8-15-90

266229
RECORD NO.

125301
SHAUGHNESSEY NO

REVIEW NO.

EEB REVIEW

DATE: IN 6-29-90 OUT 15Aug90

FILE OR REG. NO. 35977-4

PETITION OR EXP. NO.

DATE OF SUBMISSION 4-13-90

DATE RECEIVED BY EFED 6-27-90

RD REQUESTED COMPLETION DATE 9-28-90

EEB ESTIMATED COMPLETION DATE 9-28-90

RD ACTION CODE/TYPE OF REVIEW 331

TYPE PRODUCT(S) Insecticide

DATA ACCESSION NO(S) 414920-01

PRODUCT MANAGER, NO. 17

PRODUCT NAME(S) Logic Fire Ant Bait

COMPANY NAME MAAG Agrochemicals, Inc.

SUBMISSION PURPOSE Review Fish Early Life Stage Test

SHAUGHNESSEY NO.	CHEMICAL	% A.I.
125301	Fenoxycarb	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

August 13, 1990

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Review of toxicity data for Fenoxycarb

FROM: James W. Akerman, Chief
Ecological Effects Branch
Environmental Fate and Effects Division (H7507C)

TO: Phillip Hutton (PM 17)
Insecticide/Rodenticide Branch
Registration Division (H7505C)

EEB has completed the review of a new Fenoxycarb study submitted by MAAG Agrochemicals Inc.. The following is a brief summary of the review:

STUDY IDENTIFICATION: Thompson, Kenneth, R., and Cohle, Paul, Early Life Stage Toxicity of Fenoxycarb Technical to Rainbow trout (Oncorhyncus mykiss) in a flow-through System, Analytical Bio-Chemistry Laboratories, inc., Aquatic Toxicology Division, 7200 East ABC Lane, P.O. Box 1097, Columbia, Missouri, 65205, submitted by Maag Agrochemicals Inc., 5690 58th Avenue, Vero Beach, Florida 32961-6430, MRID # 414920-01.

CONCLUSION: This study is scientifically sound and fulfills the SEP Guideline requirements for a Fish Early Life-Stage Test. Based on the most sensitive parameter (length) the MATC, NOEC, and LOEC values of Fenoxycarb (94.757%) for Rainbow trout (Oncorhyncus mykiss) were >0.048 and <0.092 mg/L, 0.048 mg/L, and 0.092 mg/L respectively.

RECOMMENDATIONS: N/A

If you have any questions regarding this study please contact Harry Winnik, Biologist, EFED/EEB, 557-7463.

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August 13, 1990

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CONCURRENCES								
SYMBOL	H7507C	H7507C	H7507C					
SURNAME	WINNIK	Craven	Akerman					
DATE	8-13-90	8/14/90	8/14/90					

EPA Form 1320-1 (12-70) OFFICIAL FILE COPY

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DATA EVALUATION RECORD

1. **CHEMICAL:** Fenoxycarb
Shaughnessy #125301

2. **TEST MATERIAL:** Fenoxycarb, 94.757%

3. **STUDY TYPE:** Fish Early Life-Stage

4. **STUDY IDENTIFICATION:** Thompson, Kenneth, R., and Cohle, Paul, Early Life Stage Toxicity of Fenoxycarb Technical to Rainbow trout (Oncorhyncus mykiss) in a flow-through System, Analytical Bio-Chemistry Laboratories, inc., Aquatic Toxicology Division, 7200 East ABC Lane, P.O. Box 1097, Columbia, Missouri, 65205, submitted by Maag Agrochemicals Inc., 5690 58th Avenue, Vero Beach, Florida 32961-6430, MRID # 414920-01

5. **REVIEW BY:** Harry A. Winnik
Biologist
EFED/EEB
Signature: Harry A. Winnik
Date: 7-19-90

6. **APPROVED BY:** Henry Craven
Supervisory Biologist
EFED/EEB
Signature: Henry T. Craven
Date: 8/13/90

7. **CONCLUSIONS:** This study is scientifically sound and fulfills the SEP Guideline requirements for a Fish Early Life-Stage Test. Based on the most sensitive parameter (length) the MATC, NOEC, and LOEC values of Fenoxycarb (94.757%) for Rainbow trout (Oncorhyncus mykiss) were >0.048 and <0.092 mg/L, 0.048 mg/L, and 0.092 mg/L respectively.

8. **RECOMMENDATIONS:** N/A

9. **BACKGROUND:** The study was submitted by Maag Agrochemicals Inc., to support the registration of Logic Fire Ant Bait.

10. **DISCUSSION OF INDIVIDUAL TESTS:** N/A

11. **MATERIALS AND METHODS:**

A. Test Animals: (excerpted from the submission)

Unfertilized rainbow trout eggs and milt for this study were obtained from Mt. Lassen Trout Farm, Red Bluff, California. They were collected from adult brood fish on August 23, 1989, placed into plastic bags and packed with ice in a cooler. The cooler was then shipped to ABC Laboratories via overnight delivery. Upon receipt on August 24, 1989 the eggs and milt were at ≈8°C. Without allowing contact with water, the eggs were gently poured into a dry plastic pan and the milt was thoroughly mixed with the eggs. After addition of the milt, enough ≈8°C control water was added to cover the eggs and the mixture was gently stirred to insure maximum fertilization. Approximately 60 seconds after mixing, the eggs were rinsed with control water several times then covered again with water and allowed to water harden for ≈2 hours. While water hardening the eggs were acclimating to test temperature (10 ±1.5°C). They were then distributed to the test system incubation cups.

B. Test System: (excerpted from the submission)

The test system dilution water was obtained from uncontaminated deep well water, part of which was passed through a reverse osmosis (R.O.) system, and then blended back to a total hardness of approximately 40 to 50 mg/L (as $CaCO_3$) and a pH of approximately 7.8.

A two-liter proportional diluter system described by Mount and Brungs, with a Hamilton® Model 420 syringe dispenser, was used for the intermittent introduction of a solution of Fenoxycarb technical dissolved in dimethylformamide (DMF) to four replicate test chambers per concentration. Flow-splitting cells divided each of the five test solutions and the control water into 2 aliquots, each of which was again divided in half before being delivered to the replicate test chambers. The accuracy of the test solution split into the 4 replicate chambers was checked prior to study initiation and once during the study. The inside dimensions of the glass test aquaria measured approximately 15.6 X 30.7 cm with a water depth of approximately 25 cm, yielding an approximate 12 liter replicate chamber volume. Each replicate test aquarium drain was covered with 16 mesh stainless steel screen to prevent escape of the rainbow

trout fry. For the first 77 days of the 96 day study, water/test solution was delivered to the 12 liter replicate chambers at an average rate of approximately 78.5 L/replicate/day. The flow rate was increased during the last 19 days to approximately 136 L/replicate/day as a precaution against the increased oxygen demand that larger fry place on the test water. The test aquaria were immersed in a water bath held at ≈10°C by Min-O-Cool® refrigeration units. All aquaria were illuminated by incandescent and wide spectrum fluorescent bulbs during a 16-hour daylight photoperiod, after the embryos had hatched into fry. The mean light intensity (measured with a Licor, Inc. Quantum/Radiometer/Photometer Model LI-185B using an LI-210SB Photometric Sensor) was 120 ±17.8 footcandles at the water surface.

The rainbow trout eggs were incubated in cups suspended in the treatment and control water. These egg incubation cups were made from 9.0 cm diameter X 14 cm high glass tubing with Nytex® screening (16 mesh) silicone glued to the bottom. To insure exchange of water, the egg cups were oscillated vertically (3 to 6 cm) in the test solution and/or water by means of a rocker arm apparatus driven by a low rpm electric motor. The motors were turned on at study day 32 when hatch began, and oscillated until the fry were released on study day 48.

C. Dosage: (excerpted from the submission)

The desired nominal concentration of Fenoxycarb technical for Level-5 was 0.10 mg/L. Since the toxicant solution for Level 5 was delivered undiluted from the toxicant mixing cell, the nominal concentration of Fenoxycarb technical in this cell was also 0.10 mg/L.

The diluter stock solution was prepared by diluting 0.818 g (gross weight) of test material to a 0.050 liter volume with dimethylformamide (DMF). A volume of DMF equivalent to the concentration in Level 5 was delivered to the solvent control (0.0069 ml/L).

At a purity of 94.757%, the 0.818 g contained 0.775 g of Fenoxycarb technical. The 775 mg of Fenoxycarb dissolved in 0.05 liter of DMF yielded a 15,500 mg/L solution. The reservoir of stock on the test system was stored in an amber bottle and was connected to the syringe injector via teflon tubing. Approximately 25 ml of stock was added to the test system at a time. The remainder was stored in a refrigerator and was later added when the level in the amber bottle became low. Generally, 50 to 60 ml of stock was used weekly. Nominal exposure levels utilizing the 50%

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proportional diluter system based on the Level-5 concentration of 0.10 mg/L were 0.10, 0.05, 0.025, 0.013 and 0.0063 mg/L.

D. Design: (excerpted from the submission)

The study was initiated by distributing several impartially selected newly fertilized rainbow trout eggs at a time into successive incubator cups in each of the 4 replicate exposure aquaria per concentration. This procedure continued until 35 eggs were located in each incubator cup, i.e. 140 eggs per concentration for a total of 980 eggs in the study. In addition, 50 eggs in separate incubator cups were placed in each of 4 replicates of the control chambers for determining chambers during this study. Egg mortality, as discerned by a distinct change in coloration, was recorded daily and dead eggs were removed to prevent fungal growth.

After 12-days of exposure, the eggs reserved for viability (fertilization success) determination were removed and placed in a 10% glacial acetic acid solution. After several minutes in the solution the embryos became clear. Fertilization and embryo development were indicated by the presence of a neural keel, which was visible as a white line. The percent viability was determined by dividing the number of embryos with neural keels by 50 and then multiplying by 100. The mean percent viability for the 4 replicates was then calculated.

When hatching commenced, the number of embryos hatched in each incubation cup was recorded daily until day 39. Hatch was determined to be $\geq$95% complete on day 36 in the control. For this reason, study day 36 became day 0 for the 60 day post-hatch growth period. The number of larval fry was reduced to 15 per replicate on day 39 (day 3 post-hatch).

The fry were released from the incubation cups into the growth chambers on day 48 (12 days post-hatch). The fry were monitored for abnormal (sublethal) behavioral or physical changes and mortality by visually inspecting each growth chamber daily and recording the data. Survival data were collected for statistical analysis on both growth measurement days (days 35 and 60 post-hatch).

Feeding began on day 53, 17 days post-hatch. Initially, the fry were fed live brine shrimp nauplii. Ground salmon starter was added to their diet on day 56. The fish were generally fed 3 times per day. The food used during the study included Salmon Starter (ABC fish food Lot No. 37998 and 37999) purchased from Zeigler Brothers, Inc., in Gardners, Pennsylvania and brine shrimp (Artemia salina)

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from Ocean Star International, Inc., in Snowville, Utah (ABC fish food Lot No. 37576). All aquaria were siphoned as needed to remove fecal material, excess food and any biological growth on the glass or stainless steel screen.

Growth, as determined by standard length of the fry, was determined by the photographic method of McKim and Benoit on study day 71 (35 days post-hatch). The fish were transferred to a glass photographic chamber (with a mm grid bottom via netting and photographed using 35 mm color slide film.

For ease of measurement, the developed slides were then projected onto a Calcomp digitizing tablet and the fish images traced with a cursor which entered the length data directly into a data worksheet in the Sigma-Scan measurement computer program. Calibration data entered into the program allowed for the adjustment of fish measurements to their actual standard lengths. The length data was later directly transferred to other programs for statistical analysis.

At test termination, study day 96 (60 days post-hatch), all surviving fish were sacrificed in tricane methanesulfonate (MS-222). They were then blotted on paper towels to remove excess moisture and weighed. The weights were entered on a computer worksheet via direct data capture. Lengths were then measured again using Sigma-Scan by placing the fish directly on the Calcomp digitizing tablet.

Water quality parameters of temperature, dissolved oxygen (D.O.), conductivity, and pH were measured on days 0, 1, 7 and every week thereafter. Water quality was also monitored on the final day of the study.

E. Statistics: (excerpted from the submission)

Dichotomous data were analyzed by 2 x 2 contingency tables pairing the control responses to each exposure level. The dichotomous data were then entered as a proportion (e.g. number alive in replicate ÷ number in replicate at initiation) into the Toxstat program and transformed using arcsine transformation. An analysis of variance (ANOVA) was performed to determine if a significant difference ($P<0.05$) existed between groups (i.e., control, test level 1, 2, etc.). The data were then analyzed using Dunnet's mean comparison test which compared the control to the test levels.

Continuous data were assessed by analysis of variance techniques for nested design experiments in a manner similar to that described by McClave, et. al.. Nested effects were assessed and their degrees of freedom and sum of squares

pooled with those of the experimental error if it was determined that such effects were not significant. If nested effects (either within aquaria or chambers) existed, the contribution of these effects to the overall variability within the study was determined. A subjective decision then was made whether or not to pool the effects due to nesting with the experimental error.

Statistically significant differences ($P<0.05$) in the continuous data were determined by the ANOVA calculations; Tukey's HSD and Dunnett's mean comparison tests were used to determine those treatment levels having responses significantly different from the control response. Length and weight data were entered as replicate means for the ANOVA and Dunnett's test, which were performed using the Toxstat program. Individual fish lengths and weights were the basis for the ANOVA and Tukey's HSD test, performed using the Systat program.

12. **Reported Results:**

Water quality parameters of dissolved oxygen, temperature, conductivity, pH, hardness and alkalinity were measured in the control and treated aquaria on a weekly basis. The ranges of water quality parameters were as follows: dissolved oxygen, 9.0 to 10.5 mg/L (83 and 97% saturation at 10°C respectively); temperature, 9.1 to 11.8°C; pH, 7.7 to 8.2; conductivity, 80 to 400 µmhos/cm; hardness, 36 to 240 mg/L; and alkalinity, 44 to 256 mg/L. Excessively high readings for conductivity, hardness and alkalinity occurred on study days 63 and 64 and were due to a malfunction of the well water/R.O. water blending system and were considered atypical of the remainder of the study. The highest readings for conductivity, hardness and alkalinity excluding these two days were 130 µmhos/cm, 50 mg/L and 58 mg/L, respectively.

(the following is excerpted from the submission)

Study Initiation/Viability--Newly fertilized rainbow trout eggs (fertilized <8 hours before test initiation) were used for the initiation of this study. After 12-days the viability of the additional 200 eggs (50 per replicate) placed in the control chambers at initiation was determined by clearing them with acetic acid. The control chambers contained only dilution water during this study. The formation of a neural keep appearing as a thing white line in the cleared eggs indicated the success of fertilization. Viability of these additional eggs ranged from 96 to 100% in the 4 replicates. The mean viability was 99%. It should be noted that the egg fertilization procedure took place in

control dilution water outside of the test system just prior to study initiation and that the additional eggs for the viability test were incubated in control dilution water. Therefore, the test material had no influence on the results of the viability test.

Time to Hatch--Hatch began on day 32 and continued until day 39. On day 39, seven eggs remained in the test system, scattered through the control and four of the test levels. In one of the eggs partial embryo development was observed, but in the remaining six no development was seen. These 7 unhatched eggs were removed from the test system on day 39. No effect in time to hatch was noted in the exposure concentrations when compared to the control.

Swim-up--Newly hatched fry began swimming up from the bottom of the test chambers at 13 days post-hatch (day 49). The number of fry swimming up in each chamber was recorded for days 49 - 55. There were no obvious differences in time to swim-up in any of the test chambers. Also, no sublethal physical or behavioral effects were noted at any time during the study in any of the test concentrations.

Hatchability--As discussed above, egg viability was determined from a viability test that indicated mean viability to be 99%.

Percent hatch ranged from a low of 96% in Levels 1, 2, 3, and 4 to a high of 99% in the solvent control and Level 5. No statistically significant differences ($P<0.05$) were found in the hatchability data for the control and five test levels.

Fry Survival--Survival of trout fry continuously exposed to Fenoxycarb technical during the 60 day post-hatch growth period is in Table 8 and Figure 3. Analysis of the 35 and 60 day post-hatch data indicated that fry survival in the exposure aquaria was not significantly reduced ($P<0.05$) when compared to the control.

Effects on Length and Weight--Fry growth was analyzed at 2 points during the study: length on day 35 post-hatch and length and weight on day 60 post-hatch. A growth reduction was indicated only in the Level-5 fish in the day 60 post-hatch analysis by Tukey's and Dunnett's tests. No growth effect was indicated in the day 35 post-hatch analysis.

Barlett's test indicated homogeneity of group variance for both the day 35 and day 60 post-hatch growth data.

13. **STUDY AUTHOR'S CONCLUSIONS/QUALITY ASSURANCE MEASURES:**

Egg hatchability and survival were not significantly reduced in any exposure level when compared to the controls. Growth reduction was significant at the highest exposure level (Level-5, 0.092 mg/L) when compared to the controls. Therefore, based on the growth data, the NOEC, LOEC, and MATC are estimated to be 0.048 mg/L, 0.092 mg/L, and 0.066 mg/L respectively.

"The study was conducted following the intent of the Good Laboratory Practice Regulations and the final report was reviewed by Analytical Bio-Chemistry Laboratories' Quality Assurance Unit."

14. **REVIEWER'S DISCUSSION AND INTERPRETATION OF STUDY RESULTS:**

A. Test Procedures: This study is scientifically sound and generally meets the Guidelines for a Fish Early Life-Stage study but deviated from the SEP as follows:

The SEP states that a hardness of 40 to 48 mg/L $CaCO_3$ and pH of 7.2 to 7.6 is recommended. In this study the hardness and pH ranges were 36 to 240 mg/L $CaCO_3$ and 7.7 to 8.2 respectively.

The SEP recommends that the temperature range for the study using Rainbow trout (Oncorhyncus mykiss) is 10 $\pm$ 2°C. Although in this study the weekly temperatures ranged from 9.1 to 11.8°C, the readings for the continuous temperature measurements range from 8.5 to 11.3°C.

B. Statistical Analysis: Survival, hatchability, length and weight data were reanalyzed by the reviewer using analysis of variance, Dunnett's test, Bonferroni's test, and Duncan's test (see attached).

The results of an ANOVA, Bonferroni's and Dunnett's test showed no significant difference in hatchability between the solvent control and the different treatment concentrations.

The results of an ANOVA and Bonferroni's, Dunnett's, and Duncan's tests showed no significant difference in mortality between the solvent control and the different treatment concentrations.

The results of an ANOVA and Bonferroni's, Dunnett's, and Duncan's tests showed no significant difference in the growth parameter, length, between the solvent control and the 0.0059, 0.012, 0.022, and the 0.048 mg/L mean measured Fenoxycarb test concentrations. There was a significant

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difference between the solvent control and the 0.092 mg/L concentration.

The results of an ANOVA and Bonferroni's, Dunnett's, and Duncan's tests showed no significant difference in the growth parameter, weight, between the solvent control and the 0.0059, 0.012, 0.022, and the 0.048 mg/L mean measured Fenoxycarb test concentrations. There was a significant difference between the solvent control and the 0.092 mg/L concentration.

The results were in good agreement and are considered acceptable.

C. Discussion of Results: Hatching and survival were not affected by Fenoxycarb at any concentrations tested. Larval weight and length were significantly reduced in the 0.092 mg/L test concentration.

Therefore, based on the growth parameters length and weight, the MATC, NOEL, and LOEC values of Fenoxycarb for the Rainbow trout (Oncorhyncus mykiss) were >0.048 and <0.092 mg/L, 0.048 mg/L, and 0.092 mg/L respectively.

D. Adequacy of the Study:

(1) Classification: Core

(2) Rationale: The study was scientifically sound and fulfills the SEP Guideline requirements.

(3) Repairability: N/A

15. **COMPLETION OF ONE-LINER FOR STUDY:**

Attachments

General Linear Modcls Procedure
Class Level Information

Class	Levels	Values
TRT	7	a b c d e f g

Number of observations in data set = 28

Dependent Variable: HATCH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	7.00000000	1.16666667	1.17	0.3608
Error	21	21.00000000	1.00000000		
Corrected Total	27	28.00000000			

HATCH Mean	R-Square	C.V.	Root MSE
34.0000000	0.250000	2.941176	1.000000

19, 1990 190 mortality 5:56 Thursday, July

General Linear Models Procedure

Dependent Variable: HATCH

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TRT	6	7.00000000	1.16666667	1.17	0.3608

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TRT	6	7.00000000	1.16666667	1.17	0.3608

Bonferroni (Dunn) T tests for variable: HATCH

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.

Alpha= 0.05 df= 21 MSE= 1
Critical Value of T= 3.45
Minimum Significant Difference= 2.4418

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	TRT
A A	34.750	4	g
A A	34.750	4	b
A A	34.000	4	a
A A	33.750	4	e
A A	33.750	4	c
A A	33.500	4	d
A	33.500	4	f

Duncan's Multiple Range Test for variable: HATCH

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 21 MSE= 1

Number of Means	2	3	4	5	6	7
Critical Range	1.469	1.543	1.594	1.624	1.648	1.667

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TRT
A A	34.750	4	g
A A	34.750	4	b
A A	34.000	4	a
A A	33.750	4	e
A A	33.750	4	c
A A	33.500	4	d

A 33.500 4 f

General Linear Models Procedure
Dunnett's T tests for variable: HATCH
NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.
Alpha= 0.05 Confidence= 0.95 df= 21 MSE= 1
Critical Value of Dunnett's T= 2.790
Minimum Significant Difference= 1.9726

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

General Linear Models Procedure

TRT Comparison		Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
g	- b	-1.973	0.000	1.973
a	- b	-2.723	-0.750	1.223
e	- b	-2.973	-1.000	0.973
c	- b	-2.973	-1.000	0.973
d	- b	-3.223	-1.250	0.723
f	- b	-3.223	-1.250	0.723

---TRT=a---

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	32.0000000	35.0000000	34.0000000	1.4142136

--- TRT=b ---

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	34.0000000	35.0000000	34.7500000	0.5000000

--- TRT=c ---

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	33.0000000	34.0000000	33.7500000	0.5000000

TRT=d

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	32.0000000	35.0000000	33.5000000	1.2909944

TRT=e

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	32.0000000	35.0000000	33.7500000	1.5000000

TRT=f

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	33.0000000	34.0000000	33.5000000	0.5773503

Analysis Variable : HATCH

TRT=g

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	34.0000000	35.0000000	34.7500000	0.5000000

Class Level Information

Class	Levels	Values
TRT	7	a b c d e f g

Number of observations in data set = 28

Dependent Variable: SURV

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	2.35714286	0.39285714	1.43	0.2484
Error	21	5.75000000	0.27380952		
Corrected Total	27	8.10714286			

R-Square	C.V.	Root MSE	SURV Mean
0.290749	3.530484	0.523268	14.8214286

Dependent Variable: SURV

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TRT	6	2.35714286	0.39285714	1.43	0.2484

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TRT	6	2.35714286	0.39285714	1.43	0.2484

Bonferroni (Dunn) T tests for variable: SURV

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.

Alpha= 0.05 df= 21 MSE= 0.27381

Critical Value of T= 3.45

Minimum Significant Difference= 1.2777

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	TRT
A	15.000	4	a
A			
A	15.000	4	b
A			
A	15.000	4	c
A			
A	15.000	4	d
A			
A	15.000	4	f
A			
A	14.500	4	e
A			
A	14.250	4	g

General Linear Models Procedure
Duncan's Multiple Range Test for variable: SURV
NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate
Alpha= 0.05 df= 21 MSE= 0.27381

Number of Means	2	3	4	5	6	7
Critical Range	0.769	0.807	0.834	0.850	0.862	0.872

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	TRT
A	15.000	4	a
A			
A	15.000	4	b
A			
A	15.000	4	c
A			
A	15.000	4	d
A			
A	15.000	4	f
A			
A	14.500	4	e
A			
A	14.250	4	g

Dunnett's T tests for variable: SURV
NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.
Alpha= 0.05 Confidence= 0.95 df= 21 MSE= 0.27381
Critical Value of Dunnett's T= 2.790
Minimum Significant Difference= 1.0322
Comparisons significant at the 0.05 level are indicated by '***'.

TRT Comparison		Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
a	- b	-1.032	0.000	1.032
c	- b	-1.032	0.000	1.032
d	- b	-1.032	0.000	1.032
f	- b	-1.032	0.000	1.032
e	- b	-1.532	-0.500	0.532
g	- b	-1.782	-0.750	0.282

TRT=a

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	15.0000000	15.0000000	15.0000000	0

TRT=b

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	15.0000000	15.0000000	15.0000000	0

TRT=c

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	15.0000000	15.0000000	15.0000000	0

TRT=d

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	15.0000000	15.0000000	15.0000000	0

TRT=e

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	13.0000000	15.0000000	14.5000000	1.0000000

TRT=f

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	15.0000000	15.0000000	15.0000000	0

TRT=g

N Obs	N	Minimum	Maximum	Mean	Std Dev
4	4	13.0000000	15.0000000	14.2500000	0.9574271

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 = 415

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	180.0864668	30.0144111	3.24	0.0040
Error	408	3780.5435717	9.2660382		
Corrected Total	414	3960.6300385			

R-Square	C.V.	Root MSE	LENGTH Mean
0.045469	6.875063	3.044017	44.2762035

Dependent Variable: LENGTH

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TRT	6	180.0864668	30.0144111	3.24	0.0040

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TRT	6	180.0864668	30.0144111	3.24	0.0040

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Bonferroni (Dunn) T tests for variable: LENGTH

NOTE: This test controls the type I experimentwise error rate but generally has a higher type II error rate than Tukey's for all pairwise comparisons.

Alpha= 0.05 Confidence= 0.95 df= 408 MSE= 9.266038

Critical Value of T= 3.05723

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

General Linear Models Procedure

TRT Comparison		Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
a	- b	-1.498	0.201	1.900	
a	- d	-1.158	0.541	2.240	
a	- f	-0.661	1.038	2.737	
a	- e	-0.446	1.268	2.982	
a	- c	-0.249	1.450	3.149	
a	- g	0.266	1.988	3.709	***
b	- a	-1.900	-0.201	1.498	
b	- d	-1.359	0.340	2.039	
b	- f	-0.862	0.837	2.536	
b	- e	-0.647	1.067	2.781	
b	- c	-0.450	1.249	2.948	
b	- g	0.065	1.786	3.508	***
d	- a	-2.240	-0.541	1.158	
d	- b	-2.039	-0.340	1.359	
d	- f	-1.202	0.497	2.196	
d	- e	-0.987	0.727	2.441	
d	- c	-0.790	0.909	2.608	
d	- g	-0.275	1.446	3.168	
f	- a	-2.737	-1.038	0.661	
f	- b	-2.536	-0.837	0.862	
f	- d	-2.196	-0.497	1.202	
f	- e	-1.484	0.230	1.944	
f	- c	-1.287	0.412	2.111	
f	- g	-0.772	0.949	2.671	
e	- a	-2.982	-1.268	0.446	
e	- b	-2.781	-1.067	0.647	
e	- d	-2.441	-0.727	0.987	
e	- f	-1.944	-0.230	1.484	
e	- c	-1.531	0.182	1.896	
e	- g	-1.016	0.719	2.455	

TRT Comparison		Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
c	- a	-3.149	-1.450	0.249	
c	- b	-2.948	-1.249	0.450	
c	- d	-2.608	-0.909	0.790	
c	- f	-2.111	-0.412	1.287	
c	- e	-1.896	-0.182	1.531	
c	- g	-1.184	0.537	2.258	
g	- a	-3.709	-1.988	-0.266	***
g	- b	-3.508	-1.786	-0.065	***
g	- d	-3.168	-1.446	0.275	
g	- f	-2.671	-0.949	0.772	
g	- e	-2.455	-0.719	1.016	
g	- c	-2.258	-0.537	1.184	

General Linear Models Procedure

Duncan's Multiple Range Test for variable: LENGTH

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 408 MSE= 9.266038
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 59.26248

Number of Means	2	3	4	5	6	7
Critical Range	1.111	1.168	1.205	1.233	1.256	1.275

Means with the same letter are not significantly different.

Duncan Grouping			Mean	N	TRT
		A A	45.194	60	a
B B		A A	44.992	60	b
B B		A A	44.652	60	d
B B	D D	A	44.155	60	f
B	D D D	C C C	43.925	58	e
	D D	C C	43.743	60	c
	D	C	43.206	57	g

Dunnett's T tests for variable: LENGTH

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

Alpha= 0.05 Confidence= 0.95 df= 408 MSE= 9.266038
Critical Value of Dunnett's T= 2.579

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

TRT Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
a - b	-1.232	0.201	1.634	
d - b	-1.773	-0.340	1.093	
f - b	-2.270	-0.837	0.596	
e - b	-2.512	-1.067	0.379	
c - b	-2.682	-1.249	0.184	
g - b	-3.238	-1.786	-0.334	***

TRT=a

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	37.3728500	52.0704300	45.1935775	2.6166890

TRT=b

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	39.5220700	52.7834800	44.9923265	3.1076733

TRT=c

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	30.7044700	51.4787700	43.7432277	3.5279062

TRT=d

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	32.2060300	50.4871000	44.6523240	3.4693664

TRT=e

N Obs	N	Minimum	Maximum	Mean	Std Dev
58	58	36.2797300	49.7460300	43.9254322	3.0833638

TRT=f

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	38.2010900	51.7240700	44.1552743	2.7586439

TRT=g

N Obs	N	Minimum	Maximum	Mean	Std Dev
57	57	37.7537800	49.5185600	43.2060628	2.5752541

Class Level Information

Class	Levels	Values
TRT	7	a b c d e f g

Number of observations in data set = 417

Dependent Variable: LENGTH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	24.77275046	4.12879174	1.33	0.2435
Error	410	1275.19209304	3.11022462		
Corrected Total	416	1299.96484351			

R-Square	C.V.	Root MSE	LENGTH Mean
0.019056	5.914956	1.763583	29.8156531

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TRT	6	24.77275046	4.12879174	1.33	0.2435

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TRT	6	24.77275046	4.12879174	1.33	0.2435

Bonferroni (Dunn) T tests for variable: LENGTH

NOTE: This test controls the type I experimentwise error rate but generally has a higher type II error rate than Tukey's for all pairwise comparisons.

Alpha= 0.05 Confidence= 0.95 df= 410 MSE= 3.110225

Critical Value of T= 3.05713

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

TRT Comparison			Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
b	-	f	-0.758	0.227	1.211
b	-	d	-0.730	0.254	1.238
b	-	a	-0.609	0.375	1.359
b	-	g	-0.482	0.506	1.495
b	-	e	-0.454	0.539	1.532
b	-	c	-0.169	0.815	1.799
f	-	b	-1.211	-0.227	0.758
f	-	d	-0.957	0.028	1.012
f	-	a	-0.836	0.148	1.133
f	-	g	-0.709	0.279	1.268
f	-	e	-0.680	0.312	1.305
f	-	c	-0.396	0.589	1.573
d	-	b	-1.238	-0.254	0.730
d	-	f	-1.012	-0.028	0.957
d	-	a	-0.863	0.121	1.105
d	-	g	-0.737	0.252	1.240
d	-	e	-0.708	0.285	1.278
d	-	c	-0.423	0.561	1.545
a	-	b	-1.359	-0.375	0.609
a	-	f	-1.133	-0.148	0.836
a	-	d	-1.105	-0.121	0.863
a	-	g	-0.858	0.131	1.120
a	-	e	-0.829	0.164	1.157
a	-	c	-0.544	0.440	1.424
g	-	b	-1.495	-0.506	0.482
g	-	f	-1.268	-0.279	0.709
g	-	d	-1.240	-0.252	0.737
g	-	a	-1.120	-0.131	0.858
g	-	e	-0.964	0.033	1.030
g	-	c	-0.679	0.309	1.298
e	-	b	-1.532	-0.539	0.454
e	-	f	-1.305	-0.312	0.680
e	-	d	-1.278	-0.285	0.708
e	-	a	-1.157	-0.164	0.829
e	-	g	-1.030	-0.033	0.964
e	-	c	-0.717	0.276	1.269

TRT Comparison		Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
c	- b	-1.799	-0.815	0.169
c	- f	-1.573	-0.589	0.396
c	- d	-1.545	-0.561	0.423
c	- a	-1.424	-0.440	0.544
c	- g	-1.298	-0.309	0.679
c	- e	-1.269	-0.276	0.717

Duncan's Multiple Range Test for variable: LENGTH

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 410 MSE= 3.110225
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 59.56237

Number of Means	2	3	4	5	6	7
Critical Range	0.642	0.675	0.696	0.712	0.726	0.737

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	TRT
	A	30.203	60	b
	A			
B	A	29.976	60	f
B	A			
B	A	29.949	60	d
B	A			
B	A	29.828	60	a
B	A			
B	A	29.697	59	g
B	A			
B	A	29.664	58	e
B				
B		29.387	60	c

Dunnett's T tests for variable: LENGTH

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

Alpha= 0.05 Confidence= 0.95 df= 410 MSE= 3.110225
Critical Value of Dunnett's T= 2.578

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

TRT Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
f - b	-1.057	-0.227	0.604
d - b	-1.084	-0.254	0.576
a - b	-1.205	-0.375	0.455
g - b	-1.340	-0.506	0.328
e - b	-1.376	-0.539	0.298
c - b	-1.645	-0.815	0.015

TRT=a

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	26.0107500	33.1220400	29.8275785	1.7120682

TRT=b

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	25.6087000	34.9983900	30.2026242	1.9914993

TRT=c

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	26.9895800	33.0979400	29.3874908	1.4816788

TRT=d

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	26.3188300	33.7399100	29.9485463	1.8583884

TRT=e

N Obs	N	Minimum	Maximum	Mean	Std Dev
58	58	26.5950300	34.5645800	29.6636426	1.9453363

TRT=f

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	26.1852400	33.8104500	29.9760543	1.6664380

TRT=g

N Obs	N	Minimum	Maximum	Mean	Std Dev
59	59	26.9585600	34.0602300	29.6965834	1.6369326

Class Level Information

Class	Levels	Values
TRT	7	a b c d e f g

Number of observations in data set = 415

Dependent Variable: WEIGHT

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	2.09904666	0.34984111	4.60	0.0002
Error	408	31.04864988	0.07609963		
Corrected Total	414	33.14769654			

R-Square	C.V.	Root MSE	WEIGHT Mean
0.063324	21.07589	0.275862	1.30889639

d
ependent Variable: WEIGHT

Source	DF	Type I SS	Mean Square	F Value	Pr > F
TRT	6	2.09904666	0.34984111	4.60	0.0002

Source	DF	Type III SS	Mean Square	F Value	Pr > F
TRT	6	2.09904666	0.34984111	4.60	0.0002

Bonferroni (Dunn) T tests for variable: WEIGHT

NOTE: This test controls the type I experimentwise error rate but generally has a higher type II error rate than Tukey's for all pairwise comparisons.

Alpha= 0.05 Confidence= 0.95 df= 408 MSE= 0.0761

Critical Value of T= 3.05723

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

TRT Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
b - a	-0.1329	0.0210	0.1750	
b - d	-0.1088	0.0451	0.1991	
b - c	-0.0599	0.0941	0.2481	
b - f	-0.0275	0.1265	0.2805	
b - e	-0.0253	0.1300	0.2853	
b - g	0.0686	0.2246	0.3806	***
a - b	-0.1750	-0.0210	0.1329	
a - d	-0.1299	0.0241	0.1781	
a - c	-0.0809	0.0731	0.2271	
a - f	-0.0485	0.1054	0.2594	
a - e	-0.0463	0.1090	0.2643	
a - g	0.0476	0.2036	0.3596	***
d - b	-0.1991	-0.0451	0.1088	
d - a	-0.1781	-0.0241	0.1299	
d - c	-0.1050	0.0490	0.2030	
d - f	-0.0726	0.0813	0.2353	
d - e	-0.0704	0.0849	0.2402	
d - g	0.0235	0.1795	0.3355	***
c - b	-0.2481	-0.0941	0.0599	
c - a	-0.2271	-0.0731	0.0809	
c - d	-0.2030	-0.0490	0.1050	
c - f	-0.1216	0.0324	0.1863	
c - e	-0.1194	0.0359	0.1912	
c - g	-0.0255	0.1305	0.2865	
f - b	-0.2805	-0.1265	0.0275	
f - a	-0.2594	-0.1054	0.0485	
f - d	-0.2353	-0.0813	0.0726	
f - c	-0.1863	-0.0324	0.1216	
f - e	-0.1517	0.0036	0.1589	
f - g	-0.0578	0.0981	0.2541	
e - b	-0.2853	-0.1300	0.0253	
e - a	-0.2643	-0.1090	0.0463	
e - d	-0.2402	-0.0849	0.0704	
e - c	-0.1912	-0.0359	0.1194	
e - f	-0.1589	-0.0036	0.1517	
e - g	-0.0627	0.0946	0.2519	

TRT Comparison		Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
g	- b	-0.3806	-0.2246	-0.0686	***
g	- a	-0.3596	-0.2036	-0.0476	***
g	- d	-0.3355	-0.1795	-0.0235	***
g	- c	-0.2865	-0.1305	0.0255	
g	- f	-0.2541	-0.0981	0.0578	
g	- e	-0.2519	-0.0946	0.0627	

Duncan's Multiple Range Test for variable: WEIGHT

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.05 df= 408 MSE= 0.0761
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 59.26248

Number of Means	2	3	4	5	6	7
Critical Range	0.101	0.106	0.109	0.112	0.114	0.116

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	TRT
	A	1.3994	60	b
	A			
B	A	1.3783	60	a
B	A			
B	A	1.3543	60	d
B	A			
B	A	1.3053	60	c
B				
B	C	1.2729	60	f
B	C			
B	C	1.2693	58	e
	C			
	C	1.1748	57	g

Dunnett's T tests for variable: WEIGHT

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

Alpha= 0.05 Confidence= 0.95 df= 408 MSE= 0.0761
Critical Value of Dunnett's T= 2.579

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

TRT Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
a - b	-0.1509	-0.0210	0.1088	
d - b	-0.1750	-0.0451	0.0847	
c - b	-0.2240	-0.0941	0.0358	
f - b	-0.2564	-0.1265	0.0034	
e - b	-0.2610	-0.1300	0.0010	
g - b	-0.3562	-0.2246	-0.0930	***

TRT=a

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	0.7020000	2.0200000	1.3783500	0.2457270

TRT=b

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	0.8870000	2.1220000	1.3993833	0.3008254

TRT=c

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	0.3150000	2.0310000	1.3052667	0.2906459

TRT=d

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	0.4450000	1.9970000	1.3542500	0.3154816

TRT=e

N Obs	N	Minimum	Maximum	Mean	Std Dev
58	58	0.7380000	1.8430000	1.2693448	0.2842743

TRT=f

N Obs	N	Minimum	Maximum	Mean	Std Dev
60	60	0.7770000	1.9540000	1.2729000	0.2401561

TRT=g

N Obs	N	Minimum	Maximum	Mean	Std Dev
57	57	0.7530000	1.8670000	1.1747544	0.2420725