock held at the Brixham Laboratory. The fish were originally obtained from Sea Plantations, Incorporated, Salem, MA and were held in the laboratory for 9 months prior to the start of the study.

The female gametes were induced by spawning. The ova (after stripping females) were mixed with sperm obtained from macerated excised testes of male fish. Viability was verified after 20 hours.

After the embryos were distributed to embryo cups, they were treated with a 15-second exposure of malachite green, then washed with seawater. Fish were fed Artemia salina and Promin after 11 days (posthatch).

b. Test System - A flowthrough system was used for this study.

[Excerpted from submission]

"The flow of the seawater (salinity 34 +/- 2 °/00) used in this study was controlled by a ball-valve and passed into a storage tank with a constant head. Freshwater, controlled by a flow through glass capillary tube, was also passed to this tank to produce the required salinity.

"The water was pre-heated in the tank and gentle aeration was used to ensure adequate mixing. The dilution water of the required salinity (nominal 25 °/00) was then allowed to flow by gravity to each mixing cell.

"Watson Marlow peristaltic pumps were used to deliver the stock solutions of the test substance to the mixing cells. Independent magnetic stirrers were employed to ensure adequate mixing before the test solutions were fed to the exposure vessels by gravity feed.

"Five nominal concentrations 1.0, 0.56, 0.32, 0.18 and 0.010 µg/L of PP321 and separate carrier (DMF) and dilution water controls were used in the study and replicate tanks (A + B) were employed at all concentrations and controls. Glass aquaria measured 30 cm length x 20 cm width x 20 cm depth; an overflow drain was incorporated at the end of each aquarium which maintained a constant test volume of approximately 9 litres. The water depth in each tank was approximately 15 cm.

"The dosing system was designed so that each replicate tank received 100 ml/minute of the required test solution and a further 100 ml/minute ran to waste. At these rates of dosing the calculated number of aquarium volume replacements was 16 per 24-hour period. Further details of the test system are given in Appendix 2.

"Illumination of the test system was provided by four Crompton white fluorescent lights situated directly above the aquaria.

"The photoperiod employed was 12 hours of light at 2800-3300 lux alternating with 12 hours of darkness. Light measurements were determined with a Centronic model 110 photometer."

The dilution water consisted of seawater diluted with freshwater to attain the salinity of 23.5 to 26.7 percent.

Embryo cups were constructed from 8 cm lengths of 5 cm OD transparent plastic tubing and nylon mesh cemented on the base of the cup. The cups were suspended in the test chambers and oscillated vertically over a distance of 2 to 5 cm at a rate of 2 oscillations/minute in the test solutions.

c. Dose - The five nominal concentrations included 1.0, 0.56, 0.32, 0.18, and 0.010 µg/L of PP321. A solvent control (DMF) and a control were also included.

d. Study Design - Fifteen embryos were randomly distributed in batches of five into each of 28 embryo incubation cups.

All test solutions were analyzed at the start and finish of the exposure period and alternate replicates were measured twice weekly. All water samples were taken in 250 mL volumetric flasks immersed in tanks below surface of the water.

Percent hatch and percent survival of embryos, and total lengths and weights of larvae were determined at test termination.

e. Statistics - [Excerpted from submission]

"The percentage hatch and survival data were analyzed by one-way analysis of variance (Ref 2). Where the F-statistic was significant at the 5% level Dunnett's t-tests were performed, to compare the treatments against the controls, looking for differences at the 5% and 1% significance levels (Ref 3 and 4).

"For the larval length and weight data the replicates in each treatment and in the controls were tested for differences at the 5% level. In the absence of significant differences the replicates for each treatment and the controls were pooled and a one-way analysis of variance carried out. This was followed by Dunnett's t-tests, at the 5% and 1% levels, between each of the treatments and the controls. The relative standard deviations (RSD) of the weights of the two controls were calculated to determine the acceptability of the data according to the EPA Environmental Effects Guidelines (Ref 5)."

12. Reported Results: [Excerpted from submission]

"Hatchability

"The hatchability of sheepshead embryos was not significantly affected ($P<0.05$) in any replicate test vessel in this study. The percentage hatchability ranged from 81.3 to 100% with an overall mean value of 90.5%. These values were calculated on the number of larvae released. Data obtained on the hatchability are shown in Table 4.

"Larval survival

"Larval survival was not significantly affected ($P<0.05$) in any concentration or control. The larval survival for all PP321 concentrations ranged from 75.9 to 93.3% based on the initial embryos exposed. The corresponding values for the carrier (DMF) were 80-86.2% and the dilution water control 83.9-86.7%. Survival data are shown in Table 4.

"Larval growth

"No significant effect ($P<0.05$) was found in the length data in any concentration of PP321 or in the carrier or dilution water controls at the completion of the study.

"A significant effect ($P<0.05$) was found in the weight data at the highest concentration tested (mean measured concentration of 0.38 μg/l PP321.

"No significant effect ($P<0.05$) was found in the weight data for all other PP321 concentrations tested.

"Larval weights and lengths are shown in Tables 4, 6 and 7.

"The no observed effect concentration (NOEC) was therefore considered to be 0.25 μg/l PP321. The observed effect concentration (OEC) was considered to be 0.38 μg/l PP321.

"PP321 analyses

"Measurements were made on hexane extracts of water samples taken from the exposure tanks.

"Good correlation was found between replicate tanks and the mean measured value obtained for all measurements was 41% of the nominal exposure concentration value, with a range of values from 36.0 to 46.9% of the nominal levels.

"Data obtained are shown in Table 3.

"Chemical parameters monitored

"Heavy metals and pesticide concentrations in the seawater and freshwater were in keeping with expected values (Table 2). Analyses of the fish food diets are also given in Table 5.

"It is considered that none of the contaminants were present in sufficient quantity to have adversely affected the quality of the study.

"Physical parameters monitored

"Dissolved oxygen levels ranged from 6.0 to 7.6 mg/l.

"The pH values ranged from 8.2 to 8.3 pH units.

"Temperature values ranged from 24.1 to 26.2°C.

"The data obtained (reported as ranges of values) show little variation during the whole study period (see Table 1).

"Statistics

"The statistics obtained from the data for the hatch, survival, lengths and weight data together with the relative standard deviation of the control fish are shown in Tables 7-12.

"No statistical difference was found ($P<0.25$) between the carrier and dilution water control length and weight data. The replicates of each test concentration were pooled and the pooled data were compared against the pooled data of both the carrier and dilution water controls.

"The acceptability of the test (Ref 5) was determined from the relative standard deviation (RSD=100 times the standard deviation divided by the mean) of the weight of the fish which were alive at the end of the test in any control chamber.

"The values obtained for this study were 22.9 and 31.0% for the carrier control and 22.7 and 25.2% for the dilution water control and the data are therefore acceptable, being less than 40% (Ref 5). These data are shown in Table 12."

13. Study Author's Conclusions/Quality Assurance Measures:

No significant effect was determined for larval survival or larval length. However, a significant effect was indicated for larval weight at 0.38 µg/L (mean measured concentration) PP321. Therefore, the no-observable-effect level (NOEL) was determined to be 0.25 µg/L and the lowest-observable-effect level (LOEL) was determined to be 0.38 µg/L PP321.

The conduct of this study has been inspected/audited in accordance with ICI's policies and procedures for Good Laboratory Practice, as follows . . . .

14. Reviewer's Discussion and Interpretation of the Results:

a. Test Procedures - The following discrepancies were noted in the study:

- The raw data were not submitted.

- The SEP Guidelines (M. Rexrode and T. Armitage 1986), require a minimum of 20 embryos per replicate cup with 4 replicates per concentration (80 embryos total). This study only used 60 embryos per treatment level. The protocol attached to the study (submitted by ICI as well) recommended 80 embryos per treatment level. The study author (or company) should explain why their own protocol was not adhered to.

- Since the raw data were not submitted, the statistical analysis cannot be completed. The data for each egg incubation cup are needed in order to conduct an ANOVA, and determine a NOEL.

- According to Residue Analysis of Fish Diet (Table 5), Artemia salina and Promin, which were the feed sources for the test organisms, were contaminated with PCBs, with levels ranging from 30 to 51 ppb.

- The study author should verify the precise embryonic stage at the beginning of the exposure. The embryos should have been 2 to 24 hours old at the beginning of the test. Twenty-four hours after being placed in the incubation cups, they should be counted and examined for dead or heavily fungused individuals, which should be discarded without disturbing the viable embryos.

The counting and examination should be repeated on a daily basis (M. Rexrode and T. Armitage 1986). Since the raw data were not submitted, this specific information was not available for review.

- The live fish should be counted (including lethargic and abnormal in either swimming behavior or physical appearance) 11, 18, 25, and 32 days after hatching. This information was not available for review.

- The study author indicated that the fish were fed until "Completion of the study." The fish should not be fed for at least 24 hours prior to termination on day 32. In addition, the amount of food should be the same for both the control and the treatment groups--otherwise, growth could not be a meaningful endpoint.

- The embryo cups should be made from glass jars with the bottoms replaced with 40-mesh stainless steel or nylon screen, not plastic tubing.

- The number of deformed was not reported. In addition, the study author did not report if abnormal behavior was indicated.

- The measured concentrations ranged from 20 to 64 percent at the nominal concentrations. The measured concentration of the test material in any chamber should be no more than 20 percent higher or 50 percent lower than the nominal concentration. See Attachment A for summary of analytical results.

- The study author did not indicate how many males or females were used to produce the embryos. The protocol submitted indicated eggs < 24 hours old from at least five females should be used. Since the study deviated from the protocol, i.e., number of eggs per egg incubation cup/treatment level, it is unclear if the study deviated from the submitted protocol with regards to this parameter as well.

- The photoperiod should have been 16L/8D, not 12 hours light/12 hours dark. The light intensity should have been 400 to 800 Lux instead of 2800 to 3300 Lux.

b. Statistical Analysis - Since the raw data were not submitted, the statistical analysis could not be verified.

The following should be included in the reported data:

- Number embryos hatched in each egg incubation cup;

- Time to hatch--for each egg incubation cup;

- Mortality of embryos, larvae, juveniles;

- Time to swim up; and

- Other effects such as deformities, abnormal behavior.

c. Discussion of Results -

Since the raw data were not submitted, the discrepencies outlined in section 14 could not be clarified. There are specific concerns as outlined below:

- The light intensity and photoperiod vary considerably from the SEP guidelines for the fish early life stage testing.

- In addition, the reported NOEL for this study is approximately the same as the reported LC_{50} values for both the warmwater and colwater fish. This is unusual, and raises concern.

- The measured concentrations ranged from 20 to 64 percent of the nominal, instead of the recommended values of no more than 20 percent greater or 50 percent lower than the nominal concentrations.

d. Adequacy of Study

1) Classification - Supplemental--96.6% w/w.

2) Rationale - Based on the major discrepancies outlined in section 14, this study is classified as supplemental.

3) Repairability - If the raw data are submitted and clarify all the concerns outlined in section 14, the study may be reconsidered for reclassification.

Attachment

TABLE 4

DATA ON HATCHABILITY AND SURVIVAL OF SHEEPSHEAD EMBRYOS AND LARVAE EXPOSED TO PP321

EXPOSURE TANK		PP321* µg/l	NO OF EMBRYOS AT START	NUMBER OF FRY HATCHED	NUMBER OF FRY RELEASED	% HATCH - NUMBER HATCHED x100 / NO OF EMBRYOS**	% HATCH - NUMBER RELEASED x100 / NO OF EMBRYOS	LARVAE NUMBER SURVIVING (28 days)	LARVAE % SURVIVAL FROM HATCH	LARVAE % SURVIVAL FROM INITIAL ***	AVERAGE LENGTH # mm	AVERAGE LENGTH # SD	AVERAGE WEIGHT # mg	AVERAGE WEIGHT # SD
2	A	) 0.38	30	27	27	90.0	90.0	26	96.3	86.7	17.7	(2.1)	†154.8	(48.4)
	B	)	30	29	29	96.7	96.7	28	96.6	93.3	18.1	(1.2)	†161.0	(31.2)
4	A	) 0.25	30	26	26	86.7	86.7	25	96.2	83.3	18.5	(1.5)	177.3	(39.1)
	B	)	29	27	27	93.1	93.1	25	92.6	86.2	18.6	(1.2)	182.6	(37.4)
1	A	) 0.14	32	26	26	81.3	81.3	25	96.2	78.1	18.5	(1.1)	172.4	(27.8)
	B	)	30	29	29	96.7	96.7	27	93.1	90.0	17.7	(2.1)	163.3	(47.4)
6	A	) 0.07	29	24	24	82.8	82.8	22	91.7	75.9	18.6	(1.6)	190.5	(47.9)
	B	)	29	25	25	86.2	86.2	24	96.0	82.8	18.5	(1.7)	186.1	(47.3)
5	A	) 0.04	30	30	30	100.0	100.0	28	93.3	93.3	18.7	(1.1)	184.4	(35.4)
	B	)	31	29	29	93.5	93.5	28	96.6	90.3	17.6	(1.1)	163.3	(33.6)
3	A	) Carrier(DMF)	30	27	27	90.0	90.0	24	88.9	80.0	18.1	(2.4)	177.0	(54.9)
	B	) control	29	27	27	93.1	93.1	25	92.6	86.2	18.6	(1.6)	186.4	(42.7)
7	A	) Dilu water	30	28	28	93.3	93.3	26	92.9	86.7	18.4	(1.6)	176.1	(40.0)
	B	) control	31	26	26	83.9	83.9	26	100.0	83.9	18.3	(1.6)	168.0	(42.4)

* Values are expressed as mean measured concentrations (ug/l) of PP321

Statistical data were calculated on ** the hatchability and *** overall survival from initial embryos.

† Values are significantly ($P<0.05$) different from control values. # SD = standard deviation.

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Pages 10 through 12 are not included in this copy.

The material not included contains the following type of information:

_____ Identity of product inert ingredients.

_____ Identity of product impurities.

_____ Description of the product manufacturing process.

_____ Description of quality control procedures.

_____ Identity of the source of product ingredients.

_____ Sales or other commercial/financial information.

_____ A draft product label.

_____ The product confidential statement of formula.

_____ Information about a pending registration action.

X FIFRA registration data.

_____ The document is a duplicate of page(s) _____.

_____ The document is not responsive to the request.

The information not included is generally considered confi
by product registrants. If you have any questions, please
the individual who prepared the response to your request.

Amendment to DER

Sheepshead Minnow Early Life Stage

The following are responses to the submitted data:

- The number of embryos (60) are significantly less than the recommended SEP guïdelines (M. Rexrode and T. Armitage 1986). In addition, using the recommended protocols in Pesticide Assessment Guidelines Subdivision E, published in August 1982, the number of embryos should have been > 80 eggs per treatment level.

  In this case, percent hatchability ranged from 81.3 to 100 percent. Therefore, it appears the fewer number of embryos per treatment did not affect the results of this study. The company should be informed that future studies submitted with 60 embryos per treatment are also suspect.

- The PCB levels of 51 ppb are within the acceptable limits drafted by ASTM (1983).

- The eggs were reported to have been approximately 27 hours old at test initiation. Since the eggs were < 48 hours old, EEB does not expect the exposure to embryos to have been significantly affected. Future studies submitted by the company should use embryos < 24 hours old to ensure the studies' scientific soundness.

- Since the company recorded daily if abnormalities or adverse behavioral symptoms were noticed, it appears that this observation parameter has been addressed.

- Since all fish were fed up until 12 hours prior to test termination, it appears the feeding would not affect the results of the weights between treatment groups.

- The practice of using plastic incubation cups is not recommended since this class of chemicals are known to absorb to substances such as plastic. There is also a concern for leaching as well. The company should not have used the Environmental Effects Guidelines Ref. EG 11, but referred to the protocols recommended in the 1982 Subdivision E Guidelines for fish early life stage testing. The USEPA National Quality Laboratory 1972 recommended glass incubation cups.

  Since residue analysis was conducted at least every 7 days, and the concentrations remained within the same range, it appears this did not adversely affect the study. However, the company should be aware this is not a recommended practice and may affect the future studies if this procedure is continued.

- We are aware of the nature of this class of chemical and the difficulty in achieving a measured concentration to the nominal concentration. Since the concentrations within each treatment level seemed relatively consistent, this discrepancy is not expected to affect the study.

- The number of females (28) used to obtain the eggs are expected to produce enough spawnings to provide good variability. The number of males used are also expected to be satisfactory.

- The light intensity does raise concern, even when dividing by 2, as suggested by the author the reported lux ranged from 1400 to 1650. EEB is unaware of the photodegradation in water, and the light intensity may affect the chemical in such a way that the compound would break down and not be available to the test organism. However, since residue analysis was conducted, this is not expected to affect the scientific soundness of the studies.

- The statistical analysis using ANOVA and ANOVA Arc Sine was conducted on the following parameters:

  (See attachments)

% survival of embryos	= NOEL > 0.38 ug/L
% larval survival from hatch	= NOEL > 0.38 ug/L
% larval survival from initial	= NOEL > 0.38 ug/L
Length	= NOEL > 0.38 ug/L
Weight	= NOEL = $\leq$ 0.25 ug/L
	= LOEL = 0.38 ug/L

  These results indicate PP321 affects weight, a growth parameter at levels as low as 0.25 ug/L.

  EEB categorizes this compound as very highly toxic to the sheepshead minnow.

- It appeared that the highest dose group had delayed hatching, but after conducting an ANOVA program it appeared that there was not a significant difference in time to hatch. The c.v. value was as high as 37.4, which indicates the statistical analysis was not as good since we prefer < 20.0 (see Attachment E).

Discussion of Results

It appears that the discrepancies outlined earlier in the DER have been adequately addressed.

The company should be aware that the recommended protocols in Subdivision E 1982 should have been used.

The deviations in the methodology are not expected to have affected this study, but this may not be the case for future studies submitted by this company.

Adequacy of Study

1. Classification - Core - 96% w/w.

2. The discrepancies have been adequately addressed.

3. Repairability - N/A.

Discussion of Results

It appears that the discrepancies outlined earlier in the DER have been adequately addressed.

The company should be aware that the recommended protocols in Subdivision E 1982 should have been used.

The deviations in the methodology are not expected to have affected this study, but this may not be the case for future studies submitted by this company.

Adequacy of Study

1. Classification - Core - 96% w/w.

2. The discrepancies have been adequately addressed.

3. Repairability - N/A.

Candace Brassard
Ecological Effects Branch
Hazard Evaluation Division (TS-769-C)

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CARY, N.C. 27511-8000

1 SAS 12:08 WEDNESDAY, DECEMBER 16, 1987

OBS	TRT	RESP1	RESP2	RESP3	RESP4	RESP5	RESP6	RESP7	RESP8	RESP9	RESP10	RESP11	RESP12	RESP13	RESP14	RESP15	RESP16	RESP17	RESP18	RESP19	RESP20
1	A	80.0	100.0	100.0	80.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	B	100.0	100.0	100.0	87.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	C	78.6	86.7	86.7	85.8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	D	86.7	76.5	100.0	93.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	E	87.5	85.8	93.0	93.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	F	93.3	86.7	100.0	93.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

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GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

NUMBER OF OBSERVATIONS IN DATA SET = 120

NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER, ONLY 24 OBSERVATIONS CAN BE USED IN THIS ANALYSIS.

1 SAS 12:08 WEDNESDAY, DECEMBER 16, 1987

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: EFFECT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V
MODEL	5	729.47566946	145.89513389	1.46	0.2503	0.289040	13.290
ERROR	18	1794.31559009	99.68419945		ROOT MSE		EFFECT MEA
CORRECTED TOTAL	23	2523.79125954			9.98419749		75.1252271

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR >
TRT	5	729.47566946	1.46	0.2503	5	729.47566946	1.46	0.250

1 SAS 12:08 WEDNESDAY, DECEMBER 16, 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

17

ALPHA=0.05 DF=18 MSE=99.6842

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING		MEAN	N	TRT
	A	84.790	4	B
	A			
B	A	77.121	4	F
B	A			
B	A	76.687	4	A
B	A			
B	A	73.624	4	D
B	A			
B	A	71.675	4	E
B				
B		66.856	4	C

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  171.     ONOTE: COPYRIGHT (C) 1984,1986 SAS INSTITUTE INC., CARY, N.C.  27511, U.S.A.
  245.            CARY, N.C. 27511-8000
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  248.                                                                          R    R    R    R    R    R    R    R    R    R    R
  249.                          R    R    R    R    R    R    R    R    R    R    E    E    E    E    E    E    E    E    E    E    E
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  251.            O    T     S    S    S    S    S    S    S    S    S    S    P    P    P    P    P    P    P    P    P    P    P
  252.            B    R     P    P    P    P    P    P    P    P    P    P    1    1    1    1    1    1    1    1    1    1    2
  253.            S    T     1    2    3    4    5    6    7    8    9    0    1    2    3    4    5    6    7    8    9    0
  254.
  255.            1    A    92.6 88.9  .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
  256.            2    B    96.6 93.3  .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
  257.            3    C    96.0 91.7  .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
  258.            4    D    93.1 96.2  .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
  259.            5    E    92.6 96.2  .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .    .
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  262.
  263.                                                GENERAL LINEAR MODELS PROCEDURE
  264.
  265.                                                  CLASS LEVEL INFORMATION
  266.
  267.                                                CLASS     LEVELS    VALUES
  268.
  269.                                                TRT          6      A B C D E F
  270.
  271.
  272.                                              NUMBER OF OBSERVATIONS IN DATA SET = 120
  273.
  274.
  275.     NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER,
  276.           ONLY     12 OBSERVATIONS CAN BE USED IN THIS ANALYSIS.
  277.     1                                                SAS                  12:05 WEDNESDAY, DECEMBER 16, 1987
  278.
  279.                                                GENERAL LINEAR MODELS PROCEDURE
  280.
  281.     DEPENDENT VARIABLE: EFFECT
  282.
  283.     SOURCE                    DF       SUM OF SQUARES          MEAN SQUARE       F VALUE       PR > F       R-SQUARE          C.V
  284.
  285.     MODEL                      5          49.35834058          9.87166812          1.23       0.3989       0.505764        3.717
  286.
  287.     ERROR                      6          48.23336784          8.03889464                     ROOT MSE                  EFFECT MEA
  288.
  289.     CORRECTED TOTAL           11          97.59170842                                         2.83529445                  76.2721217
  290.
  291.
  292.     SOURCE                    DF         TYPE I SS     F VALUE     PR > F          DF         TYPE III SS     F VALUE     PR >
  293.
  294.     TRT                        5          49.35834058        1.23     0.3989           5          49.35834058        1.23     0.398
  295.     1                                                SAS                  12:05 WEDNESDAY, DECEMBER 16, 1987
  296.
  297.                                                GENERAL LINEAR MODELS PROCEDURE
  298.
  299.                                  DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: EFFECT
  300.                                  NOTE: THIS TEST CONTROLS THE TYPE I COMPARISONWISE ERROR RATE,
```

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	6.93782	7.19077	7.30814	7.36758	7.39479

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	79.110	2	F
A			
A	77.155	2	B
A			
A	76.734	2	D
A			
A	76.456	2	E
A			
A	75.829	2	C
A			
A	72.348	2	A

?

```
? fetch 7978clr
7978CLR : INVALID.
? fetch 7978 clr
? l 'n/c.'
  171.     ONOTE: COPYRIGHT (C) 1984,1986 SAS INSTITUTE INC., CARY, N.C.  27511, U.S.A.
  245.           CARY, N.C. 27511-8000
? l 245/l
  245.           CARY, N.C. 27511-8000
  246.     1                                                SAS                    12:07 WEDNESDAY, DECEMBER 16, 1987
  247.
  248.                                                                                R   R   R   R   R   R   R   R   R   R   R
  249.                        R       R   R   R   R   R   R   R   R   R   E   E   E   E   E   E   E   E   E   E   E
  250.                        E       E   E   E   E   E   E   E   E   E   S   S   S   S   S   S   S   S   S   S   S
  251.            O   T       S       S   S   S   S   S   S   S   S   S   P   P   P   P   P   P   P   P   P   P   P
  252.            B   R       P       P   P   P   P   P   P   P   P   P   1   1   1   1   1   1   1   1   1   1   2
  253.            S   T       1       2   3   4   5   6   7   8   9   0   1   2   3   4   5   6   7   8   9   0
  254.
  255.            1   A     86.2    80.0   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
  256.            2   B     90.3    93.3   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
  257.            3   C     82.8    75.9   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
  258.            4   D     90.0    78.1   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
  259.            5   E     83.3    86.2   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
  260.            6   F     86.7    93.3   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .   .
  261.     1                                                SAS                    12:07 WEDNESDAY, DECEMBER 16, 1987
  262.
  263.                                                GENERAL LINEAR MODELS PROCEDURE
  264.
  265.                                                   CLASS LEVEL INFORMATION
  266.
  267.                                                CLASS     LEVELS    VALUES
  268.
  269.                                                TRT          6      A B C D E F
  270.
  271.
  272.                                              NUMBER OF OBSERVATIONS IN DATA SET = 120
  273.
  274.
  275.     NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER,
  276.           ONLY     12 OBSERVATIONS CAN BE USED IN THIS ANALYSIS.
  277.     1                                                SAS                    12:07 WEDNESDAY, DECEMBER 16, 1987
  278.
  279.                                                GENERAL LINEAR MODELS PROCEDURE
  280.
  281.     DEPENDENT VARIABLE: EFFECT
  282.
  283.     SOURCE                    DF       SUM OF SQUARES          MEAN SQUARE       F VALUE       PR > F       R-SQUARE          C.V
  284.
  285.     MODEL                      5          150.90138394          30.18027679          1.88       0.2312       0.610982        5.887
  286.
  287.     ERROR                      6           96.08021537          16.01336923                  ROOT MSE                  EFFECT MEA
  288.
  289.     CORRECTED TOTAL           11          246.98159931                               4.00167080                  67.966075
  290.
  291.
  292.     SOURCE                    DF          TYPE I SS     F VALUE     PR > F          DF          TYPE III SS     F VALUE     PR >
  293.
  294.     TRT                        5          150.90138394        1.88     0.2312           5          150.90138394        1.88     0.23
  295.     1                                                SAS                    12:07 WEDNESDAY, DECEMBER 16, 1987
  296.
  297.                                                GENERAL LINEAR MODELS PROCEDURE
```

NOT THE EXPERIMENTWISE ERROR RATE

ALPHA=0.05 DF=6 MSE=16.0134

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	9.79188	10.1489	10.3145	10.3984	10.4368

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	73.396	2	B
A			
A	71.776	2	F
A			
A	67.009	2	E
A			
A	66.804	2	D
A			
A	65.787	2	A
A			
A	63.023	2	C

?

HARMONIC MEAN OF CELL SIZES=50.8031

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	0.635915	0.668704	0.689802	0.705652	0.718991

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN GROUPING	MEAN	N	TRT
A	18.5674	46	C
A			
A	18.5280	50	E
A			
A	18.3408	49	A
A			
A	18.2321	56	B
A			
A	18.1019	52	D
A			
A	17.9208	53	F

? ***

\R? ok
NDS EDITING TIME
ADS, 52 PAGE WRITES
EADS, 0 DISK WRITES
OFF OBS WYLBUR AT 13:32:57 12/16/87 (87.350)
CONN MNS: 7.14 CPU SECS .13 DA I/O: 10 TERM I/O: 269
CONN: $1.07 CPU: $.09 EXCP: $.36 *TOTAL*: $1.52
SSION

20 clr

VALID.

OBS	TRT	RESP1	RESP2	RESP3	RESP4	RESP5	RESP6	RESP7	RESP8	RESP9	RESP10	RESP11	RESP12	RESP13	RESP14	RESP15	RESP16	RESP17	RESP18	RESP19	RESP20
1	A	18.9	20.9	20.6	17.3	18.7	19.1	20.0	18.1	18.4	18.9	19.5	19.0	.	.	.	.	.	.	.	.
2	A	17.3	19.2	20.1	19.3	17.4	17.1	19.8	17.3	17.8	18.7	15.8	18.0	.	.	.	.	.	.	.	.
3	A	18.8	18.3	12.3	17.6	15.3	18.0	19.2	19.5	20.3	20.2	19.0	18.1	.	.	.	.	.	.	.	.
4	A	19.0	18.1	19.1	19.8	19.3	19.0	11.0	20.8	18.0	13.2	18.5	21.0	18.1	.	.	.	.	.	.	.
5	B	17.7	17.5	18.3	16.7	19.5	18.0	17.5	17.3	16.9	19.9	18.3	16.7	18.6	19.1	.	.	.	.	.	.
6	B	19.4	18.4	19.5	18.8	18.8	17.7	18.6	19.3	17.5	17.4	18.7	18.9	.	.	.	.	.	.	.	.
7	B	19.8	15.8	19.8	17.5	18.2	17.5	18.2	18.5	18.3	16.9	.	.	.	.	.	.	.	.	.	.
8	B	20.6	18.3	21.4	16.6	19.4	19.2	18.6	17.4	19.3	15.7	19.7	15.7	.	.	.	.	.	.	.	.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.0	.	.	.	.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20.5	18.0	18.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

17	D	16.2	18.2	19.2	16.8	18.8	18.0	16.2	17.8	19.5	17.7	19.4	18.2	.	.	.	.	.	.	.	.
18	D	20.7	15.9	19.0	15.8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
19	E	19.1	19.9	19.2	19.4	19.1	19.1	17.8	19.6	19.1	19.4	17.7	19.4	14.8	18.0	18.9	16	.	.	.	.
20	E	18.8	17.4	20.7	19.0	14.7	19.6	16.7	17.6	20.6	17.5	18.1	19.7	.	.	.	.	.	.	.	.
21	E	19.5	19.7	18.8	17.6	19.1	18.9	20.3	21.0	18.4	16.7	17.3	20.5	20.3	17.6	18.8	17	.	.	.	.
22	E	17.4	17.5	19.2	18.7	17.5	17.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
23	F	17.9	18.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
24	F	16.2	18.2	18.1	18.0	18.8	16.7	20.8	18.7	13.9	18.1	16.8	18.7	.	.	.	.	.	.	.	.
25	F	19.7	18.7	20.2	17.9	16.8	18.5	19.5	15.8	18.4	17.6	16.8	16.9	12.0	.	.	.	.	.	.	.
26	F	18.7	17.4	14.7	17.3	19.2	16.1	18.7	18.3	19.0	20.0	19.8	19.4	17.1	17.7	19.2	.	.	.	.	.
27	F	19.7	18.3	18.5	17.6	16.3	17.6	14.4	19.0	19.4	18.5	20.2	.	.	.	.	.	.	.	.	.

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

NUMBER OF OBSERVATIONS IN DATA SET = 540

NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER, ONLY 306 OBSERVATIONS CAN BE USED IN THIS ANALYSIS.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE
MODEL	5	15.65451422	3.13090284	1.20	0.3077	0.019653
ERROR	300	780.87937466	2.60293125		ROOT MSE	RES
CORRECTED TOTAL	305	796.53388889			1.61336024	18.27

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE
TRT	5	15.65451422	1.20	0.3077	5	15.65451422	1.20

GENERAL LINEAR MODELS PROCEDURE

24

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESP

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

ALPHA=0.05 DF=300 MSE=2.60293

GENERAL LINEAR MODELS PROCEDURE

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

ALPHA=0.05 DF=282 MSE=1767.31

WARNING: CELL SIZES ARE NOT EQUAL.
HARMONIC MEAN OF CELL SIZES=47.4502

NUMBER OF MEANS	2	3	4	5	6
CRITICAL RANGE	17.1455	18.0295	18.5984	19.0257	19.3853

MEANS WITH THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT.

DUNCAN	GROUPING	MEAN	N	TRT
	A	186.071	45	C
	A			
	A	181.782	49	A
	A			
B	A	175.780	44	E
B	A			
B	A	173.895	55	B
B	A			
B	A	170.615	41	D
B				
B		157.991	54	F

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) clr

ÌLID.

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SAS 12:03 WEDNESDAY, DECEMBER 16, 198

OBS	TRT	RESP1	RESP2	RESP3	RESP4	RESP5	RESP6	RESP7	RESP8	RESP9	RESP10	RESP11	RESP12	RESP13	RESP14	RESP15	RESP16	RESP17	RESP18	RESP19	RESP20
1	A	18.9	20.9	20.6	17.3	18.7	19.1	20.0	18.1	18.4	18.9	19.5	19.0	.	.	.	.	.	.	.	.
2	A	17.3	19.2	20.1	19.3	17.4	17.1	19.8	17.3	17.8	18.7	15.8	18.0	.	.	.	.	.	.	.	.
3	A	18.8	18.3	12.3	17.6	15.3	18.0	19.2	19.5	20.3	20.2	19.0	18.1	.	.	.	.	.	.	.	.
4	A	19.0	18.1	19.1	19.8	19.3	19.0	11.0	20.8	18.0	13.2	18.5	21.0	18.1	.	.	.	.	.	.	.
5	B	17.7	17.5	18.3	16.7	19.5	18.0	17.5	17.3	16.9	19.9	18.3	16.7	18.6	19.1	.	.	.	.	.	.
6	B	19.4	18.4	19.5	18.8	18.8	17.7	18.6	19.3	17.5	17.4	18.7	18.9	.	.	.	.	.	.	.	.
7	B	19.8	15.8	19.8	17.5	18.2	17.5	18.2	18.5	18.3	16.9	.	.	.	.	.	.	.	.	.	.
8	B	20.6	18.3	21.4	16.6	19.4	19.2	18.6	17.4	19.3	15.7	19.7	15.7	.	.	.	.	.	.	.	.
9	B	17.6	17.4	17.5	18.7	19.5	17.3	16.6	19.0	.	.	.	.	.	.	.	.	.	.	.	.
10	C	17.7	21.3	18.4	14.7	18.1	19.1	20.3	19.9	20.5	18.0	18.4	19.1	.	.	.	.	.	.	.	.
11	C	19.6	19.5	19.0	15.5	19.8	18.8	18.4	18.7	19.1	19.9	16.4	16.7	.	.	.	.	.	.	.	.
12	C	18.6	19.0	18.9	18.9	19.8	17.8	19.0	18.7	18.7	19.1	18.9	21.6	19.2	.	.	.	.	.	.	.
13	C	17.9	12.6	17.3	18.5	16.4	19.3	19.4	17.2	20.4	.	.	.	.	.	.	.	.	.	.	.
14	D	19.7	16.9	19.0	20.6	18.5	19.7	19.9	16.3	19.1	18.9	17.5	17.3	.	.	.	.	.	.	.	.

OBS	TRT	RESP1	RESP2	RESP3	RESP4	RESP5	RESP6	RESP7	RESP8	RESP9	RESP10	RESP11	RESP12	RESP13	RESP14	RESP15	RESP16	RESP17	RESP18	RESP19	RESP20
1	A	13	6	11	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	B	8	8	11	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	C	8	6	12	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	D	11	12	6	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	E	13	8	12	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	F	4	1	14	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

GENERAL LINEAR MODELS PROCEDURE

CLASS LEVEL INFORMATION

CLASS	LEVELS	VALUES
TRT	6	A B C D E F

NUMBER OF OBSERVATIONS IN DATA SET = 120

NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER, ONLY 24 OBSERVATIONS CAN BE USED IN THIS ANALYSIS.

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V
MODEL	5	22.20833333	4.44166667	0.35	0.8768	0.088143	37.442
ERROR	18	229.75000000	12.76388889		ROOT MSE		RESP MEA
CORRECTED TOTAL	23	251.95833333			3.57265852		9.5416666

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR >
TRT	5	22.20833333	0.35	0.8768	5	22.20833333	0.35	0.876

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESP

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

ALPHA=0.05 DF=18 MSE=12.7639

NUMBER OF MEANS	2	3	4	5	6

DUNCAN	GROUPING	MEAN	N	TRT
	A	11.250	4	E
	A			
	A	10.250	4	A
	A			
	A	9.250	4	C
	A			
	A	9.250	4	D
	A			
	A	9.000	4	B
	A			
	A	8.250	4	F

?

THIS LINE IS COMPRESSED AT 17 CHARACTERS PER INCH.
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16, 1987 1

		OBS	REP1	REP2	REP3	REP4	REP5	REP6	REP7	REP8	REP9	REP10	REP11	REP12	REP13	REP14	REP15	REP16	REP17	REP18	REP19	REP20
OBS	TRT																					
1	A	13	6	11	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	B	8	8	11	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	C	8	6	12	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	D	11	12	6	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	E	13	8	12	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	F	4	1	14	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

1 SAS 15:17 WEDNESDAY, DECEMBER 16, 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 = 120

NOTE: ALL DEPENDENT VARIABLES ARE CONSISTENT WITH RESPECT TO THE PRESENCE OR ABSENCE OF MISSING VALUES. HOWEVER, ONLY 24 OBSERVATIONS CAN BE USED IN THIS ANALYSIS.

1 SAS 15:17 WEDNESDAY, DECEMBER 16, 1987

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RESP

>20%

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V
MODEL	5	22.20833333	4.44166667	0.35	0.8768	0.088143	37.442
ERROR	18	229.75000000	12.76388889		ROOT MSE		RESP MEA
CORRECTED TOTAL	23	251.95833333			3.57265852		9.5416666

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR >
TRT	5	22.20833333	0.35	0.8768	5	22.20833333	0.35	0.876

1 SAS 15:17 WEDNESDAY, DECEMBER 16, 1987

GENERAL LINEAR MODELS PROCEDURE

DUNCAN'S MULTIPLE RANGE TEST FOR VARIABLE: RESP

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

29

ALPHA=0.05 DF=18 MSE=12.7639

NUMBER OF MEANS	2	3	4	5	6

293.

DUNCAN GROUPING	MEAN	N	TRT
A	11.250	4	E
A			
A	10.250	4	A
A			
A	9.250	4	C
A			
A	9.250	4	D
A			
A	9.000	4	B
A			
A	8.250	4	F

?